

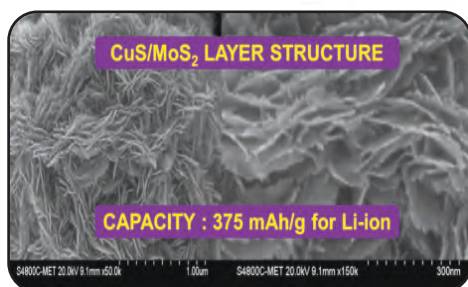
ANNUAL REPORT

2017-2018

28th Year



Innovation in Electronic Materials



CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY (C-MET)

Scientific Society under
Ministry of Electronics and Information Technology (MeitY)
Government of India

Governing Council of C-MET (2017-2018)

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Hon'ble Minister
Ministry of Electronics & Information Technology
Electronics Niketan, 6, CGO Complex
New Delhi-110 003

Shri P. P. Chaudhary **Deputy-Chairman**
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Ministry of Electronics & Information Technology
Electronics Niketan, 6, CGO Complex
New Delhi-110 003 (up to 02.09.2017)

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Electronics Niketan, 6, CGO Complex
New Delhi-110 003 (from 03.09.2017 onwards)

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New Delhi-110 003 (from 23.06.2017 onwards)

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Former secretary, Defence R&D
Member Niti Aayog, Niti Aayog building
Parliament street, New Delhi-110 001

Dr. Ajay Kumar **Member**
Additional Secretary,
Ministry of Electronics & Information Technology
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New Delhi-110 003 (up to 01.12.2017)

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Ministry of Electronics & Information Technology
Electronics Niketan, 6, CGO Complex,
New Delhi-110 003 (from 19.03.2018 onwards)

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Ministry of Electronics & Information Technology
Electronics Niketan, 6, CGO Complex,
New Delhi-110 003

Shri Rajiv Kumar **Member**
Joint Secretary (Societies),
Ministry of Electronics & Information Technology
Electronics Niketan, 6, CGO Complex,
New Delhi-110 003

Dr. Debashis Dutta **Member**
Group Coordinator (R&D Electronics),
Ministry of Electronics & Information Technology
Electronics Niketan, 6, CGO Complex,
New Delhi-110 003 (up to 31.12.2017)

Shri. Arvind Kumar **Member**
Group Coordinator (R&D Electronics),
Ministry of Electronics & Information Technology
Electronics Niketan, 6, CGO Complex,
New Delhi-110 003 (from 01.01.2018 onwards)

Prof. T. R. N. Kutty **Member**
Chairman, Working Group
Electronic Materials and Component
Development Programme (EMCD)
No. 48, HMT Layout, 7th Cross/ 7th Main
Rebindranath Tagore Nagar (PO)
Bangalore - 560 012

Shri. P. Sudhakar **Member**
Ex-Chairman & Managing Director
and OSD to DAE
Electronics Corporation of India Ltd. (ECIL),
Hyderabad - 500 062

Dr. Baldev Raj **Member**
Director
National institute of Advance Studies(NIAS)
IISc Campus,
Bengaluru - 560 012 (upto 06.01.2018)

Dr. A. K. Bhaduri **Member**
Distinguished Scientist & Director,
Indira Gandhi Centre for Atomic Research,
Kalpakkam - 603 102

Prof. (Dr.) Sanjay K. Nayak **Member**
Director General, CIPET
Dept of Chemicals & Petrochemicals,
Ministry of Chemicals & Fertilizers
T.V.K. Industrial Estate,
Guindy, Chennai - 600 032

Dr. Debashis Dutta **Member**
Director General
Center for Development of Advanced Computing
(C-DAC), Pune University Campus
Pune - 411 007

Dr. N. R. Munirathnam **Member-Secretary**
Director General
Centre for Materials for Electronics Technology
Panchawati, Off Pashan Road
Pune - 411 008

ANNUAL REPORT

2017 - 2018



CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY (C-MET)

Scientific Society under
Ministry of Electronics and Information Technology (MeitY),
Government of India

VISION & MISSION

VISION

C-MET will become a premier R&D organization known all over the world for its knowledge base, innovations and expertise in Electronic Materials.

MISSION

To develop knowledge base in electronic materials and their processing technology for Indian industries and to become a source of critical electronic materials, know-how and technical services for the industry and other sectors of economy.

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FOREWORD



The purpose of this annual report of C-MET for the year 2017-18 is to highlight consolidated technical information, accomplishments and overall impact of technologies developed and transferred by C-MET during the period.

C-MET under the aegis of Ministry of Electronics and Information Technology (MeitY) has evolved itself as a unique R&D institution, focusing mainly on electronics and allied materials for over 28 years. As guided by Honorable Governing Council and Steering Committee members, C-MET continues to excel in its commitment to R&D for strategic, commercial and social sectors. The niche and multidisciplinary R&D areas being engaged by C-MET demonstrates its commitment for delivering the products with quality, reproducibility and capacity to build-up at pilot plant scale.

At this juncture, I would like to elucidate a few notable achievements of C-MET during the year 2017-18. C-MET has transferred two technologies to private industries and efforts are being made to transfer 5 more technologies which are ready for transfer to interested entrepreneurs/start-ups. This year, 16 sponsored projects were successfully completed, and 8 new externally funded projects have been initiated and 17 sponsored projects are ongoing. With the help of External Budgetary Resources (EBR) and committed, and passionate personnel of C-MET all the planned targets could be realized. During the year, research performance indicators of C-MET continued to be impressive in terms of 9 National/International patent applications (2 awarded and 7 applied), 40 research papers in peer-

reviewed international journals, 39 contributory papers at various National/ International conferences, and 49 invited talks at various National/ International scientific events. This year 2 Indian patents have been awarded. All these awards and honours are testimony to the research excellence of C-MET research fraternity. This year C-MET bagged "First Prize" of ELCINA-EFY Awards for Outstanding Achievements in "Research & Development". The prestigious award was presented by Shri A. Prakash Sawhney, Secretary, MeitY on 14th September 2017. As usual, this year also scientists and students from C-MET bagged 09 national awards for innovations in national conferences/symposia. These awards belong to each and every CMET'an, who has worked hard with such great passion and dedication.

We take great pride in organizing an International conference on the occasion of Annual Foundation day every year on rotation basis in each centres of C-MET. Coincidentally, the day March 8th, happens to be International Women's Day. C-MET invited several women Scientists/researchers who are working in the niche area of electronics & allied materials and listened to them as a part of International Conference on Advanced Semiconductor Materials & Devices (ICASMD 2018). The response to ICASMD was overwhelming and more than 225 delegates at National and International level have participated in the deliberations. There were 10 National and 08 International experts from different parts of the globe attended and delivered invited/plenary lectures. Nearly 80 abstracts have been presented by students and R&D personnel from premier

academic, R&D institutions and industries in the field of advanced semiconductor materials & devices. To encourage them, prizes for best presentations were also distributed. The outcome would be useful for making GaN based devices for future communication. During the conference, the idea of National Networking of Manufacturing Institutions (NNMI) for Semiconductor devices in India has been incubated.

अमंत्रक्षरं नास्ति नास्ति मूलमनौषधम्।

अयोग्यः पुरुषौ नास्ति योजकस्तत्र दुर्लभः ॥

There is no letter which doesn't have charm (curative property). There is no root which doesn't have medicinal property. Rare is a person who knows its proper application.

We at CMET would like the Indian industries to embark upon our ideas and technologies developed to nurture the progress and progressive advanced technology findings in to the next era and augment the "Make in India" programme a grand success.

Dr. N. R. Munirathnam
Director General

INTRODUCTION

Centre for Materials for Electronics Technology (C-MET) has been set up as a registered Scientific Society in March 1990 under Ministry of Electronics and Information Technology (MeitY), (formerly known as Department of Electronics) as a unique concept for development of viable technologies in the area of materials mainly for electronics. C-MET is operating with its three laboratories located at Pune, Hyderabad and Thrissur with specialized research mandate at each place.

OBJECTIVES

The objectives of C-MET are:

- To establish the technology up to pilot-plant scale for a range of electronic materials and transfer the same to industry for commercialization.
- To establish relevant characterization facilities.
- To undertake applied research activities in the area of its operation.

C-MET has set up its vision, mission and strategy to achieve its objectives.

R & D IN ELECTRONIC MATERIALS & SIGNIFICANCE OF C-MET

Electronic materials form an important segment of Advanced Materials. The materials technology is highly guarded by the major players considering their critical nature. Today, Information Technology (IT) is one of the premier global technologies. IT comprises data (or information) generation, categorization, transmission, retrieval, processing, and propagation to the benefit of society. Microelectronics is the keystone of information technology. A strong IT network needs supporting systems and sub-systems, which have the roots in the advanced electronic materials. Although electronic materials are primarily associated with computers, the internet and mobile technologies; they are used in many applications which help to improve overall quality of life and arrest climate change. Electronic materials form an extremely complex subject area. The progress made in traditional scientific fields often depends upon new developments in electronic materials. Advanced electronic materials (viz. nano-scale electronic materials for miniaturized subsystems and systems and nano-spintronics by considering, in particular, nano-architecture and scalability issues) have been identified as one of the critical technology areas by both developed and developing nations. Electronic materials are crucial to the total development of a nation irrespective of the preference be given to defence, agriculture, education, medicine, space or any other field. New heterostructure device concepts will be the basis for further improvements in micro and optoelectronics. High-K (permittivity materials) play an important role in down-scaling metal oxide semiconductor field effect transistors and dynamic random-access memories. Non-volatile memories currently represent large proportion of the semiconductor market and are one of the most important technologies for mobile applications, the main end product being the flash memory. If the present trend is an indication, advancement in electronic materials technology may become the base of the total technology strength of a nation in future.

Research and development activities in the electronic materials domain have been pursued in various institutions in the country. However, a clear focus to undertake client relevant R&D activities lies only with C-MET. This uniqueness of C-MET can be judged through its objectives laid down during its establishment. All the developmental programmes undertaken and carried out during previous years and currently are in accordance with these objectives. Various process and product technologies were developed in the area of electronic materials through all these years, but a major stumbling block was the after effects of globalization and open market scenario immediately after the formation of C-MET. Understanding this scenario, new knowledge-based methodologies have been evolved to increase the partnership of end users like industries and strategic sectors in C-MET's technical program.

OUR APPROACH AND CURRENT STRATEGY

OUR APPROACH

- Majority of Indian electronic materials related industries do not have well defined in-house R&D

facilities and are not in a position to set up new production line for new technologies through scale-up. At the same time, after the globalization, it has become imperative for them to improve their production with respect to quality, quantity and delivery time to compete with the foreign counterparts. To achieve this, they have to depend on either foreign collaborators or identify a suitable Indian partner, which is capable of delivering the results. Industry had faced problems with absorption and up-gradation of imported technologies, to keep up with the latest trends in product quality and hence, it has become essential for them to improve it with the help of agency like C-MET, which is having a strong knowledge base. C-MET has identified this, as a right opportunity to shake hand with the industry. A shift from the technology transfer to providing services to industry is required in the changed scenario.

- Strategic sectors have been routinely facing uphill task to procure the requisite materials or components for their operation from western countries. Indian industries are lacking in the cutting-edge technologies. Identification of a right agency in both these cases is very important and C-MET has a major role to play in terms of bridging the gaps. C-MET's expertise, infrastructure and years long experience suit to take up this challenging responsibility. Hence, the total system has been mobilized and geared up to utilize the present situation in favour of C-MET. Accordingly, C-MET has signed major MoUs with DRDO, ISRO and DAE institutes.

CURRENT STRATEGY

In order to accomplish the set objectives, we have adopted the following strategy for project execution at C-MET based on available expertise, competence and infrastructure to maximize the participation in strategic and industrial sectors.

- To develop the indigenous technologies in the area of Electronic materials to support strategic sector

The salient features are as follows :

- **Powerbank of capacity 1000 mAh have been fabricated using modified cathodes LCO and anodes LTO.**
- **Established pilot plant facility for production of 50F supercapacitors.**
- **Developed quickly rechargeable energy lamp based on supercapacitors for remote locations lighting applications.**
- **Developed magneto-dielectric materials and composites for miniaturized antenna fabrication.**
- To implement projects which are expected to generate technologies/results which would be commercialized in near future and the products/processes which are required for critical areas covering space, atomic energy, defence and Industry etc, that are essentially small volume but high value products.
 - **Supplied 40 kg of Hafnium sponge to Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram for the fabrication of aerospace alloys for high temperature nozzle applications.**
 - **Two numbers of Low temperature Co-fired Ceramics (LTCC) based designs have been fabricated for BRNS (BARC) for strategic applications.**
 - **Augmented the ultra-low loss microwave substrates to 8"x8" size and delivered 50 Nos of products to Radio Frequency (RF) division of BARC for 1kW Solid State Amplifier design.**
 - **Supplied 7 kg of 7N (99.99999 at.%) purity tellurium material to Solid State Physics Laboratory (SSPL) for Mercury Cadmium Telluride (MCT) device fabrication.**
 - **Delivered 100 gm batch production of nano silver powder to MODISON METALS LTD., Mumbai for solar cells and EMI shielding applications.**
 - **Thick film based low temperature (~400 °C) and high temperature (~1000 °C) sensors have been developed for aero-turbine applications.**
- Electronic Waste, RoHS and Thermal sensor for societal applications

- First Government owned "Restriction of Hazardous Substances (RoHS)" analytical facility is successfully running towards self-sustainability.
 - Successfully developed two-dimensional (2D) imaging technique for the precise prediction of breast cancer location.
 - Transparent heater technology developed for automobile and electronic applications.
 - Carbon aerogel materials preparation for supercapacitor applications has been demonstrated at 3 kg per batch pilot plant level.
 - Augmented environmental friendly E-waste recycling of Printed Circuit Boards (PCBs) up to the capacity of 100 kg/day.
 - Separation of Yttrium oxide (Y_2O_3) & Europium oxide (Eu_2O_3) from spent phosphors has been successfully carried out up to 100 gm batch level.
- To develop strong knowledge base

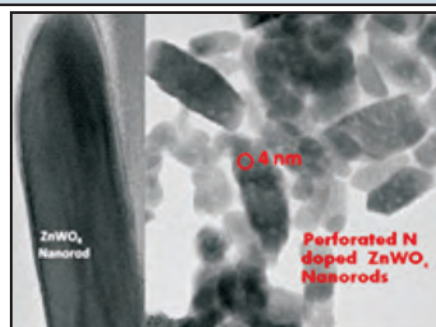
The technology development activities and pilot plant activities cannot be sustained for longer period unless these are backed by internal scientific capability and expertise of requisite standards. This could be generated by various means, e.g., by undertaking basic research in the concerned areas within the country and/or abroad, undertaking training and research by C-MET scientists, as also, providing C-MET facilities to outside scientists. This, in turn, will help in sustaining future activities of C-MET, as well as to achieve the objective of becoming the 'Centre of Excellence'. Moreover, development of strong knowledge base in specialized arena of electronic materials viz. latest materials for Energy Conversion & Storage devices, Microwave materials, viable technologies for recycling of Electronic waste, Wide Band Gap (WBG) compound semiconductors, technologies to purify electronic materials to Ultra high purity, latest packaging technologies for Low & High temperature Co-fired Ceramic (LTCC & HTCC) packages, various sensors for smart cities and Internet of Things (IOT), Supercapacitors for energy storage and allied applications, high accuracy sensors and actuators, transparent conducting oxides (TCO), ultrasonic transducer probes for medical imaging, cost-effective solution for early breast cancer detection etc. is also essential from the standpoint of Knowledge process outsourcing as a global phenomenon.

Core Competence at C-MET Laboratories

C-MET's R & D activities have been implemented in three laboratories at Pune, Hyderabad and Thrissur. The laboratory at Pune functions as headquarters also and extends central coordination support. Each of these laboratories has its own area of specialization with requisite infrastructure and expertise. This approach has proven to be successful in creating core competence at each laboratory.

- **Pune Laboratory**

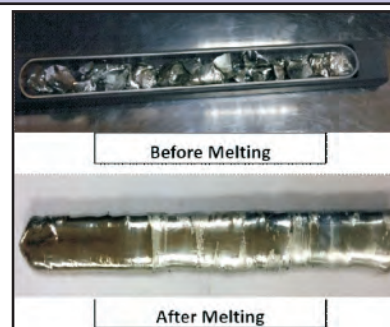
Materials for Electronic Packaging,
Materials for Renewable Energy and
Sensors, Nano-materials / composites



Nano N-Doped ZnWO_4 for water splitting

- **Hyderabad Laboratory**

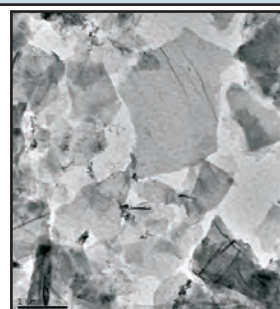
Ultra - High Pure (UHP) Materials, Compound
Semiconductors, Refractory Metals, Alloys,
RoHS and E-Waste recycling



Germanium melting zone

- **Thrissur Laboratory**

Microwave Dielectrics, Supercapacitors,
Multilayer Ceramics, Actuators and Sensors



TEM Image of Graphene for supercapacitor applications

C-MET ORGANIZATION STRUCTURE

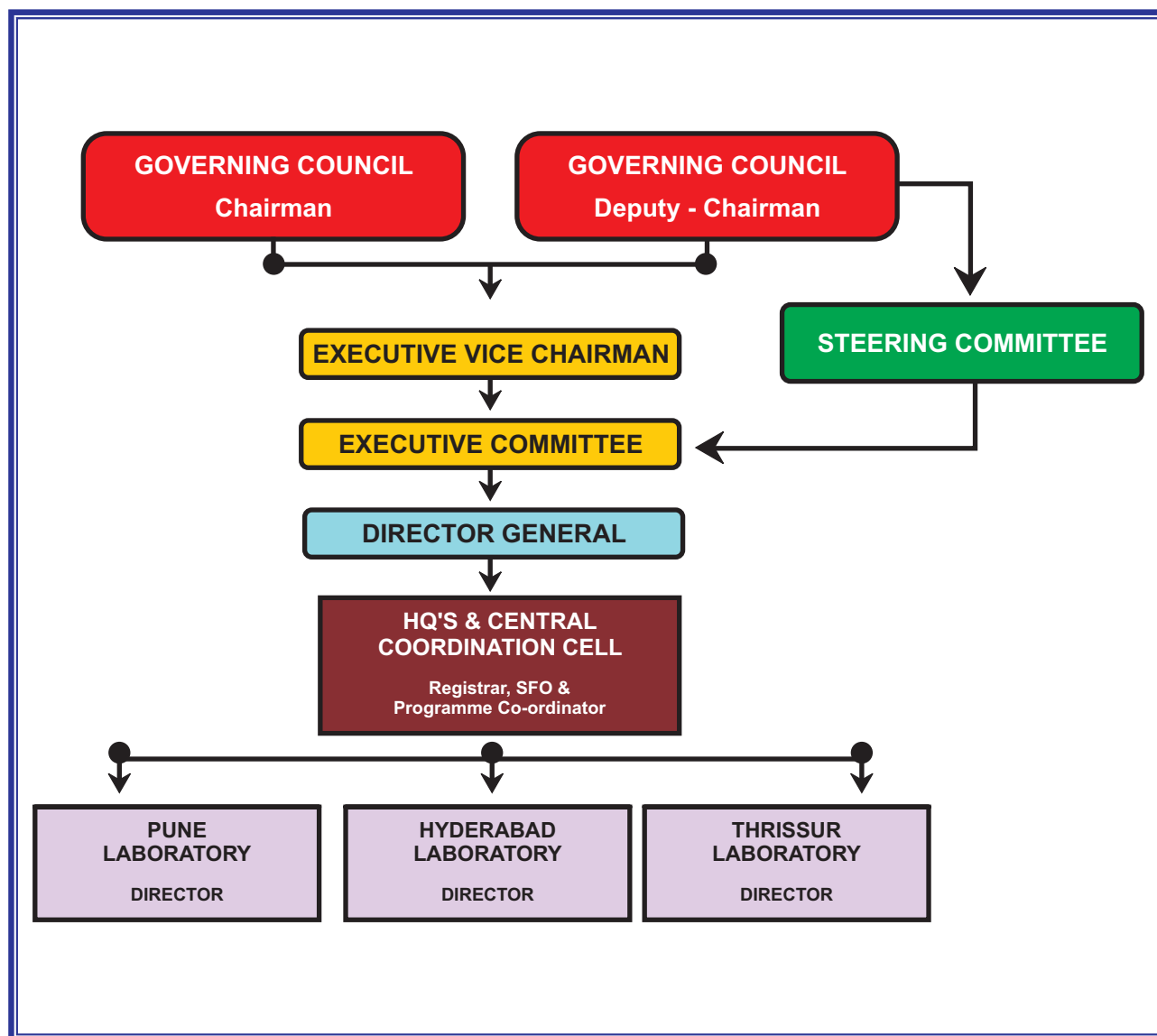
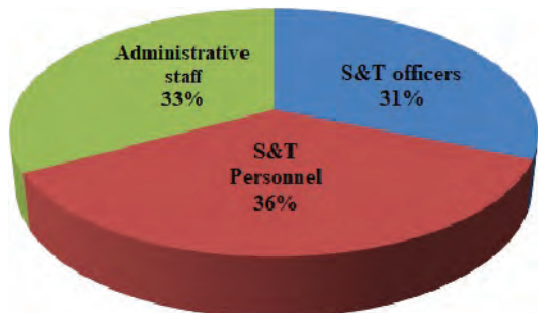


Figure 1 : Organization Chart of C-MET

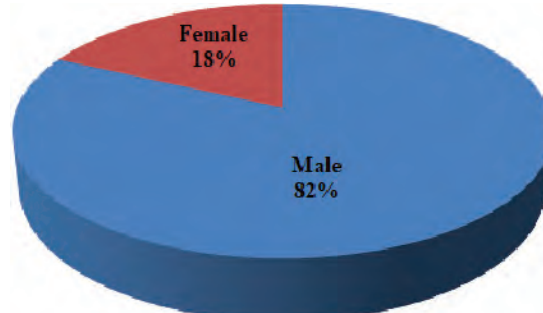
Human Resource Indicators (as on 31.03.2018)

C-MET team consists of 36 S&T officers, 41 S&T, support personnel and 38 administrative staff. Among S&T staff, 41 personnel are having Ph.D. degrees. Additionally, there are 94 Project staff / Ph.D. students, DST Inspire / Young scientist working at three laboratories of C-MET.

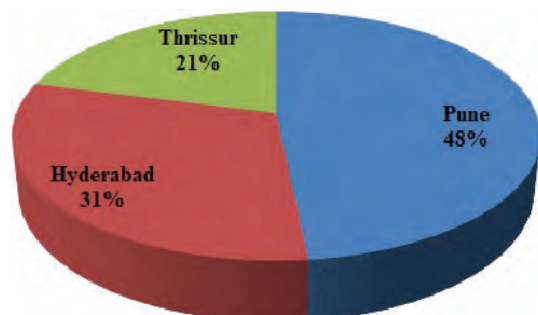
Total Staff



Gender Ratio of Employees



Project Staff / Ph.D Students



Category wise distribution of Employees

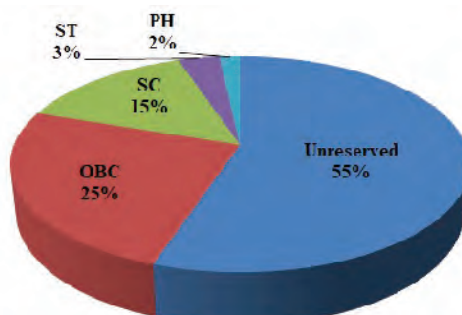


Figure 2 : Human Resource Indicators of C-MET

Sexual Harassment of women at work place (Prevention, Prohibition and Redressal) :
No such cases are reported at C-MET during 2017-18.

R & D Activities

During the year 2017-18, the main technical activities of C-MET covered the following:

- Implementation of supplementary grant-in-aid projects from MeitY as well as various government funding agencies like DST, ISRO, BARC, BRNS, DRDO, DAE, Private Industry and Public Sector etc.
- Technical and Materials characterization services.

Core Program:

It was proposed to have more coordinated and focused approach to the R & D area, where C-MET can deliver by exploiting its long experience in the development of traditional and advanced electronic materials and expertise gained hitherto and through inter-laboratory research interactions.

In this context, six major core programs as enlisted in the following table which have been selected for implementation.

S. No.	Core Program	Selection Criteria	Broad Objectives
1	Integrated Electronics Packaging	<ul style="list-style-type: none"> • Strategic Requirement • Potential Hub for Electronics Packaging Solutions 	<ul style="list-style-type: none"> • Development of LTCC Materials of integrated passive components • Development of LTCC Devices • Development of High Density Interconnects
2	Nano-materials and Devices	<ul style="list-style-type: none"> • Advanced Research leading to Cutting-edge Technologies 	<ul style="list-style-type: none"> • Development of low loss transparent conducting oxide based plasmonic materials and devices. • Large scale synthesis of metal, metal oxide and metal nitride nanopowders by thermal plasma. • Development of nanomaterials for sensing applications in smart cities. • Nanostructures for solar hydrogen production, fuel cells and thermoelectric cells.
3	Ultra-High Purity Materials & Compound Semiconductors	<ul style="list-style-type: none"> • Indigenization of critical materials and electronic devices for defence 	<ul style="list-style-type: none"> • Development of the technology and product up to pilot plant level and supply to meet the input materials requirements of strategic sectors, e.g. Space, DRDO and DAE. • Development of Process Technology for Refractory Metals Nanopowders. • Development of Process Technology for Silicon Carbide (SiC) Single Crystals.
4	Materials for Renewable Energy	<ul style="list-style-type: none"> • Indigenous development of materials, devices and systems for Energy 	<ul style="list-style-type: none"> • Development of process technology and supply of materials for solar energy and other renewal energy industries.

S. No.	Core Program	Selection Criteria	Broad Objectives
		Storage/Conversion for strategic and commercial applications	<ul style="list-style-type: none"> • Development of semiconductor nanostructures for photocatalytic H₂ generation by water and H₂S splitting. • Development of nanoscale cathode, anode and allied materials for battery applications. • Thermoelectric materials and devices.
5	Sensors and Actuators	For strategic and allied applications	<ul style="list-style-type: none"> • Development of Nano Material Based Thick Film Sensors. • Development of textured ceramics for Micro actuator.
6	Electronic Waste and RoHS	<ul style="list-style-type: none"> • Recycling of Hazardous waste to reduce environmental pollution • Extraction of precious metals from electronic waste • E-waste (Management) Rules 2016 compliance of electronic materials, devices, products and systems. 	<ul style="list-style-type: none"> • E-waste Recycling : Development of pilot plant technology for environmentally safe recycling of E-waste and extraction and recovery of precious metals. • ROHS : Characterization of electronic and allied products as per standard IEC 62321. procedures using NABL accredited analytical facility for the E-waste (Management) Rules 2016 / RoHS Directive.

All these programs are supplemented / complimented by Grant-In-Aid sponsored projects.

Externally Funded Projects

In addition to ongoing sponsored projects continued from the last year, C-MET has initiated 08 new grant-in-aid projects and technical services projects, 17 ongoing grant-in-aid projects, and 16 projects have been completed during the year. C-MET earned external funding (IEBR) to the tune of Rs. 629.62 lakhs during the year 2017-18. The unit wise sponsored project funding pattern is depicted in Figure 3.

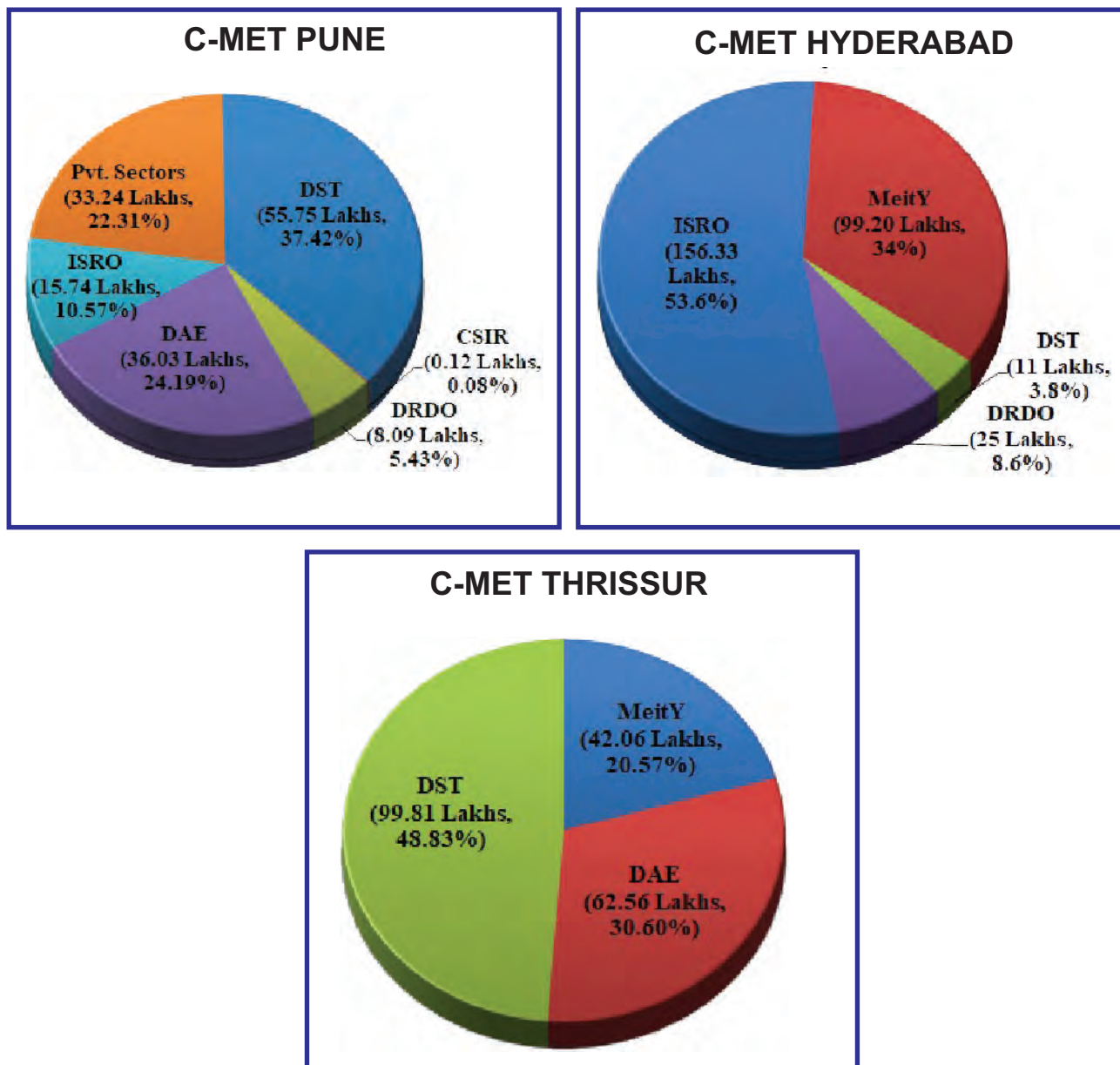


Figure 3. Sponsored Projects at C-MET Pune, Hyderabad and Thrissur

The growth in IEBR is graphically shown in Figure 4.

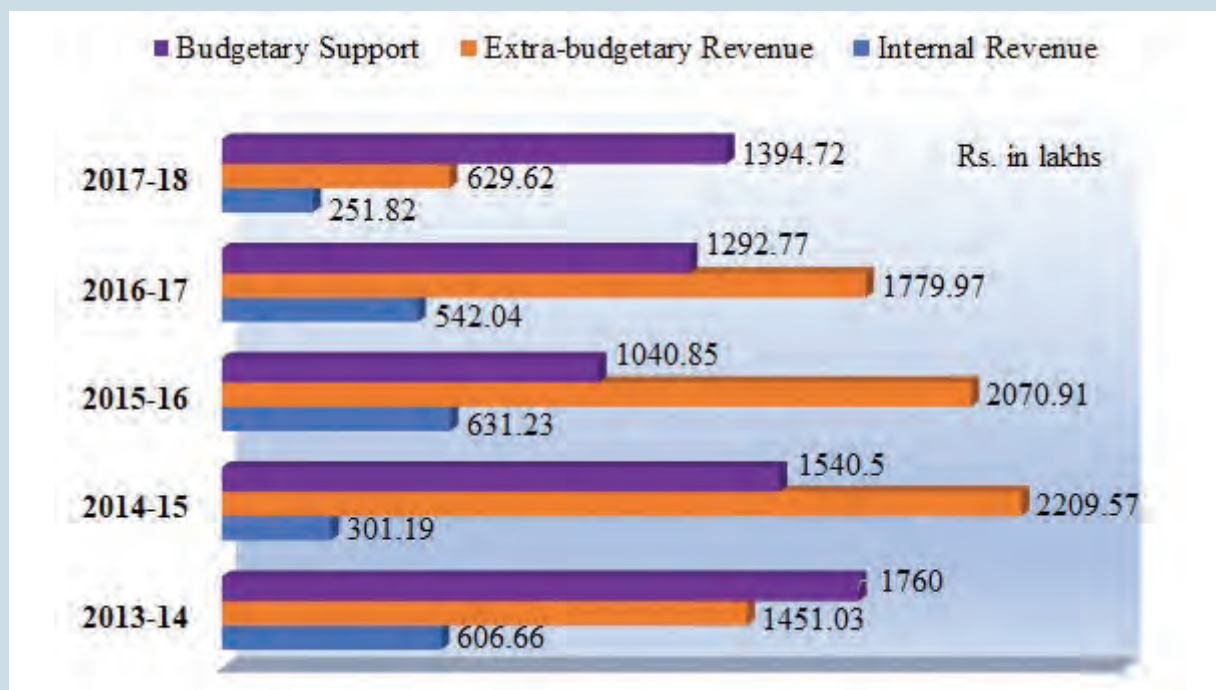


Figure 4. Budgetary support (BS), Internal revenue (IR) and Extra-budgetary revenue (EBR) of C-MET since 2013-2014

C-MET has also been enhancing its intellectual outputs in terms of publications, conference papers, Indian and foreign patents and invited talks as seen in Figure 5. The trend clearly evidences better scientific recognition of the R&D capability of C-MET scientists.

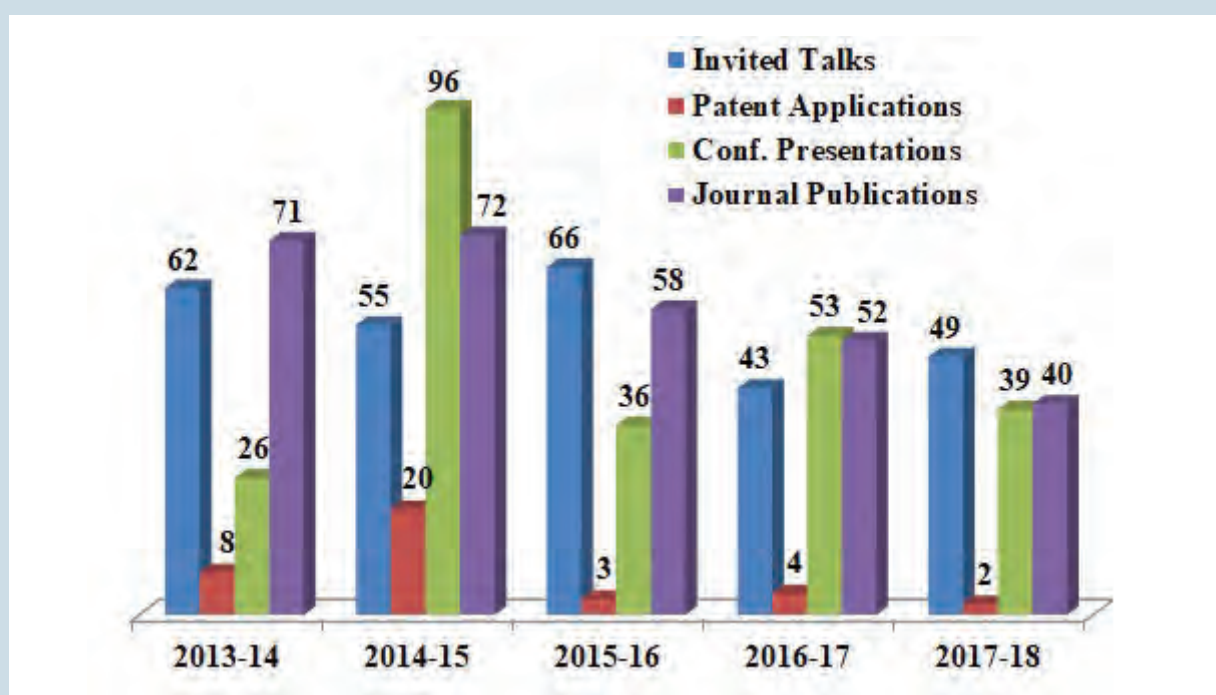


Figure 5. Intellectual Output of C-MET since 2013-14

Technologies Transferred

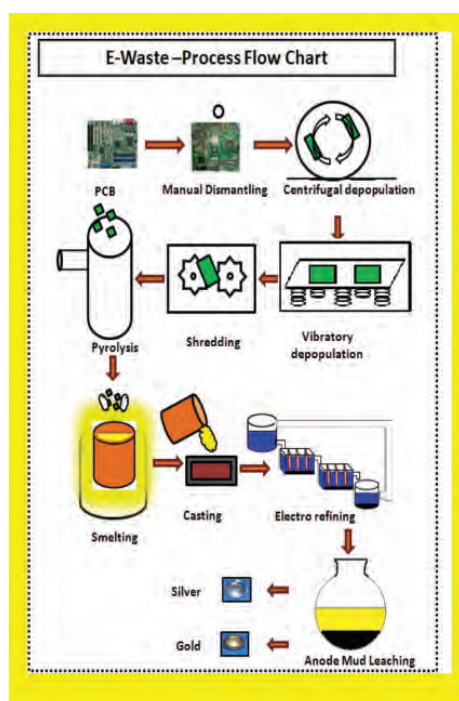
Two technologies have been transferred to the Indian industries during 2017-18.

1. Photopatternable silver and photoconductor thick film pastes for Photosensors technology has been transferred to M/s Ants ceramics, Mumbai (ToT fee of Rs. 14.30 Lakhs + Taxes) on 28.02.2018 at C-MET, Pune.
2. Quickly Rechargeable Emergency Lamp technology has been transferred to a start-up company M/s. Aessar, Thrissur (ToT fee of Rs. 0.97 Lakhs + Taxes) on 16.02.2018 at C-MET, Thrissur.

Technologies Ready for Transfer

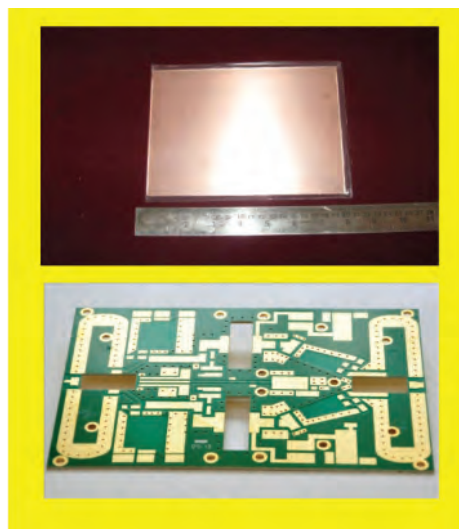
This year 5 technologies are ready for transfer to the Indian industries. The glimpses of these technologies are given below.

1. E-waste Recycling: From Printed Circuit Boards (PCBs) to Precious metals



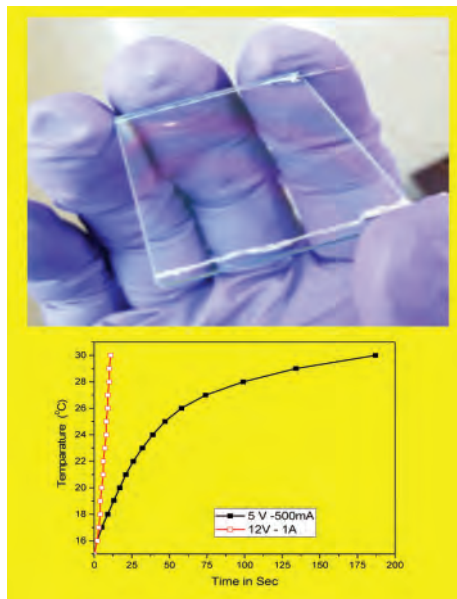
C-MET has developed unique / E-waste recycling process technology for thermal decomposition of printed circuit boards in an environmental friendly way by separation of inorganic fillers and metals by smelting process, anode casting, electro refining of copper and recovery of gold and silver from anode mud. The technology cost has been worked out in three different categories: (1) from PCBs to Black Copper, (2) from black copper to extraction of valuable metals (gold, silver, copper and palladium) and (3) from PCBs to Valuable metals (which is essentially 1+2), to facilitate the individual entrepreneur to absorb any one of the technologies or combination of them on non-exclusive basis depending on there expertise. The level of technology readiness at C-MET : TRL5.

2. Microwave substrates with dielectric constant 4.4



C-MET has developed low dielectric constant ($\epsilon_r = 4.4$ and $\tan \delta = 0.0018$) ceramic filled PTFE substrates and intellectual property for the innovation is protected by US Patent No. US9505902B2 in the year 2016. These copper cladded microwave substrates are suitable for solid state amplifier up to 500 watts and is ready for transfer. Since the development project is funded by BRNS, the technology will be transferred by Department of Atomic Energy. Salient features of the indigenously developed substrates compared to commercially available ones are, ultra-low loss tangent for selectivity, low dielectric anisotropy and tight dielectric tolerance and excellent temperature stability for Radio Frequency applications. The level of technology readiness at C-MET : TRL 6.

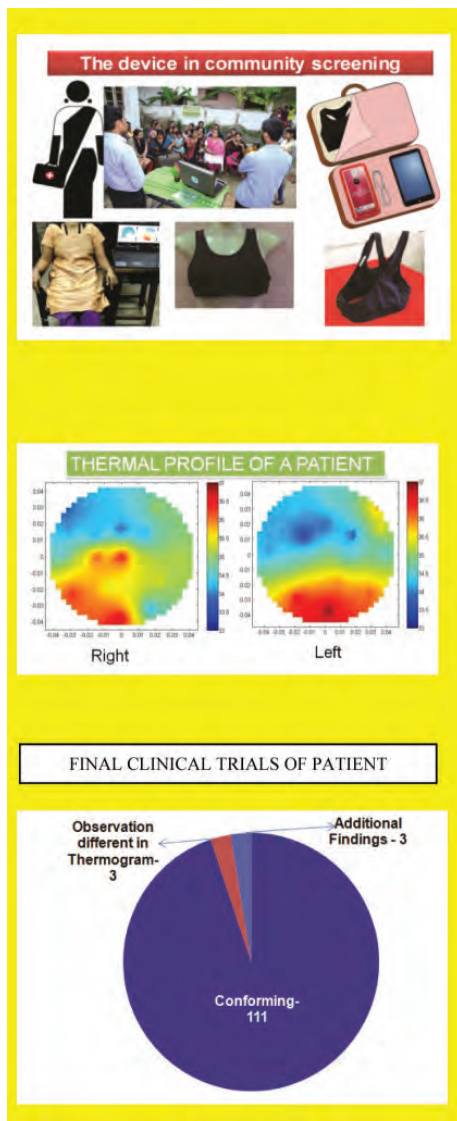
3. Transparent Heater



C-MET has developed optically transparent heater film on glass substrates for defrosting applications through a simple and cost-effective process technology. The heater film provides uniform heating on its surface by applying a small electric power and can be employed in cold environments and for defrosting and anti icing applications in automobile and consumer industries.

Demonstrated on 2"x1" size and the technology can be easily up-scaled to any size. Typical specifications of the product are (i) optical transparency >90% (in visible region), (ii) sheet resistance ~100 Ω /sq, (iii) heater film thickness 200 nm and (iv) substrate : standard soda lime glass. The level of technology readiness at C-MET : TRL 4.

4. Wearable device and analysis system for early detection and screening of Breast Cancer



Breast Cancer is now the most common cancer in India and accounts for approximately 27% of all cancers in women. Early detection of breast cancer has the potential to achieve 100% cure of the disease. In India, a stigma towards regular screening for cancer exists due to fear and ignorance. Reliance on Western guidelines employing regular mammography is impractical in India due to the large population of young patients with more dense breasts along with the high cost of the machines and trained manpower and staff requirements. Therefore, a more practical alternative should be there to identify potential women in a community by quick initial screening process and only suspected cases may be referred for further diagnosis. C-MET has developed a wearable device by using high sensitivity thermal sensors for the early detection and screening of breast cancer. The initial clinical trials were conducted in 75 patients and around 200 volunteers and the results are in line with the standard diagnostic tools such as mammogram, ultrasound and CT scan. This device can be operated with minimum training and is portable. This device does not inflict any pain or involve any radiation exposure and above all the privacy of the woman is ensured.

C-MET has filed two Indian patent applications (No.: 201741017186 and No.: 201711047118) and one US patent (No. 15/926,935) for this technology. The level of technology readiness at C-MET : TRL 7.

5. Aerogel based Supercapacitors


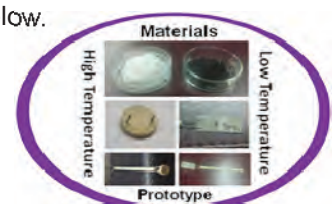


C-MET has developed complete indigenous technology for production of Aerogel Supercapacitor (Capacitances 0.47 F to 50.0 F) in cylindrical radial lead forms, for various electronics, automobile, power electronics and energy storage applications. This technology comprises (a) production of carbon aerogel in pilot scale, (b) fabrication of electrodes for supercapacitor and (c) production of aerogel supercapacitors of different sizes/values which is offered in either part / full on non-exclusive basis. The level of technology readiness at C-MET : TRL5.

Completed Grant-in-Aid Projects :

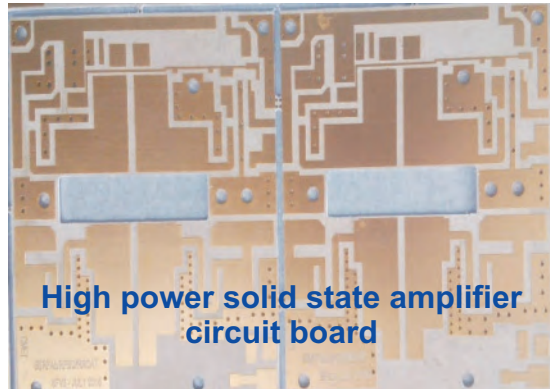
The major achievements in respect of completed *grant-in-aid* projects are furnished below :

S. No.	Title of the Project	Funding Agency & Duration	Total Outlay ₹ (Lakhs)	Achievements for 2017-2018
C-MET, Pune				
1	Development of LTCC materials for general purpose applications (PN/SP/045)	DST + CMET 27.11.2012 to 31.12.2017	536.16	<ul style="list-style-type: none"> Up-scaled tape casting process to continuous tape casting. Up-scaled Ag based screen printing and <i>via</i> filling pastes to 100g scale. Up-scaled Ag-Pd based screen printing and <i>via</i> filling pastes to 20g scale.
2	Development of active materials (Cathode and Anode) for high energy density Lithium-ion cell/ Battery with fabrication of Prototype cell (PN/SP/049)	MeitY, New Delhi 30.09.2013 to 29.09.2017	498.05	<ul style="list-style-type: none"> Fabricated full coin cells (~60 Nos) and pouch cells (~30 Nos) using in-house developed and commercial active materials. Successfully Completed Reverse Engineering of the commercially (Macromax and Panasonic Make) available cells. Temperature dependent battery performance testing of the fabricated cells has been performed in collaboration with Bharat Electronics Limited (BEL), Pune. Final closure meeting of the project was held on 25.09.2017. The project has been closed technically and financially.
3	Development of visible Light Active Titanium oxynitride and Tantalum oxynitride Photo catalysts for H ₂ O Splitting (PN/SP/051)	DRDO 12.05.2014 to 11.05.2017	44.03	<ul style="list-style-type: none"> Successfully upscaled to 10 gm batch for Tantalum oxynitride, N-Ta₂O₅ syntheses after extensive experiments/characterisation and the samples have been tried for its activity for Hydrogen (H₂) generation by Water (H₂O) splitting. The application study shows promising results. The project is completed, and final report is submitted to DRDO.
4	Prototype development of Fuel Cell using nano functional materials (PN/SP/054)	MeitY, New Delhi 2.7.2014 to 28.12.2017	31.68	<ul style="list-style-type: none"> Development and characterization of PtCo nanoalloy on carbon is successfully completed. Development of PdNi and PdCo nanoalloy is completed. The basic model of prototype development of Fuel Cell is completed. Final report is submitted to NIT, Warangal.
5	Development of nanostructured PdTe powder for Thermoelectric Application (PN/SP/057)	BRNS 23.09.2014 to 22.09.2017	19.00	<ul style="list-style-type: none"> Nanostructured PdTe has been synthesized and structural analysis has been thoroughly studied / performed. Measurements of electrical conductivity, thermal conductivity and Seebeck coefficient have been conducted for PbTe, Bi₂Te₃ and PdTe samples at

S. No.	Title of the Project	Funding Agency & Duration	Total Outlay ₹ (Lakhs)	Achievements for 2017-2018
				<p>BARC, Mumbai. The application results are promising.</p> <ul style="list-style-type: none"> The project has been completed and the final report has been submitted.
6	Synthesis and characterization of conducting polymer/ nanostructured WO ₃ hybrid for low temperature NOx detection (PN/SP/058)	ISRO 14.08.2015 to 13.08.2017	14.41	<ul style="list-style-type: none"> Successfully developed a proto-type NOx Sensor device based on modified WO₃ nanostructures with the following promising characteristics. Response time: 1 Sec Recovery time: 10 Sec Sensitivity: 10.75 for 100 ppm Final report has been submitted. 
7	Low Temperature Co-Fired Ceramic (LTCC) based pressure sensor (PN/TS/014)	Eaton Technologies Pvt. Ltd 04.05.2015 to 31.07.2017	35.63	<ul style="list-style-type: none"> Completed all fabrication batches for LTCC based pressure sensors and submitted to the sponsoring company. Samples have been accepted and project has been closed.
8	Waste Water purification by photocatalysis process (PN/SP/053)	DST (INDO-UKERIE) Bilateral 08.05.2014 to 31.03.2017	C-MET Outlay 4.91	<ul style="list-style-type: none"> Studies and mutual interactions/ visits were completed successfully. The project closure report submitted.
9	Proof of the concept Development of Photopatternable Thick film thermistor Composite Materials for Temperature sensor Application (PN/SP/059)	DRDO 13.01.16 to 12.01.2018	64.62	<ul style="list-style-type: none"> Mn based Ferrite sensor for low temperature sensing application is fabricated and electrical measurement is carried out in the range of 100-500 °C. Yttria based sensor for high temperature sensing application is fabricated and electrical measurement is carried out in the range of 500-1000 °C. Synthesized thermistor material for both low & high temperature and prototype for low & high temperature sensor is shown below.  <ul style="list-style-type: none"> Progress Report/Final Project Report/Closure Format/Project Review Minutes - action taken etc is prepared and submitted to GTMAP, Bangalore.

S. No.	Title of the Project	Funding Agency & Duration	Total Outlay ₹ (Lakhs)	Achievements for 2017-2018
C-MET, Hyderabad				
10	Sustainability and up-gradation of Government owned Restriction of Hazardous Substances (RoHS) test laboratory. (HD/SP/029)	MeitY 01.10.2012 to 30.09.2017	553.12	<ul style="list-style-type: none"> Developed SoPs for the testing of Pb, Cd, Hg, Cr⁶⁺, PBB and PBDE as per International standard IEC 62321. Retained NABL accreditation for testing RoHS elements. Signed MoU with CPCB, New Delhi for testing the samples collected by Random check from market on payment basis. Conducted 9 RoHS awareness programs on PAN India basis. Published articles on RoHS testing on daily Newspapers and magazines. Trained 8 post graduate level students on RoHS testing and ISO/IEC 17025:2005 system. Two days training and awareness program on RoHS was conducted on August 29 & 30, 2017 where 20 participants from industry/research organizations have been attended. Revenue generated Rs. 67.45 lakhs through testing RoHS and Non-RoHS samples. Served 106 industries and 112 Institutions for testing RoHS and Non-RoHS samples and tested total 3852 samples.
11	Development of system for preparation of high pure gallium nitride for light emitting diode (LED) and other optoelectronic applications (HD/SP/ 031)	DST 04.09.14 to 03.09.17	67.88	<ul style="list-style-type: none"> Proto-type systems for GaN synthesis, purification, growth, processing were fabricated indigenously and criticality/sensitization tests were carried out before taking up batch scale operations. Employing the directional freezing systems, homogenization and purification experiments on Ga were carried out and through fluxing technique, homogenization and synthesis experiments on 4N+ pure Ga and synthesis of GaN respectively were carried out. GaN was synthesized using Ga, Li-NaN materials systems & prepared material characterized. XRD analysis on the samples was revealed GaN phase formation. ICP-MS analysis on the prepared sample was also carried out.
C-MET, Thrissur				
12	Development of LTCC for General Purpose Applications (TH/SP/045)	DST 27.11.2012 to 31.12.2017	42.91	<ul style="list-style-type: none"> Developed various LTCC compositions (crystallizable anorthite based glass + cordierite, crystallizable anorthite based glass + Alumina) and tapes. Supplied LTCC tapes of 4 x 4 inch and 7 x 7 inch size to C-MET, Pune for further evaluation. Trained C-MET, Pune staff.

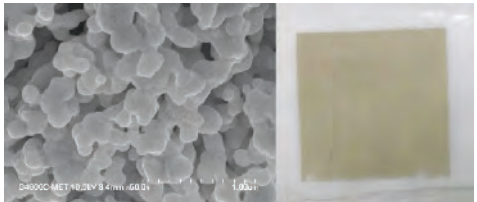



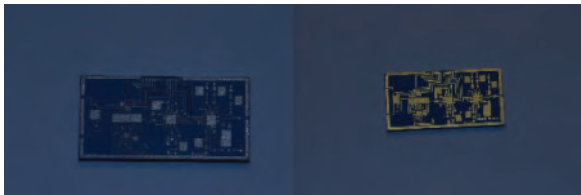

S. No.	Title of the Project	Funding Agency & Duration	Total Outlay ₹ (Lakhs)	Achievements for 2017-2018
13	Development of Thermal Sensor Based Monitoring System for the Early Detection & Screening of Breast Cancer (TH/SP/051)	MeitY 28.02.2014 to 28.02.2018	C-MET Outlay 139.85	<ul style="list-style-type: none"> C-MET has made more than 1000 numbers of chip thermistor probes. Total 11 wearable devices with different sizes have been made. A unique analysis system was developed which gives 2D images of the thermal profile of the breast. For the classifications of the abnormality stages, a program was developed. Conducted clinical trials of the wearable device on 117 patients and around 200 volunteers. The results are in line with the standard diagnostic tools such as mammogram, ultrasound and CT scan. Standalone software was generated for the analysis system developed by C-MET.
14	Development of transition metal doped TiO ₂ for photocatalytic generation of hydrogen by water splitting (TH/SP/052)	BRNS 5.09.2014 to 30.09.2017	27.69	<ul style="list-style-type: none"> Nanosized TiO₂ and various transition metal (Fe, Co, Ni and Cu) doped TiO₂ were prepared through hydrothermal method and characterized using various instrumental techniques. Photosensitive water splitting in a quartz photoreactor produced ~870 $\mu\text{mol h}^{-1}\text{g}^{-1}$ of H₂ under visible irradiation as evidenced by GC-TCD using Ar as the carrier gas.
15	Development, production and supply of microwave substrates for 750 W amplifiers (TH/SP/053)	BRNS 15.07.2014 to 31.03.2018	237.86	<ul style="list-style-type: none"> 250 Nos. of copper cladded Microwave substrates have been fabricated through patented SMECH process for high power solid state amplifier. Delivered 250 Nos of gold finished microwave circuit boards suitable for 750 W solid state amplifier fabrication at RRCAT, Indore. Delivered 50 Nos of copper cladded microwave substrates of size 200 mm (L) x 200 mm (B) x 0.762 mm (T) to RF Division, BARC for high power solid state amplifier design. MoU project successfully completed by delivering committed microwave substrates to RRCAT and BARC there by meeting all targeted specifications. <div data-bbox="810 1680 1362 2067" data-label="Image">  <p>High power solid state amplifier circuit board</p> </div>

S. No.	Title of the Project	Funding Agency & Duration	Total Outlay ₹ (Lakhs)	Achievements for 2017-2018
16	Al internal electrode based Ultra Low Temperature Co-fired Ceramic (u-LTCC) for Microwave Electronic packaging application (TH/SP/055)	BRNS 20.01.2015 to 31.03.2018	24.55	<ul style="list-style-type: none"> Alternate Single phase $\text{Bi}_2\text{Mo}_2\text{O}_9$ system synthesized. Dielectric properties confirmed with Al paste. Demonstrated co-fireability of the developed ceramic and Aluminium based electrode paste for microwave electronic packaging application.

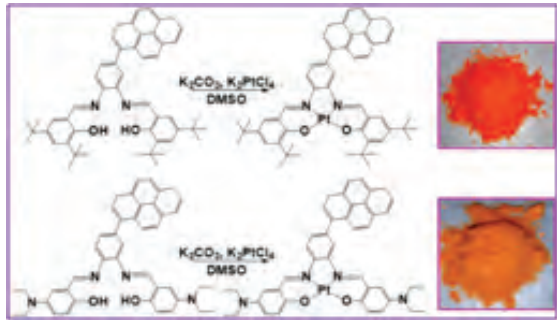
On-going Grant-in-Aid Projects :

The consolidated progress in respect of on-going *grant-in-aid* projects is furnished belows :



S. No.	Title of the Project	Funding Agency & Duration	Total Outlay ₹ (Lakhs)	Achievements for 2017-2018
C-MET, Pune				
1	Development of microcrystalline silver powder for photovoltaic cells and EMI shielding applications (PN/TS/015)	Madison Metals Ltd. Vapi 01.01.2017 to 30.06.2017	26.44	<ul style="list-style-type: none"> Optimized up-scaling of silver powder (Ag) product range of 50-100 g scale. Prepared silver paste compositions using different batch of powders and glass frit composition for solar cell application. Prepared silver paste compositions using different batch of powders and glass frit composition for the EMI shielding applications and the optimization work is in progress.  <p>Silver powder and EMI shielding mesh pattern</p>
2	Development of electroplated binary and ternary Sn-Ag-Cu based lead free solder alloy for PCB application (PN/SP/60)	DST 11.05.2016 to 10.05.2019	68.17	<ul style="list-style-type: none"> Spin coating system delivered and installed. Electrolyte systems and bath components for Sn-Cu and Sn-Ag co-deposition has been identified. The Binary alloys are getting deposited. Electrochemical studies using cyclic Voltammetry show single step co-deposition occurring for both the binary alloys. Fine tuning of the compositions to be done. Co-deposition bath for ternary Sn-Ag-Cu system is being developed. Preliminary identification of components done. Studies in progress.
3	Fabrication of 2D heterostructures by CVD (PN/SP/061)	BRNS 09.3.2017 to 08.3.2020	34.99	<ul style="list-style-type: none"> Chemical vapor deposition and Dip coating systems installed. Initial experimental trials have been initiated.  <p>CVD and Dip coating systems</p>
4	Fabrication of LTCC based induction coil magnetic sensor (PN/TS/013)	BARC 19.01.2015 to 18.01.2017 (Extended up to 18.06.2018)	148.5 + Taxes	<ul style="list-style-type: none"> Mark - I samples were tested by BARC. All samples have passed the acceptance criteria. An additional Mark-1.5 delivery was asked by BARC and additional funding and extension has been given. Mark 1.5 samples have been fabricated and submitted to BARC. Results of testing awaited.

S. No.	Title of the Project	Funding Agency & Duration	Total Outlay ₹ (Lakhs)	Achievements for 2017-2018
5	Development of microwave circuits (PN/TS/012)	SAC, ISRO 16.06.2011 to 31.03.2018	45.00 + Taxes	<ul style="list-style-type: none"> Samples of 2 tiles of Iteration (IT) 2 have been fabricated and submitted to SAC for testing. Samples of Iteration 3 and 4 are being fabricated.  <p>LTCC fabricated 2 tiles of IT-2 Ag and Au samples</p>  <p>LTCC fabricated 2 tiles of IT-3 Au and filter</p>
C-MET, Hyderabad				
6	Establishment of extended pilot plant facility at C-MET, Hyderabad for preparation of 320 kg per annum Hafnium sponge. (HD/TS/001) (This is a Continuous Project for the preparation of Hf sponge @ Rs. 2.38 lakhs/kg for VSSC. During the year 2017-18, Rs. 70.27 lakhs have been received)	VSSC (ISRO) 31.12.2016 onwards	70.27 760.57	<ul style="list-style-type: none"> 22 kg Hf sponge delivered to VSSC as per specifications. Another 23 kg Hf sponge is ready for delivery to VSSC. 20 MT nitric acid procured, follow up taken with VSSC and NFC for Zr scrub raffinate. Solvent extraction of 1 KL feed completed in cycle-2 and cycle-3. 8 KL sodium nitrate effluent and 5 KL impure effluent disposed off. 36.4 kg Hf oxide, 90 kg briquette, 140 kg Hf chloride, 70 kg reduced mass prepared. 45 kg Hf sponge prepared after shredding in three batches and characterized. 22 kg Hf Sponge supplied to VSSC / MIDHANI for EB refining. EB refined Hf sponge is meeting target specs, alloy preparation initiated. Rs. 68.39 lakhs received from VSSC against 3rd 20 kg MoU and one month minimum maintenance charge for April, 2017. Enquiry received, quotation submitted, and purchase order received from VSSC for 70 kg Hf sponge supply. Rs. 66.55 lakhs received from VSSC as advance against purchase order. Bigger size (400 Litre /hour capacity) solvent washing system procured and commissioned in wet area. Bigger size cooling water sump and pumping system installed in dry area.

S. No.	Title of the Project	Funding Agency & Duration	Total Outlay ₹ (Lakhs)	Achievements for 2017-2018
7	Environmentally Sound Methods for Recovery of metals from PCB's: Phase - II (HD/SP/32)	MeitY 22.08.14 to 21.08.19	1126.80	<ul style="list-style-type: none"> A mechanical shed of 800 m² area constructed through BSNL. Pyrolysis and smelting systems are up scaled to 100 kg/day capacity. Designed and developed a gas cleaning system comprises of secondary burner chamber, quenching and scrubbing systems. Developed a fire refining procedure to reduce tin content in the black copper. Fire refining of black copper with fluxes and oxygen purging has resulted in improved copper percentage and reduced tin content and finally <1% tin was achieved in refined copper. Scaled up the electrorefining process to 30 kg Cu per day at EPPL. Nearly 650 Kg PCBs E-waste has been processed and obtained 56 kg of black Copper. Feasibility studies conducted to recover tantalum from spent PCBs.
8	Development of Ultra purification process for high scale production of 7N grade Cd & Te. (HD/SP/33)	SSPL, DRDO 08.12.15 to 07.05.18	76.93	<ul style="list-style-type: none"> Batch enhancement process up to 4 kg per batch on high pure Te & Cd was optimized. Design of heaters to achieve narrow zone length and to accommodate higher dia quartz tube was completed. The same was fabricated locally. Four kg each of high pure tellurium & cadmium certified by NRC, Canada were supplied to SSPL, DRDO as part of project deliverables. Three batch enhancement zone refining experiments on high pure Te & Cd were carried out with optimized parameters. As against targeted quantity of 9 kg each of Ultra high Pure (UHP) Te & Cd, 7.00 kg of UHP tellurium & 3.70 kg of UHP cadmium with desired specifications developed at C-MET, Hyderabad under this project were tested at NRC, Canada and supplied to SSPL as part of project deliverables.
9	Ru(II)&Ir(III)-polypyridine dyads complexes with long-lived 3IL excited state as photosensitizers for visible light switches photocatalytic applications (HD/SP/34)	DST-SERB 01.04.16 to 31.03.19	37.00	<ul style="list-style-type: none"> Two coumarin based Ru(II)-polypyridine complexes (Ru-1 & Ru-2) were synthesized and characterized to elucidate structures. Their DNA binding and cleavage studies were investigated by gel-electrophoresis technique in the presence of Ru(II) complexes after irradiation of visible light. The cytotoxicity <i>in vitro</i> of the present complexes toward HeLa, BEL-7402 and MG-63 cells was assessed. These investigations have been resulted as publication in Materials Science & Engineering C a reputed international journal. In order to further achieve the objectives of the project, two polypyridyl ligands are isolated by attaching the

S. No.	Title of the Project	Funding Agency & Duration	Total Outlay ₹ (Lakhs)	Achievements for 2017-2018
				<p>organic chromophores such as naphthobipyrrole & dipyrrolebodipys to 2, 2'-bipyridine & 1, 10-phenanthroline via carbon-carbon triple bond conjugation.</p> <ul style="list-style-type: none"> Along with the above, two tetradentate Schiff-base ligands have been isolated by imine coupling of bromo-phenyl-diamine and/or diamino-phenazine with different substituted-Salicylaldehydes. These molecules will be utilized for isolation of Ru(II), Pt(II) and Ir(III) complexes. 
10	SiC single crystal bulk growth process development: (Phase II) (HD/SP/35)	DMRL / DRDO 27.07.2016 to 26.07.2020	998.78	<ul style="list-style-type: none"> Civil structure augmentation of SiC lab required for establishing Clean Room completed. Growth of 6H SiC single crystal (12 Nos.) carried out for DoE optimization of process parameters and confirms ~ 100% singular polytype area of 2" diameter boule. SiC boules (4 Nos) grown as per DoE are cut into slices at SSPL for further analysis. Critical source materials (SiC seed, SiC powder, Graphite crucibles, Pyrometer, Air Flow Sensors, etc) required to grow SiC single crystal were procured. Optical Microscope (to study SiC seed/wafer morphology & microstructure); and Helium Leak Detector (for checking leak in SiC reactor) were commissioned.
11	Process development for recovery of rare earths from CFLs & FLs. (HD/SP/36)	DST-WM 02.09.2016 to 01.09.2019	39.36	<ul style="list-style-type: none"> Bulb eater procured and installed. Recovered Y, Eu, Ce & Tb by 6N acid leaching followed by solvent extraction using DEPHA as an extracting solvent. Optimized the acid leaching process of rare earths from waste phosphors using 6N sulfuric acid. Extracted rare earths: Y, Eu, Ce & Tb using DEPHA as an extractor for solvent extraction experiment.
12	Recycling of scrap Germanium to ultra-high pure	DRDO 17.10.2016 to 16.10.2019	122.07	<ul style="list-style-type: none"> Fabrication of Induction Zone Refining System and Resistive Zone Refining System for Germanium purification is in advanced stage. Germanium melting

S. No.	Title of the Project	Funding Agency & Duration	Total Outlay ₹ (Lakhs)	Achievement for 2017-2018
	Germanium (HD/SP/37)			<p>trial experiments by Induction heating have been successfully conducted at factory site.</p> <ul style="list-style-type: none"> Established Induction Zone Refining System and Resistive Zone Refining System for purification of scrap Germanium. Induction Zone Refining trial experiments conducted. Clean room refurbishment initiated. Improvements in Germanium matrix volatilization. Specifications of UPS finalized for Induction and Resistive Zone Refining Systems.
13	Development of ultra-high pure Zinc for detector applications (HD/SP/38)	BRNS 05.12.2016 to 04.12.2018	32.44	<ul style="list-style-type: none"> Vacuum distillation experiments conducted. Uniform melting for bar preparation completed. Zone refining experiments are in progress. Specifications finalized, and PO placed for high vacuum unit. Specifications finalization of metal granulation system and PO placed for the conversion of Zinc ingot to less 3 mm dia shots. Specifications finalization is in progress for retort fabrication for Zinc distillation experiments.
C-MET, Thrissur				
14	Dev. & Setting-up of Pilot Scale Production of Aerogel Supercapacitors for electronic applications (TH/SP/054)	MeitY & DST 01.08.2014 to 31.07.2018	2210.66	<ul style="list-style-type: none"> Re-Produced 4 batches of Organic Aerogel of two selected compositions in bulk using Aerogel Pilot Plant, which were then converted to corresponding Carbon Aerogels (CAG) through pyrolysis. Produced more than 10 Spools of Aerogel Electrodes (AG-E) of different widths (10-25 mm) and lengths >50 meter each for fabrication of Aerogel Supercapacitors (AGSC) of diff values. Supplied 2 AG-E spools of length >100 m each to KCCL (the industrial collaborator), which have been qualified for use in high speed capacitor manufacturing machines. Designed, fabricated and established Dehumidified clean room of Class 10,000 & RH <15%. Also commissioned multichannel high current Supercapacitor testing Module for testing/evaluation of electrical performances of Supercapacitors. Fabricated Aerogel Supercapacitors of different values (2.2 F, 3.3 F, 4.7 F, 10F, 25F, 50F), sealed in Aluminum-cans of dimensions D 12.5-22 mm x H 16.5-42 mm and performances of AGSC were tested/evaluated using HCSCTM. Fabricated three AGSC packs of 250-350F and they were supplied to ECIL for trial testing for EVM-VVPAT applications.

S. No.	Title of the Project	Funding Agency & Duration	Total Outlay ₹ (Lakhs)	Achievement for 2017-2018
				
15	Design & Dev. of Powerpacks with Aerogel supercapacitors & Fractional order modelling (TH/SP/56)	BRNS 02.07.2015 to 01.07.2018	190.61	<ul style="list-style-type: none"> Prepared Aerogel carbon (AGC) of supercapacitor grade through alternate cost-effective technique and evaluated material properties. Up-scaled the process for making 1 kg of AGC per batch. Designed and fabricated machines for making AGC electrodes through slurry-based composition and commissioning of machines are in process. Fabricated Supercapacitors of cell capacitances 5-25F using AGC and existing machineries. Supercapacitors thus produced were tested and samples of selected batches were supplied to IIT-Bombay for further testing and pack fabrication.
16	Textured PMN-PT based Piezo Ceramics (TH/SP/057)	DST-SERB 16.12.2015 to 15.12.2018	31.13	<ul style="list-style-type: none"> PMN-PT compositions of different ratios were prepared and confirmed the MPB composition. Synthesized tabular ST7 through molten salt process.
17	Magneto-dielectric substrates for miniaturized antenna application (TH/SP/058)	MeitY 09.08.2016 to 08.08.2019	80.51	<ul style="list-style-type: none"> Prepared phase pure Zn substituted analogue of Y-type hexaferrite and Z-type Hexaferrite magneto-dielectric fillers through conventional solid-state route. Fabricated polymer-YHF composite MD substrate for antenna application. The MD substrate exhibited $\mu_r=2.16587$, $\tan\delta_m<0.1$, $\epsilon_r=6.4037$, $\tan\delta\epsilon_r<0.1$. Antenna fabricated using the substrate showed miniaturization of 23% and bandwidth enhancement of 4%. 

Newly Initiated Projects

The consolidated progress in respect of newly initiated *grant-in-aid projects* is furnished below:

S. No.	Title of the Project	Funding Agency & Duration	Total Outlay ₹ (Lakhs)	Achievement for 2017-2018
C-MET, Pune				
1	Novel Nanostructured High-Performance Anode materials for High Energy Na-ion Batteries (PN/SP/064)	DST 30.11.2017 to 29.11.2020	68.27	<ul style="list-style-type: none"> Studies, experiments and design are underway to get suitable nanostructure which can give high performance anode materials to be used in high energy novel sodium - ion batteries for futuristic applications.
2	Development of nanostructured manganese ferrite (MnFe_2O_4) (PN/SP/066)	MOIL, Nagpur 01.02.2018 to 31.01.2020	24.77	<ul style="list-style-type: none"> Initial synthesis of MnFe_2O_4 nanostructures using Solvothermal method is carried out. Characterization of prepared nanostructures is in progress.
3	Synthesis of nanosized AlN ceramic powder by transferred arc plasma reactor for electronic packaging applications (PN/SP/065)	ISRO 24.01.2018 to 23.01.2020	28.64	<ul style="list-style-type: none"> Trial runs of iron powder were carried out using plasma reactor and characterized using SEM and XRD.
4	Plasmonic Ionic Liquid Crystal Stabilized Nanoclusters for optical devices (PN/SP/062)	DST-SERB 03.04.2017 to 02.04.2020	32.72	<ul style="list-style-type: none"> Synthesized stable gold nanoparticles (AuNPs) using imidazolium ionic liquids as a stabilizer as well as surfactant to give size of 5 nm.
5	Flexible solid state super capacitor device. (Project in collaboration with NIT, Nagpur) (PN/SP/063)	DST 01.07.2017 to 29.07.2020	60.64	<ul style="list-style-type: none"> Optimization of Aerogel synthesis is completed. The synthesis and characterization of porous carbon materials by carbonization aerogel is completed. Electrochemical characterization of Carbon aerogel is in progress. The optimization of synthesis of SnO_2 and $\text{V}_2\text{O}_5 @ \text{C}$ is in progress.
C-MET, Thrissur				
6	Development of transparent conducting oxide and metal nitrides as low loss plasmonic	BRNS 28.08.17 to 27.08.20	31.83	Zinc oxide films doped with indium prepared by spray coating exhibited carrier concentration upto 10^{21} cm^{-3} , after annealing in reduced atmosphere. These films can be used for plasmonic applications in near IR region.

S. No.	Title of the Project	Funding Agency & Duration	Total Outlay ₹ (Lakhs)	Achievement for 2017-2018
	materials in near IR and visible frequencies (TH/SP/059)			
7	Development of transparent conducting oxide based fibre optic plasmonic hydrogen and ammonia sensors (TH/SP/060)	DST 20.10.17 to 19.10.20	44.85	(In, Al) co-doped ZnO thin films fabricated by spin coating exhibited excellent electrical properties and high transmittance (90%) in the visible region. Attempts are going on to further increase the carrier density in these films.
8	Development of Nano NTC composition based sub- millimeter sized thermal sensors for low temperature applications (TH/SP/61)	DST 15.03.2018 to 14.03.2021	47.37	Preparation of Nano Negative Temperature Coefficient (NTC) thermistors compositions were processed by auto-combustion method.

Major Pilot Plant and Infrastructure Facilities

I. Li-Ion Batteries: Facility for synthesis of Active Materials, Single Cell fabrication and Testing of Prototype Cells

C-MET, Pune has developed indigenous cathode and anode materials using spray pyrolyzer, established fabrication and testing facility for Coin/button (2032 type) and pouch/rectangular lithium ion cells. The capacity of the developed cells is found to be comparable with that of the commercially available cells.



Figure 6. Lithium ion cell fabrication and testing facility

II. Low Temperature Co-fired Ceramic (LTCC) Packaging

The Low Temperature Co-fired Ceramic (LTCC) facility has been established (over approximate 1500 sq. ft built-up area with Class 10,000 standard) in C-MET, Pune. The laboratory is well equipped with the LTCC fabrication equipments for the fabrication of various LTCC packaging applications. The equipments include *via* punching, *via* filling, screen printing of conductive patterns on green tapes, stacking, lamination and co-firing. C-MET has also developed indigenous LTCC Tapes and pastes for general purpose LTCC applications.



Figure 7. Clean room of class 10000 and tape casting facility at C-MET, Pune

III. Hafnium Sponge for Strategic Applications

C-MET, Hyderabad has established first indigenous Hafnium (Hf) metal sponge plant to meet ISRO requirement, as shown in figure 8. The input materials used is Scrub Raffinate from Nuclear Fuel Complex containing 1-2 % Hf with respect to zirconium, which is further processed through solvent extraction to obtain HfO_2 . Chlorination, Kroll reduction and Vacuum distillation have been employed to get 99% pure Hf sponge. Hf sponge will also cater to the needs of Department of Atomic Energy (DAE) in control rods of nuclear reactors. C-MET is also working on developing novel spin off products based on the indigenous availability of Hf in different forms.



Figure 8. Hafnium Plant at C-MET, Hyderabad

IV. Silicon Carbide single crystal bulk growth facility

Silicon carbide (SiC) single crystal is a promising material for high power, high temperature, high frequency device fabrication due to its wide bandgap, high thermal conductivity and high breakdown field. Ultrapure SiC single crystal is used for making blue LEDs, substrate for GaN devices, ultrafast high voltage Schottky diodes, MOSFETs, high temperature thyristors for high power switching devices, etc.

In view of the strategic uses of SiC single crystals, an advanced sublimation reactor facility is established at C-MET, Hyderabad for 6H SiC single crystal growth of 2" diameter, figure 9 and 4H SiC single crystal boules, in collaboration with DMRL/SSPL (DRDO) to supply boules required for making substrates to be used in GaN technology at SSPL. Optimization of semi-insulating (SI) 6H SiC single crystal for device applications is under progress. Efforts are also being made to augment the SiC single crystal size to 6" dia and device grade wafers for SiC/GaN based electronic devices.

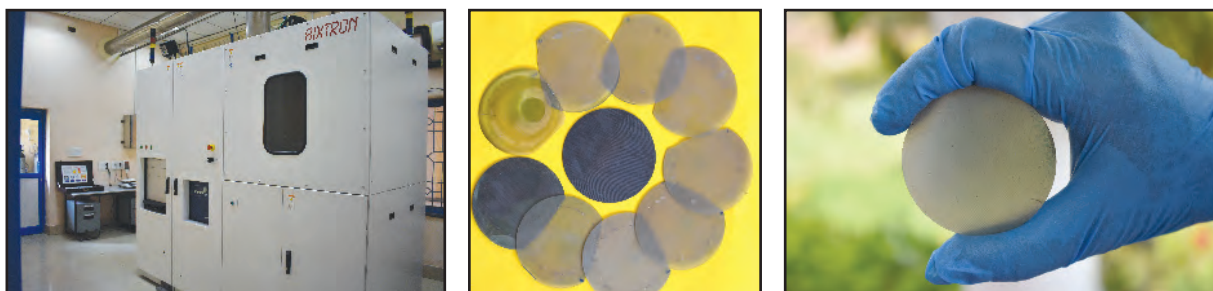


Figure 9. SiC sublimation reactor, cut-slices of 6H SiC single crystal and 2" dia 6H SiC single crystal wafer

V. Recovery of Precious Metals from Electronic Waste

C-MET has established pilot plant facility for the Environmentally Sound method for the recovery of metals from printed circuit boards. C-MET technology involves a combination of pyrometallurgy and hydrometallurgical operations wherein quantity of liquid effluents has been made minimal. Unique flux combination has been arrived at C-MET for effective separation of metal and slag. Prototype systems for the depopulation, shredding, pyrolysis, calcination, smelting and electro-refining are developed and successfully demonstrated up to 100 kg per day. Full-fledged pilot plant scale facility is being established together with an industry partner M/s E-Parisaraa at Bangalore for a capacity of 1 tonne printed circuit boards per day. Entire process is environmentally sound as the evolved gases are thermally processed for the complete destruction as per the CPCB norms.

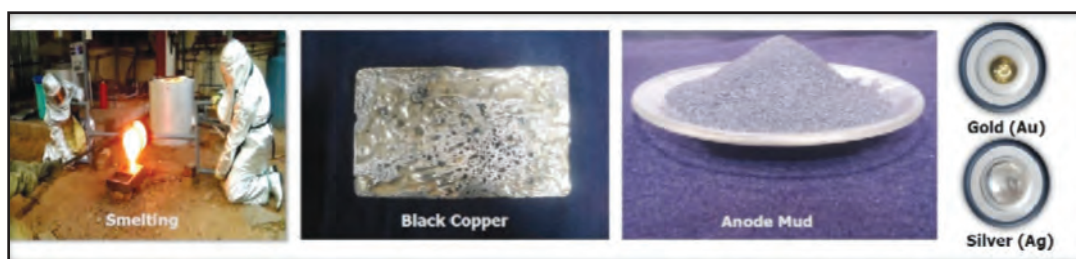


Figure 10. Pilot plant facility for the recovery of precious metals from electronic waste

VI. Ultra-High Pure (UHP) Materials Preparation Facility

The demand for Ultra High Purity (UHP) metals (> 99.99999 at.%) is increasing rapidly because of more stringent specifications especially with respect to metallic, gaseous and gas-forming impurities in the host of pure metal matrix. C-MET, Hyderabad has undertaken the project to develop these materials with the objective to meet the existing indigenous demand in the strategic sector completely and hence the self-reliance.

Process technology with indigenous equipment has been developed for processing high pure (7N grade) tellurium & cadmium for the first time in the country. Nearly 20 kg per annum of high pure Tellurium Oxide (TeO_2) has prepared and supplied to BARC, Govt. of India for preparation of isotopic nuclear medicine applications and to Solid State Physics Laboratory (SSPL), DRDO for the development of Infrared devices such as $\text{CdTe/CdZnTe/HgCdTe}$. Technology for 6N pure Cd was transferred to M/s Binani Zinc Ltd, Binanipuram, Kerala. An indigenous induction zone refiner has been established to produce ultra-high pure germanium.



Figure 11. Pilot plant facility of induction zone refining system and the extraction of Germanium

VII. Restriction of Hazardous Substances (RoHS) test Facility

C-MET, Hyderabad laboratory has established a state-of-the-art and NABL accredited chemical testing facility (bearing no. T-1780) for the analysis of electrical, electronic equipment and related products to help the industries and developed a mechanism to identify and quantify the banned hazardous substances such as Pb, Cd, Hg, Cr⁶⁺, polybrominated compounds, under E-waste (Management) Rules 2016 in the area of polymers, metals, etc. This is the only Government owned testing facility in India established with the financial support of Ministry of Electronics & IT (MeitY), Government of India. In addition to NABL accreditation, C-MET is also having Bureau of Indian Standards (BIS), Govt. of India recognition for testing of mercury levels in CFLs and Fluorescent Lamps (FLs) as per standard methods.

EDXRF (ARL Quant'X)



AAS with hydride generator



ICP-OES (725 Agilent)



ICP-MS (X S Ion)



Ion Chromatography



UV-Vis Spectrophotometer



GC-MS



Microwave Digester



Figure 12. RoHS laboratory facility for the detection of hazardous materials

VIII. Carbon Aerogel and Graphene based Supercapacitors

C-MET, Thrissur has established the state-of-the-art facilities for production of Carbon Aerogel and graphene and their conversion into supercapacitor electrodes and made prototype aerogel supercapacitor cells, which were tested by VSSC, Tata Motors, BARC, etc. and test results were found to be comparable to that of similar products of other manufacturers.

Facilities created :

- Large volume Gel reactor
- Aerogel production pilot plant
- Large volume atmosphere controlled Carbonization furnace
- Centrifugal milling machine for making Carbon aerogel powder (~100 µm)
- Automatic sieving machine
- Aerogel electrode forming machine including sub-unit for making electrode composition and fixing aerogel tape over metal foil (roll-to-roll)



Figure 13. Pilot plant facilities for the prototype development of Supercapacitors

IX. Flexible microwave substrates for High Power Microwave applications

Flexible microwave substrates are extensively used for variety of high end microwave circuit applications such as high power solid state amplifiers, patch antennas, missile guidance, mobile base stations, etc. C-MET, Thrissur has developed a patented SMECH process, which comprises of Sigma Mixing, Extrusion, Calendaring followed by Hot pressing for the fabrication of planar and dimensionally stable microwave substrates. Copper clad microwave substrates with dielectric constant values 2.9 to 14.8 were developed indigenously for the first time. In the year, 250 nos of circuit boards suitable for high power solid state amplifier and 50 nos of copper clad substrates of size 200 mm (L) x 200 mm (B) x 0.762 mm (T) were delivered to RRCAT, Indore and to BARC respectively.



Figure 14. Processing facility for microwave materials, processing equipment and deliverable products

IMPORTANT EVENTS

1. Technology transfer function of photopatternable silver and photoconductor thick film pastes for Photosensors to M/s Ants ceramics, Mumbai

Light detection is one of the kinds of sensor still catching the attention in various domestic and energy harvesting applications. This trend has created growing demand for miniaturization of conventional electro-optical systems as well as for developing novel manufacturing technology to fabricate and integrate micro-optical system as a part of electronic device. In this regard, C-MET has developed an advanced thick film photoconducting materials and paste technology for light sensing application. Typical specifications of the product are: fired thickness of 15-20mm, typical line width of 100 mm +5%, visible spectral range, rise time ~ 2.5 - 60 ms, fall time up to ~ 65 ms and dynamic range of three order. The technology was developed under MeitY sponsored project on photosensor development. The developed technology was transferred to M/S. Ants Ceramics, Mumbai on *as-is-where-is* basis. The technology transfer agreement with the total ToT fee of Rs. 14.31 Lakhs was signed by Mr. Ashwini Jain, Mr. Sabyasachi Roy, and Mr. Tushar Gothi on behalf of M/S. Ants Ceramics, Mumbai. Dr. B. B. Kale, Director, C-MET, Pune, Dr. B. D. Kulkarni, Distinguished Scientist, CSIR-NCL, Dr. D. P. Amalnerkar, Former Executive Director, C-MET and Dr. U. P. Mulik, Former Director, C-MET, Pune attended the function.



Figure 15. The technology transfer function of photopatternable silver and photo conductor thick film pastes for photosensors was held on 28.03.2018 at C-MET, Pune

2. ELCINA-EYF award to C-MET, Thrissur for outstanding achievements in Research & Development

C-MET has bagged the first prize in the prestigious ELCINA-EYF award for outstanding achievements in “Research & Development” for the year 2016-17. ELCINA-EYF awards are designed to promote entrepreneurs of electronic industry and related R&D in the country. The coveted awards were instituted in 1976 to encourage the industrial R&D to excel in various fields. The awardees are selected from large number of nominations through a peer review process by a high-level committee consisting of senior Government and industrial experts. C-MET, Thrissur received this award for the development of pilot plant production and commercialization of niche microwave substrates, which were hitherto imported only from foreign sources with exorbitantly high cost (~US \$ 250 per sq. ft.). Such microwave circuit boards are extensively used in satellite communications, missile guidance, mobile base stations, power amplifiers, collision avoidance systems etc. With the indigenous technology developed by C-MET, the cost of this strategically important material can be reduced to one by forth of imported cost. This innovation will not only provide an impetus for the “Make in India” initiative of Government of India but also help the country in leapfrogging reliable and cost effective wireless communication technologies compared to international competitors.

The award was given in a colourful function held at the Lalit, New Delhi on 14.09.2017. Dr. N. R. Munirathnam, Director General, C-MET, Dr. N. Raghu, Director, C-MET, Thrissur and Dr. R. Ratheesh, Director, C-MET, Hyderabad together received the award from Shri. Ajay Prakash Sawhney, IAS, Secretary, Ministry of Electronics & IT, Govt. of India.



Figure 16. Winners of “First Prize” of ELCINA-EFY Awards for Outstanding Achievements in “Research & Development” for the year 2016-17. Receiving award in the hands of Shri A. Prakash Sawhney, Secretary, MeitY on 14.09.2017.

3. Technology Transfer of Quickly Rechargeable Emergency Lamp

C-MET has transferred the Quickly Rechargeable Emergency Lamp technology to a start-up company M/s. Aessar on 16.02.2018 at Thrissur.



Figure 17. The technology transfer of quickly rechargeable emergency lamp event was held at C-MET, Thrissur.

4. National Science Day celebrations

As part of the celebrations of National Science Day 2018 at C-MET Thrissur, the laboratory was opened to visit by the public and students. People from various walks of life has visited the laboratory and they were explained about the technologies/products developed at C-MET. The National Science day lecture was delivered by Dr. P. Parthasarathy, Managing Director, E-Parisaraa Pvt Ltd., Bangalore on 'Indigenous Technology for E-waste Recycling'. In his talk, he highlighted the importance of indigenization of various technologies for E-waste Recycling and the challenges he faced to establish E-waste recycling facility in Bangalore. Dr. N. Raghu, Director, C-MET Thrissur and Scientists Dr. S. N. Potty and Dr. K. P. Murali have delivered a talks on the occasion.



Figure 18. National science day celebrations at C-MET, Thrissur

5. Colloquium on Smart Materials & Structures

Srinivasa Ramanujan Institute for Basic Sciences (SRIBS), an autonomous institution under Kerala State Council for Science, Technology & Environment (KSCSTE), Government of Kerala, along with C-MET, Thrissur organized a colloquium on Smart Materials & Structures at Kottayam during 24-26 November 2017. The colloquium was intended for M.Sc Physics students, young faculty members of colleges/ university departments and research scholars in Physics or Materials Science. Dr.S. N. Potty, Scientist, C-MET Thrissur was the course co-ordinator of the colloquium. Dr. N. Raghu, Director of C-MET, Thrissur inaugurated the colloquium.



Figure 19. Colloquium on smart materials & structures with all the participants

7. Visit of British Parliamentarians to Thrissur

Members of British Parliament were visited the Alathur Parliamentary constituency, where C-MET, Thrissur is located, to see the developments in the constituency on 14.02.2018. The group of British MPs include Mr. Craig Whitekar, Ms. Angela Rayner, Mr. Daniel Sechneir and Mr. Steve Reid. During their visit to the constituency, they also visited Kerala Institute of Local Administration (KILA) and were received by the Member of Parliament Dr. P. K. Biju MP and District Collector Dr. A. Koushigan. C-MET, Thrissur was also invited to this function. The developmental schemes taken up at the Alathur parliament constituency and the functioning of KILA were explained to the visiting dignitaries. Dr. N. Raghu, Director of C-MET, Thrissur spoke on the prospects of electronics in future. Dr. S. N. Potty, Scientist, C-MET, Thrissur has also attended the function.



Figure 20. Visit of British Parliamentarians to Alathur Parliamentary constituency on 14.02.2018, where C-MET, Thrissur is located, and the related news published in Indian Express newspaper

8. Swachh Bharat Abhiyan at C-MET Pune, Hyderabad and Thrissur

As a part of **Swachh Bharat Abhiyan (SBA)** campaign that aims to clean up the streets, roads and infrastructure of India's cities, smaller towns, and rural areas, C-MET Pune, Hyderabad and Thrissur staff voluntarily came forward and initiated cleanliness of the campus, laboratories and office on periodical basis. Dr. N. R. Munirathnam, Director General, C-MET participated in Swachh Bharat Campaign and inspired all staff members to ensure cleanliness around them and the laboratory. As part of the activities, experts from ITC visited the laboratory to train C-MET staff on making vermicompost from dry leaves.



Figure 21. Swachh Bharat Abhiyan at C-MET Pune, Hyderabad & Thrissur

9. Swachhta Pakhwada at C-MET & National Workshop on E-Waste Technology

As per the guidelines of C-MET, Hqrs (PN/ADM/MIS/141/2014 dated 31.01.2018) and MeitY, Govt. of India (1(33)/2017-Engg dated 30.01.2018), C-MET, Pune, Hyderabad & Thrissur observed Swachhta Pakhwada from 01-15 February 2018. During this period, all the scientific, administrative, supporting staff and students were actively participated in cleaning the campuses respectively. The directors of all the three C-MET laboratories have inspired all staff members to ensure cleanliness around them and the laboratory.

As a part of Swachhta Pakhwada, a “National Workshop on E-waste Technology” was organised on 08.02.2018 at Hyderabad jointly by C-MET & C-DAC, Hyderabad. Dr. Sandip Chatterjee, Director and OSD to Secretary, MeitY, New Delhi has delivered a key note lecture entitled “E-Waste Management- MeitY initiatives”, followed by a talk on “E-waste Management & Environmental Protection” of Dr. (Prof) Kesav Bulbule, Consultant E-Waste Project. The programme was conducted in connection with the on-going Swachhta Pakhwada from 01-15 February 2018. Many participants from various organisations including MeitY societies, DAE, industries, R&D organisations, Public Sector Undertaking have participated & involved in the discussions and ~150 registered participants have attended the workshop. The various organisations participated in the workshop are viz. C-MET, C-DAC, STPI, STQC-ETDC, NIC, NFC, NCCCM, ECIL, E-Parisaraa, Vijaya Electricals Pvt. Ltd., Fine Train consultancy, Beta consultancy, Akhilesh Engineering, CII etc. Dr. N. R. Munirathnam, Director General CMET, Shri. P. Sudhakar, OSD to DAE, Shri E. Magesh, Director, C-DAC, Hyderabad, Shri. Ramaprasad, Director STPI, Hyderabad, Shri M. Padmanabhaiah, Director, STQC, Hyderabad, Dr. Sunil Jai Kumar, Director, NCCM, (DAE), Hyderabad and Dr. R. Ratheesh, Director, C-MET Hyderabad have deliberated during the inaugural function.



Figure 22. Swachhta Pakhwada at C-MET Pune, Hyderabad and Thrissur & National workshop on E-waste technology at C-MET, Hyderabad, Group photograph with all dignitaries and delegates

10. International Conference on Advanced Semiconductor Materials & Devices (ICASMD - 2018) and Annual Foundation Day - 2018

An International conference on Advanced Semiconductor Materials and Devices (ICASMD) was conducted at Centre for Materials for Electronics Technology (C-MET), Hyderabad during 8-10 March 2018 in conjunction with 28th C-MET Annual Foundation Day to review the need of technology driven semiconducting devices based on Gallium Nitride (GaN) and Silicon Carbide (SiC) as high temperature, high frequency and high-power devices. The conference has been served as a platform to link a bridge between different national and international R&D and industrial sectors with wide intellectual discussions. The invited speakers from National and International R&D Labs/Universities, entrepreneurs and pioneered experts were synchronized completely with core of this conference theme.

Dr. R. Ratheesh, Director C-MET Hyderabad welcome the Honorable guests Dr. R. Chidambaram, PSA to Govt. of India, Dr. G. Satheesh Reddy, SA to Raksha Mantri, Govt. of India, Dr. N. R. Munirathnam, Director General, C-MET, Prof. Victor Vedralis, Deputy Executive Director and CTO of Power America, North Carolina State University, USA, and Prof. S. B. Karupanidhi, Emeritus Professor, IISc Bangalore to the dais and thanked all the other distinguished delegates gathered at ICASMD-2018. This year it was also an auspicious occasion to celebrate International Women's Day with presence of women from different continents of the world in ICASMD. Prof. R. Chidambaram, PSA to Govt. of India delivered the keynote address and he applauded the achievements of C-MET and its contribution to the strategic sectors.



Figure 23. Dr. R. Chidambaram, PSA to Govt. of India, Honorable Guest on Dais in ICASMD 2018, and Inaugural function of Annual Foundation Day -2018 and ICASMD-2018, followed by invocation and Lighting of Lamp by women on International women's day

Dr. G. Satheesh Reddy Scientific Advisor to Raksha Mantri addressed the distinguished scientific community gathered at foundation day celebrations of C-MET and ICASMD-2018 in Hyderabad. He appreciated C-MET for achieving self-reliance in Hafnium technology for India's space requirements.

Dr. N.R. Munirathnam, chaired the concluding session of the ICASMD with words of appreciation for the invited speakers for delivering inspiring lectures. At the end, the best three poster awards were announced by Dr. N. R. Munirathnam with award prize money to first, second and third position, respectively.



Figure 24. Best poster award given by Mrs. V. Sarala, Scientist, RCI, DRDO to respective awardees

11. Display of wearable device for early detection and screening of breast cancer in the Civil service day function

C-MET's innovation on "Development of thermal sensor based wearable device for the early detection and screening of breast cancer" was shortlisted as one of the 10 best innovations for the Prime Minister's Award for Excellence in Public Administration (Innovations Category) - 2017. C-MET displayed the wearable device in the exhibition conducted in connection with the Civil service day function held on 20-21 April 2017 at New Delhi. Many district administrators and health ministry officials have shown keen interest in the product.



Figure 25. Dr. Jitendra Singh (Minister of State in the Prime Minister's Office; Ministry of Personnel, Public Grievances and Pensions; Department of Atomic Energy and Department of Space and Union Minister of State (Independent Charge) in the Ministry of Development of North Eastern Region) and Cabinet Secretary Shri Pradeep Kumar Sinha visiting C-MET product display.

12. Two days training and awareness program on Restriction of Hazardous substances (RoHS)

Two days training and awareness programme was conducted on Restriction of Hazardous Substances (RoHS), during 29-30 August 2017 at RoHS testing laboratory, C-MET, Hyderabad. Twenty, EEE Indian industry representatives have been attended the program on PAN India basis. The field experts like, Dr. Parthasarathy, MD, M/s E-Parisaraa, Bengaluru, Mr. Rajoo Goel, Director General, ELCINA, New Delhi, Dr. V. Balam, Chairman, RoHS-PRSG and Dr. S. Chatterjee, Director & OSD to Secretary, MeitY, New Delhi, Shri. Vinay Gangal, Scientist, CPCB have also attended and addressed the gathering. The two days program covered the following topics with hands on experience: (1) Approved testing procedures as per IEC 62321 and E-waste (Management) Rules – 2016; Toxicity of Hazardous Substances, Disassembling of Electronics Electrical Equipment products, Methods for the mercury analysis in compact fluorescence lamps (CFLs); E-waste management & Recycling technologies; sampling of printed circuit boards (PCB) using high energy cutting, milling and pellet press, demo on non-destructive analysis using EDXRF spectrometer; MoEF& CC, Govt. of India, E-waste (Management) Rules – 2016, RoHS regulation, Indian scenario. Training sessions on testing the RoHS substances: Lead, Cadmium, Hexa chromium, mercury and flame retardants (PBB & PBDE) including the basics and sample preparation methods have also been conducted. As an outcome of the training programme, the need for RoHS compliance has percolated among Indian industries and thereby increased the inflow of samples for RoHS compliance testing.



Figure 26. Interactive session with experts during RoHS training programme

Memorandum of Understandings (MoUs)

1. MoU was signed between C-MET Pune and Semi-conductor Laboratory Chandigarh on 24.05.2017 for the development of metal oxide semiconductors (MOS) chemicals.
2. Non disclosure agreement (NDA) between C-MET, Pune and Tata motors for advanced electronic materials on 30.11.2017 for 5 years.
3. MoU was signed between C-MET, Pune and Kirtane Pandit Information Technology Pvt. Ltd (KPIT) on 05.04.2018 for the duration of 3 months regarding the uses of sealing facilities for batteries.
4. C-MET, Hyderabad has signed Memorandum of Understanding with Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram on 14.06.2017 for the supply of 20 kgs of Hafnium Sponge for Aerospace applications.
5. MoU was signed between C-MET, Thrissur and South India Textile Research Association (SITRA), Coimbatore on 17.03.2018 for initiation of R&D activity regarding automated production of wearable device for breast cancer detection.
6. MoU was signed between C-MET, Thrissur and Government Engineering college, Thrissur on 11.07.2017 for promoting collaborative R&D activities.



7. MoU was signed between Amrita Vishwa Vidyapeetham and C-MET, Thrissur on September 2017 for promoting collaborative R&D activities. A Proposal on polymer nano-composites for high voltage under water cable application is in pipeline.

Distinguished Visitors

1. **Prof. Veena Sahajwala**, Associate Dean (Strategic Industry Relations) Faculty of Science and Director, Centre for Sustainable Materials Research & Technology, School of Materials Science & Engineering, University of New South Wales (NSW), Australia visited C-MET, Pune on 22.08.2017.



2. **Prof. Jose M. F. Ferreira**, Department of Materials and Ceramic Engineering (DEMaC), Centre for Research in Ceramics and Composites, CICECO, University of Aveiro, Aveiro, Portugal visited C-MET, Pune and delivered a lecture on 'Aqueous Colloidal Processing of Advanced Lead free Piezoelectric Ceramics' on 15.12.2017.
3. **Dr. Jin-Ook Baeg**, Korea Research Institute of Chemical Technology, Daejeon, South Korea visited C-MET, Pune and delivered a lecture on 'Solar Chemical Factory System for Highly Selective Solar Fuel/Solar Chemical Production' on 19.07.2017.
4. **Dr. Animesh Jha**, Professor of Applied Materials Science, University of Leeds, UK, visited C-MET, Pune and delivered a lecture on 'Applications of Pulsed Near IR lasers for Hard-Soft tissue Engineering' on 22.03.2018.
5. Visit of high level education Committee to C-MET, Pune: Left to Right, Dr. B. B. Kale, Director, C-MET, Pune, Prof. Rajendra Prasad, Vice-Chancellor, Nagarjuna University, Guntur; Prof. D. Narayana Rao, ProVice-Chancellor, SRM University, Amaravati; Dr. Venkata Edara, Advisor, Higher Education, Govt. of Andhra Pradesh; Dr. N. R. Munirathnam, Director General, C-MET and Prof. Avula Damodaram, Vice-Chancellor, S.V. University, Tirupati.



6. Mr. T. Nishi, Student from Kobe University, Japan visited C-MET, Thrissur during the period 04-29 October 2017 for discussions on applicability of Piezoelectric thin film for energy harvester applications.



Dr. V. Kumar (4th from left), Mr. Nishi (3rd from left) along with team members of Nanomaterials division of C-MET, Thrissur.

Visits Abroad

1. **Prof. Sulabha Kulkarni**, INSA Senior scientist working at C-MET and **Dr. Parag Adhyapak**, Scientist, C-MET, Pune visited KEK, Tsukuba, Japan from 24.11.2017 to 02.12.2017.



2. **Dr. Bharat B. Kale** Visited KRICT “The KRICT Invitation Seminar South Korea” during 13-16th March 2018.

Patents & Publications

I) National/ International Patents Awarded

1. Indian Patent Application No.1561/MUM/2010 dated 18.05.2010 entitled "a micro/nano photoconductor", Govind G. Umarji, Dinesh P. Amalnerkar, Uttamrao P. Mulik & Suresh W. Gosavi, awarded on 31.01.2018, Patent No. 292432, Patentee, Secretary DIT and Executive Director of C-MET.
2. Indian Patent application No. 3815/DEL/2012 entitled "Ceramic Filled Fluoropolymer Compositions, Methods and Applications Thereof", S. Rajesh, K. P. Murali & R. Ratheesh, Patent No. 294964 granted on 26.03.2018, Patentee, Secretary, DeitY and Executive Director of C-MET.

II) National/ International Patents Filed

1. Novel Glass – Ceramic Electrolyte for low temperature solid oxide fuel cell, Shrikant Kulkarni, Siddhartha Duttgupta, Vijaya Giramkar and Girish Phatak, US Patent Application No.- 15/542,212, Filing date : 07.07.2017, European Patent Application 16734953.9, Filing date : 18.07.2017, Indian Patent Application Number : 57/MUM/2015, Application date : 07.01.2015, PCT Application Number : PCT/IB2016/050055, PCT Application Date : 07.01.2016.
2. A non-conductive substrate with tracks formed by sand blasting, Girish Phatak, Shrikant Kulkarni, Vijaya Giramkar and Shany Joseph, US Patent Application No.- 15/542,567. Filing date : 10.07.2017, European Patent Application 16737136.8. Filing date : 18.07.2017, Indian Patent Application Number : 130/MUM/2015, Application date : 13.01.2015, PCT Application Number : PCT/IB2016/050083, PCT Application date : 08.01.2016.
3. Miniature PEM Fuel Cells using LTCC packaging, Shekhar Dimble, Shrikant Kulkarni, P. Ramesh, Tarkeshwar Patil, Girish Phatak and Siddhartha Duttgupta, US Patent Application No.- 15/552,267, Filing date : 18.08.2017, European Patent Application 16751990.9, Filing date : 12.09.2017, Indian Patent Application Number : 495/DEL/2015, Application date : 21.02.2015, PCT Application Number : PCT/IB2016/050134, PCT Application date : 13.01.2016.
4. Conductive solid oxide fuel cell electrolyte composition and a method for preparing the same, Shrikant Kulkarni, Siddhartha Duttgupta and Girish Phatak, US Patent Application No.- 15/578,700, Filing date : 30.11.2017, European Patent Application 16802645.8, Filing date : 21.12.2017, Indian Patent Application Number : 1573/DEL/2015, Application date : 01.06.2015, PCT Application Number : PCT/IB2016/050130, PCT Application date : 13.01.2016.
5. Method and system for predicting location and depth of abnormal tissue in breast of subject, Seema Ansari, M. N. Muralidharan, K. Arathy, Eva Ignatious, K. R. Ranjith, P. P. Deepak, R.S. Sudheesh, B. Satheesan, US patent application No. 15/926,935, Application date : 20.03.2018.
6. Method and system for predicting location and depth of abnormal tissue in breast of subject, Seema Ansari, M.N. Muralidharan, K. Arathy, Eva Ignatious, K. R. Ranjith, P. P. Deepak, R.S. Sudheesh, B. Satheesan, Indian Patent Application No. 201711047118, Application date : 28.12.2017.
7. Method and System for Classifying Health of Breast Tissues of a Subject, Seema Ansari, M. N. Muralidharan, K. R. Ranjith, Eva Ignatious, Hazeena Mohammed, P. P. Deepak, K. Arathy, Anupama Parameswaran, Dr. Rominus Valsalam Samuel, Santha Lekshmi, Rakesh Gopinadh, Jithin Surendrababu, Lekshmi Geethamani, Manju Blavelil Kunjappan and Binila Basheer, Indian Patent Application No. 201741017186, Application date : 16.05.2017.

III) Publications in Peer-reviewed Journals

1. Stannic oxide spherical nanoparticles: an anode material with long-term cyclability for Li-ion rechargeable batteries, Ramchandra S Kalubarme, Bharat B Kale and Suresh W Gosavi, *Mater. Res. Express*, **2017**, *4*, 085026. (IF-1.068)
2. Nanowires of Ni Substituted MnCo_2O_4 as an Anode Material for High Performance Lithium-ion Battery, Asiya

- F Shaikh, Ramchandra S Kalubarme, Mohaseen S Tamboli, Santosh S Patil, Milind V Kulkarni, Deepak R Patil, Suresh W Gosavi, Chan-Jin Park, Bharat B Kale, *Chemistry Select*, **2017**, 2, 4630-4637. (IF- Pending)
3. Triangular CdS nanostructure: effect of Mn doping on photoluminescence, electron spin resonance, and magneto-optical properties, Punam A. Jadhav & Rajendra P. Panmand & Deepak R. Patil, H. Fouad, Suresh W. Gosavi, Bharat B. Kale, *J. Nanopart. Res.*, **2017**, 19, 218. (IF-2.1)
 4. A review on cellulose and lignin-based binders and electrodes: Small steps towards a sustainable lithium ion battery, Trupti C Nirmale, Bharat B Kale, Anjani J Varma, *Int. J. Biol. Macromol.*, **2017**, 103, 1032-1043. (IF-3.096)
 5. Facile Synthesis of Unique Cellulose Triacetate Based Flexible and High-Performance Gel Polymer Electrolyte for Lithium Ion Batteries. Trupti C. Nirmale, Indrapal Karbhal, Ramchandra S. Kalubarme, Manjusha V. Shelke, Anjani J. Varma, and Bharat B. Kale *ACS Appl. Mater. Interfaces*, **2017**, 9, 34773–34782. (IF-7.7)
 6. ZnSe/ZnO Nano-Heterostructures for Enhanced Solar Light Hydrogen Generation, Asiya F. Shaikh, Sudhir S. Arbuj, Mohaseen S. Tamboli, Sonali D. Naik, Sunit B. Rane, B. Kale. *Chemistry Select*, **2017**, 2, 9174–9180. (IF-pending).
 7. Triangular CdS nanostructure: effect of Mn doping on photoluminescence, electron spin resonance, and magneto-optical properties, Punam A. Jadhav, Rajendra P. Panmand, Deepak R. Patil, H. Fouad, Suresh W. Gosavi, Bharat B. Kale, *J. Nanopart. Res.*, **2017**, 19, 218. (IF-2.1)
 8. Small steps towards a sustainable lithium ion battery A review on cellulose and lignin-based binders and electrodes, Trupti C Nirmale, B. Kale, Anjani J Varma, *Int. J. Biol. Macromol.*, **2017**, 103, 1032-1043. (IF-3)
 9. Nanostructured N-doped orthorhombic Nb₂O₅ as an efficient stable photocatalyst for hydrogen generation under visible light, Aniruddha K Kulkarni, CS Praveen, Yogesh A Sethi, Rajendra P Panmand, Sudhir S Arbuj, Sonali D Naik, Anil V Ghule, Bharat B Kale, *Dalton Trans.*, **2017**, 46, 14859-14868. (IF-4.0)
 10. Engineering 0-D to 1-D PbCrO₄ nanostructures and their visible light enabled photocatalytic H₂S splitting, N. M. Qureshi, M. D. Shinde, J. O. Baeg and B. B. Kale, *New J. Chem.*, **2017**, 41, 4000-4005. (IF-3.2)
 11. Porous N-doped Zinc Oxide Nanostructure by novel paper mediated template method and its photocatalytic study for dye degradation under natural sunlight, Gajanan Baburao Kale, Sudhir S Arbuj, Ujjwala V. Kawade, S B Rane, Jalindar D. Ambekar and Bharat B Kale, *Mater. Chem. Front.*, **2017**, 2, 163-170. (IF-pending)
 12. Nanowires of Ni Substituted MnCo₂O₄ as an Anode Material for High Performance Lithium-ion Battery, Asiya F Shaikh, Ramchandra S Kalubarme, Mohaseen S Tamboli, Santosh S Patil, Milind V Kulkarni, Deepak R Patil, Suresh W Gosavi, Chan-Jin Park, B. Kale, *Chemistry Select*, **2017**, 2, 4630-4637. (IF- Pending)
 13. Sonochemically generated Cerium doped ZnO nanorods for highly efficient photocatalytic dye degradation Satish Meshram, Parag Adhyapak, S. K. Pardeshi, Imtiaz Mulla, D. P. Amalnerkar, *Powder Tech.*, **2017**, 318, 120-127. (IF-2.94)
 14. Synthesis and Dielectric Properties of Glycine Doped Bisthiourea Zinc and Cadmium Succinates, M. N. Raste, Parag V. Adhyapak, S. K. Pardeshi, *Adv. Sci., Engn. Medicine*, **2017**, 9, 991-999. (IF-pending)
 15. Synthesis and Spectroscopic Investigations of 1, 2-Dibromoethane Linked Ferrocene Grafted Hydroxyl Terminated Polybutadiene, R. M., Jagtap, Dr. R. Kshirsagar, A. P. Shende, V. Khire, Parag V. Adhyapak, S. K. Pardeshi, *Adv. Sci., Engn. Medicine*, **2017**, 9, 635-639. (IF-pending)
 16. Removal of Methylene Blue Dye from Aqueous Solution by Using Cestrum nocturnum Leaves, as a Low-Cost Adsorbent, D. J Borkar, N. S Rajurkar, Parag V. Adhyapak, *J. Chem. Biol. Phys. Sci.*, **2017**, 7, 515. (IF-1.3)
 17. Influence of Erbium doping on hydrothermally synthesized ZnO Nanostructures and their enhanced gas

- sensing properties, Parag V. Adhyapak, L. Deepika Bharatula, Amruta Rath, Sunjae Jang, Taesung Kim, Dinesh Amalnerkar, *Current smart Mater.*, **2017**, 2, 146-152. (IF-pending)
18. Synthesis and deposition of nanostructured SnS for semiconductor-sensitized solar cell, S. S. Hortikar, V. S. Kadam, A. B. Rath, C. V. Jagtap, H. M. Pathan, I. S. Mulla, Parag V. Adhyapak, *J. Sol. State Electrochem.*, **2017**, 21, 2707–2712. (IF-2.31).
 19. Selective growth of 1D rice grain shaped rutile N-TiO₂ for degradation of organic pollutant and H₂O splitting using natural solar light; Supriya K. Khore, Navya Vani Tellabati, Sanjay K. Apte, Sonali D. Naik, Prashant Ojha, Bharat B. Kale, and Ravindra S. Sonawane, *RSC Adv.*, **2017**, 7, 33029-33042. (IF-3.1).
 20. Designing ecofriendly bionanocomposite assembly with improved antimicrobial and potent on-site Zika virus vector larvicidal activities with its mode of action, Pramod C. Mane, Ravindra D. Chaudhari, Manish D. Shinde, Deepali D. Kadam, Chung Kil Song, Dinesh P. Amalnerkar, Haiwon Lee, *Sci. Rep.*, **2017**, 7, 15531. (IF-4.25).
 21. Swift tuning from spherical molybdenum microspheres to hierarchical molybdenum disulfide nanostructures by switching from solvothermal to hydrothermal synthesis route N. Qureshi, S. Arbuj, M. Shinde, S. Rane, M. Kulkarni, D. Amalnerkar, *Nano Convergence*, **2017**, 4, 25. (IF-pending).
 22. Exploration of Nb₂O₅ Nanorods via Hydrothermal Routes for Dye Sensitized Solar Cells (DSSC) Applications, Mohite Neeta, Ballal Reshma, Shinde Manish, Rane Sunit, Mohite, K. C., Chauhan Ratna, *Energy and Environ. Focus*, **2017**, 6, 179-183. (IF-pending)
 23. Perforated ZnO Nanoflakes via Hydrothermal Routes for Dye Sensitized Solar Cells (DSSC) Applications, Mohite Neeta, Shinde Manish, Ballal Reshma, Rane Sunit, Mohite, K. C., Chauhan Ratna, *Energy and Environ. Focus*, **2017**, 6, 132-138. (IF-pending)
 24. Growth study of hierarchical Ag₃PO₄/LaCO₃OH heterostructures and their efficient photocatalytic activity for RhB degradation, Virendrakumar G Deonikar, Santosh S Panmand, Govind G Umarji, Manish D Shinde, SB Rane, Nagegownivari Ramachandra Munirathnam, Deepak R Patil, Bharat B Kale, *Phys. Chem. Chem. Phys.*, **2017**, 19, 20541-20550. (IF-4.1)
 25. ESP-Promoted Suzuki-Miyaura Cross-Coupling and Peptide Bond Formation Reactions in Water at Room Temperature, Manashjyoti Konwar, Preeti Rekha Boruah, Prakash J. Saikia, Nageshewar D. Khupse, Diganta Sarma, *Chemistry Select*, **2017**, 2, 4983-4987. (IF-pending)
 26. SnO₂-loaded BaTiO₃ nanotube arrays: fabrication and visible-light photocatalytic application, Manoj Nageri, A. B. Shalet and V. Kumar, *J. Mater. Sci: Mater. Electron.*, **2017**, 28, 9970-9976. (IF-2.0)
 27. Acceptor-defect mediated room temperature ferromagnetism in (Mn²⁺, Nb⁵⁺) co-doped ZnO nanoparticles, M. K. Satheesan, K. Vani and V. Kumar, *Ceram. Intl.*, **2017**, 43, 8098-8102. (IF-2.98)
 28. Estimation of Cd, Pb, flame retardants in electric Mosquito bat using EDXRF, ICP- OES, AAS & GC-MS, B. Divya, S. Harish, K. Ramaswamy, M. Kishore Babu, N. Raju, R. Govindaiah, U. Rambabu, N. R. Munirathnam, *Int. J. of Environ. Sci. & Tech.*, **2017**, 14, 2603-2612. (IF- 1.91)
 29. Preparation, characterization and dielectric properties of Ca₂ZrSi₄O₁₂ ceramic and filled silicone rubber composites for microwave circuit applications, P.G. Shakhil, Albin Antoney, P.V. Narayanan, T. Sanaj, Lijin Jose, N.S. Arun, R. Ratheesh, *Mater. Sci. & Engn. B*, **2017**, 225, 115-121. (IF-2.55)
 30. Morphological Evolution of Nanorod to Submicron Brick-Like Cobalt Oxide Structures Under Microwave Solvothermal Regime, Manish Shinde, Nilam Qureshi, Sunit Rane, Chisung Ahn, Taesung Kim, and Dinesh Amalnerkar, *Sci. Adv. Mater.*, **2018**, 10, 144-148. (IF-pending).
 31. Optical fiber based humidity sensor using Ag decorated ZnO nanorods, S. Jagtap, S. Rane, S. Arbuj, S. Rane, S. Gosavi, *Microelectron. Engn.*, **2018**, 187-188, 1-5. (IF-1.8)
 32. Template-free hydrothermal synthesis of beaded nanochain bundles of ZnO and their application as

photoanode in dye-sensitized solar cells, Reshma Ballal, Manish Shinde, Yogesh Waghadkar, Sudhir Arbuji, Sunit Rane, Ratna Chauhan, *Appl. Phys. A*, **2018**, 124, 203. (IF-1.69)

33. Optimization studies on Nanocrystalline NTC thermistor compositions by a self propagated high temperature synthesis route, P. P. Deepak, Mariya Parokkaran, K. R. Ranjith, M. N. Muralidharan, Seema Ansari, *Ceram. Int.*, **2018**, 44, 4360–4366. (IF-2.98)
34. Comparative Studies on Zinc Oxide Nanocrystals Synthesized by two precipitation methods, M. R. Bodke, Y. Purushotham, B. N. Dole, *Cerâmica*, **2018**, 64, 91-96. (IF- 0.8)
35. Structural properties of CZTS thin films on glass and Mo coated glass substrates: a Rietveld refinement study. P. Prabeesh, I. Packia Selvam, S. N. Potty., *Appl. Phys. A : Mater. Sci. Process.*, **2018**, 124, 225. (IF-1.455)
36. Synthesis and characterization of $\text{Na}_5\text{M}(\text{MoO}_4)_4$ (M = Y, Yb) microwave ceramics for ULTCC applications, Johnson Dhanya, Elattuvalappil Kalathil Suresh, Rajaram Naveenraj, Ravendran Ratheesh, *Ceram. Int.*, **2018**, 44, 6699–6704. (IF-2.98)
37. Influence of fillers on the re-crystallization and dielectric properties of $60\text{ZnO}-30\text{B}_2\text{O}_3-10\text{SiO}_2$ glass, M. Vincent, P. M. Afsal, K. G Vasantha kumari, S. Susanth, T. Radhika and N. Raghu, *J. Electroceram.*, (**2018**) DOI 10.1007/s10832-018-0123-4. (IF: 1.238)
38. Role of Defect Structures in Stabilization of Ferroelectric Phase in Tin-Substituted Lead ZirconateTitanate, A. Anil, K. Vani and V. Kumar, *J. Amer. Ceram. Soc.*, **2018**, 00, 1-6 (DOI: 10.1111/jace.15482) (IF: 2.841)
39. Structural, magnetic and dielectric properties of conventional and microwave sintered $\text{Ni}_{0.6}\text{Zn}_{0.4}\text{Cu}_x\text{Fe}_2\text{O}_4$, E. Chandra Sekhar, B. Rajesh Babu, K.V. Ramesh, M. Sreenivasulu, Y. Purushotham, *J. Supercond. Nov. Magn.*, **2018**, 31, 1199-1207 (IF: 1.180)
40. Assessment of Hazardous Substances in Electrical Cables: Implementation of RoHS Regulations in India, U. Rambabu, V. Balaram, R. Ratheesh, S. Chatterjee, M. Kishore Babu, N. R. Munirathnam, *ASTM J of Testing and Evaluation*, **2018**, Vol. 46 (5), 1103-1110. DOI : 10.1520/JTE20160645 (I.F- 0.65)

IV) Presentations in Conferences and Symposia

1. Enhanced charge transfer mechanism in nano-structured CdIn_2S_4 /graphene composites for photocatalytic solar hydrogen production from water, Manjiri M. Mahadadalkar, Ashwini P. Bhirud, Sonali D. Naik, Jalinder D. Ambekar, Suresh W. Gosawi, Bharat B. Kale, 8th International Conference on Advanced Material Development & Performance (AMDP-2017) held at Savitribai Phule Pune University, Pune during 11-15 July **2017**. (Award for Best poster presentation).
2. Photo-induced charge transfer mechanism in CdIn_2S_4 /g- C_3N_4 composites for solar hydrogen production, Manjiri M. Mahadadalkar, Bharat B. Kale, School on Clean and Renewable Energy Technologies via Chemical Route (I2CAM-2017) held at JNCASR, Bengaluru during 27-28 December **2017**.
3. Synthesis and Characterization of MgAl_2O_4 by Combustion Method for Microwave Applications, Deepali Dande, Sneha Kale, Ravindra Deshmukh, Varsha Chaware, Girish Phatak, 81st Annual session of Indian Ceramic Society and International conference on "Expanding Horizons of Technological Applications of Ceramics and Glasses (EH-TACG-2017)" held at College of Engineering, Pune during 14-16 December **2017**.
4. Synthesis and dielectric properties of the ZnAl_2O_4 ceramic for LTCC applications, Sneha Kale, Deepali Dande, Ravindra Deshmukh, Varsha Chaware, Girish Phatak, 81st Annual session of Indian Ceramic Society and International conference on "Expanding Horizons of Technological Applications of Ceramics and Glasses (EH-TACG-2017)" held at College of Engineering, Pune during 14-16 December **2017**.
5. Synthesis of $\text{Ca}_3\text{Co}_4\text{O}_9$ and CaMnO_3 by Combustion Method for Thermoelectric Applications, Sourabh P Adhyapak, Shrikant Kulkarni, Girish Phatak, 81st Annual session of Indian Ceramic Society and International

conference on "Expanding Horizons of Technological Applications of Ceramics and Glasses (EH-TACG-2017)" held at College of Engineering, Pune during 14-16 December **2017**.

6. Studies on Sintering and Dielectric Properties of Zinc silicate (Zn_2SiO_4) with addition of BBSZ Glass, Ravindra Deshmukh, Shrikant Kulkarni, Varsha Chaware, Girish Phatak, 81st Annual session of Indian Ceramic Society and International conference on "Expanding Horizons of Technological Applications of Ceramics and Glasses (EH-TACG-2017)" held at College of Engineering, Pune during 14-16 December **2017**.
7. Binary Sn-Ag Co-deposited Film for Fine Pitch Surfaces in PCB Applications Bhagyashree Musale, Shany Joseph, Girish Phatak, 8th International Symposium on Advanced Materials Development and Processing, Pune (AMDP-2017), held at Pune during 11th-15th July **2017**.
8. Effect of glass Ruthenate composition and aspect ratio on electrical properties of thick film resistors in LTCC, Vijaya Giramkar, Neha kularni, Gargi Inkane, Shweta Choudhary, Sneha Kale, Deepali Dande and Girish Phatak, 8th International Symposium on Advanced Materials Development and Processing (AMDP-2017) during 11-15 July **2017**.
9. Immobilization studies of alkaline phosphatase isolated from 'Arachishypogaea' adsorbed on surface of CNTs, Vijaya Giramkar, Girish Phatak and Sushma Sabharwal International Conference on Nanotechnology: Ideas, Innovations and Initiatives (ICN:3I-2017), held at IIT-Roorkee during 06 – 08 December **2017**.
10. Temperature Dependent Study of Al_2O_3 -glass Composite Thick Films on Steel Substrate, Ghanasham D. Shirke, Govind G. Umarji, Vikas L. Mathe, Uttam P. Mulik, Arjun R. Tarale and Sunit B. Rane, International Conference on Advanced Materials Development & Performance (AMDP 2017) held at Department of Physics, Savitribai Phule Pune University, Pune during 11-15 July **2017**.
11. Synthesis and Characterization of Manganese Ferrite (MnFe_2O_4) for Temperature Sensor Application, Anamika Pund, GovindUmarji, Manish Shinde, Ramadoss Marimuthu, Sudhir Arbuj, Sunit Rane and Uttam Mulik, International Conference on Advanced Materials Development & Performance held at Department of Physics, Savitribai Phule Pune University, Pune during 11-15 July **2017**.
12. Carboxylic and nitro anchored ferrocenyl benzimidazole as potential photosensitizers in dye sensitized solar cells, Ratan Chauhan, Yogesh Waghadkar, Sunit Rane, 8th East Asia Symposium on Functional Dyes and Advanced Materials Organised by CSIR-National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram during 20-22 September **2017**.
13. Photocatalytic Hydrogen generation *via* water splitting using photo-assisted grown Ag and Pt on surface of TiO_2 nanoparticles, M. Bute Kant, Sudhir Arbuj, Sunit Rane, Suresh Gosawi and Aditya Abhyankar, ICAMDP-2017 held at Department of Physics, Savitribai Phule Pune University, Pune during 11-15 July **2017**.
14. SnS_2 Nanoplates: A Promising 2D Visible-Light Photocatalyst for Hydrogen Generation, Shubhangi Damkale, Sudhir Arbuj, Sunit Rane and Bharat Kale, Joint Symposium of the 2nd International Symposium on Recent Progress of Energy and Environmental Photocatalysis & The 23rd China-Japan Bilateral Symposium on Intelligent Electrophotonic Materials and Molecular Electronics held at Katsushika campus, Tokyo University of Science, Tokyo, Japan during 1-3 December **2017**.
15. Formulation and effects of firing temperature on Al_2O_3 -Ferric oxide Based Thick Film Glass Composite for Steel Substrate", Ghanasham D. Shirke, Govind G. Umarji, Arjun R. Tarale, Vikas L. Mathe, Uttam P. Mulik, and Sunit B. Rane, EH-TACAG'17, InCerS (81st Annual Session of InCerS in conjunction with 69th Annual Session of AIPMA and 43rd Annual Session of IIC) during 14-16 December **2017**. Received 2nd price in best poster award.
16. Synthesis and Characterization of Nano Ni-Mn-Fe-Cr-Co-O NTC Compositions through SHS Route, P. P. Deepak, Seema Ansari, K. R. Ranjith and M. N. Muralidharan, in the 81st Annual Session of Indian Ceramic

Society and International Conference on Expanding Horizons of Technological Applications of Ceramics and Glasses (EH-TACAG'17) held at College of Engineering, Pune during 14-16 December **2017**.

17. Analysis of μ_r , $\tan\delta_e$ and $\tan\delta_m$ of Magneto dielectric substrates, K. Navaneeth Krishnan, K. P. Murali, C. Anukumar and P. H. Rao, 6th biennial IEEE Applied Electromagnetics Conference (AEMC-2017), held at Maharashtra Institute of Technology, Aurangabad during 19-22 December **2017**.
18. BaSrCo₂Fe₁₂O₂₂ filled PP Composites for Magneto-dielectric applications, K. Navaneeth Krishnan, M. G. Anagha and K. P. Murali, International Conference on Expanding Horizons of Technological Applications of Ceramics and Glasses (EH-TACAG'17), held at College of Engineering, Pune during 14-16 December **2017**.
19. Development of Metal Oxide based Aerogels for Hybrid Supercapacitor Electrodes, Abhishek Chowdhury, M. Pooja Bhaskar, P. A. Abraham, N. Rani Panicker, E. K. Sunny and N. C. Pramanik, International Conference on Expanding Horizons of Technological Applications of Ceramics & Glasses (EH-TACAG'17), held at College of Engineering, Pune during 14-16 December **2017**.
20. Preparation and characterization of low temperature co-firable Ca₁₅V₆Mo₆O₄₈ ceramic for microwave communication applications, K.R. Roshini, R. Naveenraj, R. Ratheesh, International conference on Expanding Horizons of Technological Applications of Ceramics and Glasses (EH-TACAG'17), held at College of Engineering, Pune during 14-16 December **2017**.
21. Preparation and Microwave Dielectric Properties Evaluation of BaV₂O₆ for u-LTCC Applications, N. Saranya, K. G. Vasanthakumari, S. Susanth, T. Radhika and N. Raghu, Annual session of Indian Ceramic Society & International Conference on Expanding Horizons of Technological Applications of Ceramics and Glasses (EH-TACAG'17), held at College of Engineering, Pune during 14-16 December **2017**.
22. Synthesis of Lead free Microwave Dielectric Glass Suitable for LTCC Applications, Mewin Vincent, P. M. Afsal, S. Susanth, K. G. Vasanthakumari, T. Radhika and N. Raghu, Annual session of Indian Ceramic Society & International Conference on Expanding Horizons of Technological Applications of Ceramics and Glasses (EH-TACAG'17), held at College of Engineering, Pune during 14-16 December **2017**.
23. Effect of Molten Salt Synthesis Parameters on the Morphology of Sr₃Ti₂O₇, K. Nimisha, K. G. Vasanthakumari, S. Susanth., T. Radhika and N. Raghu, Annual session of Indian Ceramic Society & International Conference on Expanding Horizons of Technological Applications of Ceramics and Glasses (EH-TACAG'17) held at College of Engineering, Pune during 14-16 December **2017**.
24. Piezo ceramic transformers for power electric conversion Applications, P. M. Afsal, S. Susanth, K. G. Vasanthakumari, T. Radhika and N. Raghu, Annual session of Indian Ceramic Society & International Conference on Expanding Horizons of Technological Applications of Ceramics and Glasses (EH-TACAG'17) held at College of Engineering, Pune during 14-16 December **2017**.
25. Effect of multi pass, zone length and translation rate on impurity segregation during zone refining of cadmium, D. S. Prasad, K. N. S. Sai, Balakrishna, International conference on Non-ferrous minerals and metals held at Shangri-La's-Eros Hotel, Delhi during 7-8 July **2017**.
26. Effect of distillation temperature on purification of Zinc, Y. Purushotham, S.T. Ali, National Conference on Recent Advances in Materials Science and Technologies (RAMST-2017) held at Telangana University, Nizamabad during 15-16 September **2017**.
27. Extraction of rare earths from end of life compact Fluorescent Lamps (CFLs) and Fluorescent Lamps (FLs), U. Rambabu, R. Govindaiah and K. Ramaswamy, 21st International Conference on Non-ferrous Minerals & Metals – 2017 held at Hotel Shangri-La's Eros, New Delhi during 7-8 July **2017**.
28. Recovery of Rare Earths (REEs) from Waste Phosphor - Wealth from waste, U. Rambabu, R. Govindaiah, K. Ramaswamy and A. Bhaskar Reddy, NMD-ATM – 2017 held at BITS Pilani, Goa during 11-1 November **2017**.

29. Recovery of Nitric acid from solvent extraction process effluent of Hafnium, Arbindkumar, M. R. P. Reddy, N. R. Mandry, T. Sharma NMD, ATM 2017, held at BITS Pilani Goa Campus, 11-14 November **2017**.
30. Effects of Thiocyanate and Acid Concentration on the Separation of Hafnium and Zirconium, by Arbind Kumar, M. R. P. Reddy, S. Rajesh Kumar, N. R. Mandre, T. Sharma presented in International Conference "ICNFMM 2017" organised by Corporate Monitor at New Delhi during 7-8 July **2017**.
31. Alkaline phosphatase immobilisation on carboxyl-functionalised Carbon Nano Tubes: Studies on Structural, biochemical characterisation and kinetics, Vijaya D. Giramkar, Dr. Girish J. Phatak and Prof. Sushma G. Sabharwal; accepted for presentation at Frontiers in Life Sciences and Earth sciences during 18-19 Jan **2018**.
32. Biochemical studies and characterization of immobilized alkaline phosphatases on carboxyl-functionalised Carbon Nano Tubes, Vijaya Giramkar, Sushma Sabharwal and Girish Phatak, Poster presentation at 'Frontiers in life sciences and earth sciences 2018', Organized by Prof. Ramkrishna More College of Arts and Science & Savitribai Phule Pune University, Pune during 18-19 January **2018**.
33. Preparation of ZnO thin films using sol-gel assisted spin coating technique for optoelectronic and sensing applications (Poster Presentation), Sachin Chopade, Manish Shinde, and Sunit Rane, International Conference on Nanotechnology for Human Welfare (ICNHW-2018), held at H.V. Desai College, Pune during 01st February **2018**.
34. Low temperature preparation of $\text{Cu}_2\text{ZnSnS}_4$ thin films via Na treatment (Poster Presentation), Kadambari P. Kasar, Manish D. Shinde, Sunita M. Bhagwat, Sudhir S. Arbuj, Suresh W. Gosavi, and Sunit B. Rane, International Conference on Nanotechnology for Human Welfare (ICNHW-2018), held at H.V. Desai College, Pune, during 01st February **2018**.
35. Low Temperature Preparation of $\text{Cu}_2\text{ZnSnS}_4$ Thin films for Optoelectronic Applications (Poster Presentation), Kadambari P. Kasar, Manish D. Shinde, Sunita M. Bhagwat, Sudhir S. Arbuj, Suresh W. Gosavi, and Sunit B. Rane, Raman Memorial Conference 2018, held at Department of Physics, Savitribai Phule Pune University, Pune during 23-24 February **2018**.
36. Hydrothermal synthesis and gas sensing application of WO_3 nano-flowers and nano-rods, Sachin Karpe, Amruta Rathi, B. B. Kale, N. R. Munirathnam, P. V. Adhyapak, International Conference on Advanced Semiconductor Materials and Devices (ICASMD) held at CSIR-Indian Institute of Chemical Technology, Hyderabad during 9-10 March **2018**.
37. Preparation of Hafnium Sponge from Hafnium Chloride, Arbind Kumar, S. Rajesh Kumar, Shaik Mowlali, N. Parasuram presented in "PM 18" International conference of Powder Metallurgy organized by PMAI at Mumbai during 21-23 February **2018**.
38. Defect Selective Etching of Silicon Carbide (SiC) Single Crystal, H. Sampath Kumar, H. S. Bisen, M. V. Rokade, Sandeep Mahajan, S. T. Ali; presented in ICASMD-2018 held during 8-10 March **2018**.
39. Recovery of rare earths from waste phosphors and their applications as precursors in optoelectronic devices, U. Rambabu, A. Bhaskar Reddy and K. Ramaswamy at International conference on advanced semiconductor materials and devices (ICASMD-2018) organized by C-MET, Hyderabad, during 8-10 March **2018**.

V) Invited Lectures by C-MET Scientists

1. Dr. Bharat Kale has delivered a Key note address on, National Conference on recent trends in Nanomaterials at Yashwantrao Chavan institute of science, Satara on 11th October **2017**.
2. Dr. Bharat Kale has delivered Invited talk on Green technology in State Level Seminar at R.B.N.B College, Shrirampur on 9th December **2017**.

3. Dr. Bharat Kale has delivered an invited talk on Sustainable environment friendly technologies; at Radhabai College Ahmednagar on 22nd December **2017**.
4. Dr. Bharat Kale has delivered an invited talk on glassy material for energy applications in international conference on Advanced materials (AMDP) (INDO-JAPAN) at Savitribai Phule Pune University, Pune on 14th July **2017**.
5. Dr. Bharat Kale has delivered an invited talk on nanomaterials and applications in International Conference on "Advanced Engineering Functional Materials", AEFM 2017 at GITA Bhubaneswar, Odisha on 21-23 September **2017**.
6. Dr. Phatak has delivered invited talk on LTCC Process and Materials for next generation integrated devices in LTCC, at Materials Engineering Department, DIAT, Pune, on 8th November **2017**.
7. Dr. Milind V. Kulkarni has delivered Guest lecture on "Electronics Materials and Application" at Department of Mechanical Engineering, Cusrow Wadia Institute of Technology, Pune (CWIT) on 7th September **2017**.
8. Dr. Milind V. Kulkarni has delivered an Invited talk on "Nanomaterials and Polymer Nanocomposites for Multifunctional Applications", at Two Day National Level Conference on the topic 'Recent Trends in Chemical Sciences (RTCS-2017) at Dept. of Chemistry, Dadapatil Rajale Arts and Science College, Adinathnagar, Pathardi, on 21st and 22nd December **2017**.
9. Dr. R. S. Sonawane delivered invited talk on Quantification of elemental concentration using Atomic Absorption and Inductively Coupled Plasma Optical Emission Spectroscopy Techniques at Department of Physics, Prof. Ramkrishna More College, Akurdi, Pune on August **2017** (D. B. T. Star College Scheme Lecture).
10. Dr. Parag Adhyapak has delivered a Key note address on Sensors for Smart Cities at KLE Dr. M. S. Sheshgiri College of Engg., & Tech, Belagavi on 4th November **2017**.
11. Dr. Parag Adhyapak has delivered Invited talk at workshop held at Abasaheb Garware College, Pune on 8th December **2017**.
12. Dr. Parag Adhyapak has delivered an invited talk at ICC, XXXVI Annual Conference held at School of Chemistry, Andhra University, Visakhapatnam, on 26th December **2017**.
13. Dr. Parag Adhyapak has delivered Invited Talk on 'Morphology dependent NO_x sensing response of WO₃ nanostructures' Indian Council of Chemists 5th International Conference held at Swiss Bel International Hotel, Bali Indonesia on 7-9 June **2017**.
14. Dr. Girish Phatak delivered a lecture on "Advanced Electronic Packaging and Materials", at Dept of Materials Engineering, Defence Institute of Advanced Technology (DIAT) on 8th November **2017**.
15. Dr. A. Seema delivered an invited talk on "2D Materials- Graphene" in Short term training programme on 'Nano Materials in Science Technology and Medicine - A Practical Approach' held at Department of Chemistry, Govt. Engineering College, Thrissur during 24-28 July **2017**.
16. Dr. Seema A delivered an invited talk on "Graphene based flexible electronics" in Emerging Frontiers in Chemical Sciences, (EFCS-2017) held at Farook College, Kozhikode, Kerala during 23-25 September **2017**.
17. Dr. Seema A delivered an invited talk on "Electronic & Photonic Applications of Graphene" in 'One day Symposium on Recent Advances in Photonics' held at Centre for Biophotonics, Department of Atomic and Molecular Physics, Manipal Institute of Technology, Manipal University on 13th November **2017**.
18. Dr. K.P. Murali, delivered an invited talk on "Microwave Materials & Devices" at Dept. of Electronics and Communication Engineering, Vidya Academy of Science and Technology, Thrissur held on 5th April **2017**.
19. Dr. K.P. Murali delivered an invited talk on "Effect of Particle size on the Microwave properties of Materials" in

Short term training programme on 'Nanomaterials in Science Technology and Medicine - A Practical Approach' held at Govt. Engineering College, Thrissur during 24-28 July **2017**.

20. Dr. N.C. Pramanik delivered an invited talk on "Advanced Materials for Hybrid Supercapacitors" in '54th Annual Convention of Chemists 2017' organized by Indian Chemical Society, held at UkaTarsadia University, Bardoli (Surat) during 23-25 December **2017**.
21. Dr. S. N. Potty delivered an invited talk on "Nanophotonics" in the Interdisciplinary Refresher Course in Materials Science, held at Kannur on 13th July **2017**.
22. Dr. S. N. Potty delivered an invited talk on "Thin film solar cell with earth abundant $\text{Cu}_2\text{ZnSnS}_4$ " in the Refresher Course in Renewable Energy Studies, held at Thiruvananthapuram on 18th August **2017**.
23. Dr. S. N. Potty delivered an invited talk on "Basics of X-ray diffraction" at NSS Hindu College, Changanassery on 15th September **2017**.
24. Dr. T. Radhika delivered an invited talk on "Advanced Energy Harvesting Technologies for Sustainable Environment", at Dept. of Chemistry, St. Aloysious College, Elthuruth, Thrissur, Kerala, on June **2017**.
25. Dr. N. Raghu delivered an invited talk on "Piezo Ceramics - the smartest Materials", in Colloquium on Smart Materials & Structures, held at SRIBS, Pampady, Kottayam during 24-26 November **2017**.
26. Dr. N. Raghu delivered an invited talk on "Piezoceramics for underwater applications", in the Annual session of Indian Ceramic Society & International Conference on Expanding Horizons of Technological Applications of Ceramics and Glasses (EH-TACAG'17), held at College of Engineering, Pune during 14-16 December **2017**.
27. Dr. R. Ratheesh delivered invited lecture on "Novel Microwave Ceramics and PTFE Composites for High Power Solid State Amplifier Applications" at International conference on "Expanding Horizons of Technological Applications of Ceramics and Glasses (EH-TACAG'17)" at Pune on 16th December **2017**.
28. Dr. R. C. Reddy delivered an invited lecture as a part of National Metallurgists Day celebrations on "Role of Metallurgical Industry in National Development" at IIIT, Nuzvid, AP on 14th November **2017**.
29. Dr. S.T. Ali delivered a talk on "Growth of SiC Bulk Single Crystal by PVT" in Continuing Education Programme (CEP) course at SSPL on 10th October **2017**.
30. Dr. Y. Purushotham delivered an invited lecture on "Purification of Zinc by distillation" in 20th International Conference of International Academy of Physical Sciences on "Recent advances in physical sciences and future challenges" (CONIAPS XX) at Osmania University, Hyderabad on 14-16 July **2017**.
31. Dr. V.N. Mani delivered an invited talk on "Preparation of undoped and Al-Ga-and In-doped ZnO thin films and current trends in harnessing electrical energy using GaInP/GaAs/Ge triple junction nano solar cells – Bird's Eye View" in the National Conference on Nano-materials (NCN-2017) held at Arigar Anna Government Arts college, Namakkal during 20-21 July **2017**.
32. Arbind Kumar presented invited talk on "Hafnium metal preparation: Journey from basic R & D to extended pilot plant" at CVSR College, Hyderabad on 16th August **2017**.
33. Dr. Manish Shinde delivered an Invited Lecture entitled "Use of ICT in Materials analysis" at National level seminar on "Use of ICT in Science" at BJC Arts, Science and Commerce College, Pune on 6th February **2018**.
34. Dr. Seema Ansari delivered an invited talk on "Supercapacitors: Alternative Energy Storage Systems". In International Conference on Advances in Chemical Engineering (ICACHE 2018) at Government Engineering College Thrissur on 18th -20th January **2018**.
35. Dr. V. Kumar : Design of transducer materials : a ramanperspective, Invited lecture delivered at National Seminar on Advanced Materials-ADMAT 2018 organised by School of Pure and Applied Physics, Mahatma Gandhi University, Kottayam during 23-24 March, **2018**.

36. Dr. V. Kumar : ns² lone pair – an important handle for materials design: Invited lecture delivered at National Seminar on Frontiers in Chemical Sciences 2018, organised by Department of Chemistry, Calicut University, Calicut during 26-28 February **2018**.
37. Dr. V. Kumar: NLO properties of ferroelectric thin films: Invited lecture delivered at National Seminar on Contemporary Trends in Physics at School of Physics, Kannur University, Kannur during 20-21 March **2018**.
38. Dr. V. Kumar: design of new materials; approach through defect chemistry: Invited lecture delivered at National Seminar on Science and technology of New Materials for Sustainable Future, organised by Department of Physics, Calicut University, Calicut during 7-9 February **2018**.
39. Dr. N. C. Pramanik delivered an invited lecture on "Materials for Hybrid Supercapacitors- Technological aspects & Achievements" on March 17, 2018 at Dept. of Physics, CUSAT in c/w National Workshop on 'Recent Trends on Photovoltaics 2018', held at CUSAT (Cochin) during 16-17 March **2018**.
40. Dr. S. N. Potty has delivered invited talk on Plasmonics at the Conference on Electronics, Signal processing and Communication Engineering (E-SPACE 2018) at Government Engineering College, Thrissur on 18th January **2018**.
41. Dr. S. N. Potty has delivered invited talk on CZTS Solar cell absorber films in the National Seminar on Structure & Technology of New Materials for Sustainable Future (STNM2018) at University of Calicut, Kozhikode on 8th February **2018**.
42. Dr. S. N. Potty has delivered invited talk in the National Seminar on 'Thin Film Technology and Applications' at School of Pure and Applied Physics, Mahatma Gandhi University, Kottayam on 17th February **2018**.
43. Dr. N. Raghu has delivered invited talk on "A Bird's eye view of Materials for Sustainable Future", Three - day Golden Jubilee National Seminar on Science and Technology of New Materials for Sustainable Future (STNM 2018), Calicut University, 7-9 February **2018**.
44. Dr. S. T. Ali delivered lecture on 'SiC Single Crystal - Growth and Challenges' in ICASMD 2018 held during 8-10 March **2018**.
45. Dr. V. N. Mani presented Invited talk on "Role of Epitaxial GaInP/GaAs/Ge Triple-junction Solar Cells and Advancements in Harnessing Clean and Green Solar Energy Through Concentrating Thermal Photo Voltaic Technologies - A Bird's Eye View" - International Conference on Advanced Materials for Technological Applications-ICAM 18" held at PSGR Krishnammal College for Women, Coimbatore during 03-05 January **2018**.
46. Arbind Kumar presented an Invited talk on "Electronic waste Processing at C-MET : An Overview" at NMDC R & D Centre, Hyderabad on 21st February **2018**.
47. Rajesh Kumar delivered an invited talk on "E-Waste Recycling Technologies", at Workshop on "Resource Efficiency and Circular Economy", organised by NITIAYOG during 19-20 March **2018**.
48. Dr. N.R. Munirathnam delivered an invited talk on "E-Waste Management", at Telangana Environment Congress 2018, held during 22-23, March **2018** organized by Centre for Environmental Development (CED) at NI-MSME, Yousufguda, Hyderabad.
49. Activities and achievements of MeitY Society, C-MET, Talk on 27 June-7 July **2017** at CDAC, Noida, Two weeks training program for S&T officials.

Awards and Honours

1. Received first prize in Electroceramics poster presentation for the paper titled "NaMg₃In(MoO₄)₅ ceramic for ultra-low temperature co-firable (ULTCC) applications", Dhanya Johnson, Anju. K and R. Ratheesh, in the International conference on 'Expanding Horizons of Technological Applications of Ceramics and Glasses'

(EH-TACAG'17) held at College of Engineering, Pune during 14-16 December **2017** (First Prize in Electroceramics poster presentation).

2. Dr. Raghu C Reddy hosted as Convener for Seminar on "Heat Treatment of Steels and other Alloys - Latest Trends and Opportunities", under the aegis of IIM Hyderabad Chapter on 04th September **2017**.
3. Dr. Parag Adhyapak received Indian Council of Chemists 'Dr. Arvind Kumar Memorial Award' at Andhra University, Visakhapatnam on 26th December **2017**.
4. Dr. B. B. Kale, Royal society of Chemistry, London, collaboration award **2017**.
5. Formulation and effects of firing temperature on Al₂O₃-Ferric oxide Based Thick Film Glass Composite for Steel Substrate", Ghanasham D. Shirke, Govind G. Umarji, Arjun R. Tarale, Vikas L. Mathe, Uttam P. Mulik, and Sunit B. Rane, EH-TACAG'17, 14th- 16th December **2017**, InCerS (81st Annual Session of InCerS in conjunction with 69th Annual Session of AIPMA and 43rd Annual Session of IIC), Received 2nd price in best poster award.
6. Dr. Y. Purushotham elected as Hon. Treasurer of Telangana Academy of Sciences (TAS), Hyderabad for the term **2018-20**.
7. Mr. Prabeesh has won the first prize for the best oral presentation of the paper "Spray coated kesterite absorber thin film for photovoltaic application" by P. Prabeesh, I. P. Selvam, S. N. Potty in the UGC Sponsored National Seminar on Recent Trends in Nano and Other Materials for energy efficient devices by St. Aloysius college Edathua during 20-22 July **2017**.
8. ELCINA-EFY AWARD: C-MET won "First Prize" in ELCINA-EFY Awards for Outstanding Achievements in "Research & Development" for the year 2016-17. The award was presented by Shri A. Prakash Sawhney, Secretary, MeitY on 14th September **2017**.
9. Mr. Prabeesh has won first prize for the best oral presentation "Effect of sulfurization temperature on CZTS phase formation and fabrication of thin film CZTS solar cell with Cd free buffer layer", P. Prabeesh, I. P. Selvam, S. N. Potty in the National Seminar on Recent thin film technology and applications by School of Pure and Applied Physics, M.G University Kottayam during 15-17 February **2018**.

Others

Plans and Prospects

C-MET implemented the projects in accordance with its approach and strategy. The key features of plans and prospects are:

1. To enhance the competency in advanced areas of science and technology in order to keep pace with the world scenario of electronic materials through in-house and grant-in-aid projects with inter and intra laboratory involvement.
2. Continue the interactive/working relation with strategic sector for development of critical materials and products through sponsored projects.
3. Continue the technical and materials characterization services to industries for creating more scope for consultancy projects, chemical analysis and certification for the compliance of RoHS directive and E-waste rules 2016.
4. Be a front runner in R&D of Electronic Materials and collaborate with esteemed international and national institutes/universities for creating common platform on knowledge sharing basis.
5. Development of impactful products and technologies through exploratory and requirement driven applied research.

Acknowledgment

C-MET is grateful to the Ministry of Electronics & Information Technology (MeitY), Govt. of India for its whole-hearted support and guidance during the entire year. It is my pleasure to acknowledge the support to C-MET in the form of specific sponsored projects for the technology/product development from the government and private organizations such as MeitY, ISRO (VSSC), DST, DRDO, DAE (BRNS, BARC), EATON Pvt. Ltd., Madison Metals Ltd., etc.

The guidance and proactive support of the Honourable Chairman, Deputy Chairman, Executive Vice-Chairman and members of the Governing Council of C-MET have been invaluable for effective functioning. The advice of the Steering and Executive Committee of C-MET in carrying out the programmes effectively and efficiently requires special mention. I sincerely thank all of them.

I place on record very special thanks to all the Officers and Staff members of Electronic Materials and Components Development (EMCD) Division, Finance Division, Autonomous Bodies Coordination Division (ABCD) and the other divisions of MeitY, for their extraordinary support and prompt co-operation in implementing C-MET's programs. I am also obliged to our bankers, Punjab National Bank, Canara Bank, State Bank of India, Indian Overseas Bank, Andhra Bank and Bank of India at Pune, Hyderabad and Thrissur for rendering timely services.

I earnestly owe all the staff members and project staff working in various projects of C-MET for their dedicated professional efforts in the R&D activities, administrative services and financial support in achieving the overall progress of C-MET during the year.

Dr. N. R. Munirathnam
Director General
On behalf of C-MET Team

Major Characterisation Equipments Available At C-MET

Name of The Equipment	Model	Manufacturer	Applications
PUNE LABORATORY			
UV-VIS Spectrometer	UV 3600	Hitachi, Japan	Spectroscopic Chemical Analysis
Spectrofluorometer	JOBIN YVON F3	Horiba, Japan	Defects in semiconducting materials
Photo Luminescence Spectrometer	RF-5301	Shimadzu, Japan	Luminescence studies of organic, inorganic and polymeric compounds
Potentiostat/Galvanostat	PG-100	Autolab, Netherlands	Electrochemical Synthesis and Characterization
TGA/SDTA/DSC/DPA	Toledo 821, 851	Mettler, Switzerland	Thermal Characterization of Organic, Inorganic and Polymeric samples
TMA/DMA	Perkin Elmer 7e	Perkin Elmer, USA,	Thermomechanical Analysis of Polymers
Fourier Transform Infrared Spectrometer (FT-IR)	PE Spectrum 2000	Perkin Elmer, USA	Spectroscopic Chemical Analysis
Scanning Electron Microscope (SEM) with EDAX	Philips XL-30	Philips, Netherlands	Surface Morphology and related Microanalysis
Graphite furnace Atomic Absorption Spectrometer	Avanta-sigma	Nulab, USA	Trace Impurity Analysis
Hot Stage Microscope	FP-900, Lica DMLP	Mettler- Toledo, Switzerland	Characterisation of Liquid Crystalline Polymers
Scanning Probe Microscope (SPM)	Pico plus	Agilent Technologies Inc., USA	Examination of Topological Features at Atomic Scale
Field Emission Scanning Electron Microscope (FE-SEM)	S-4800 II	Hitachi, Japan	Surface Morphology and related Microanalysis
Field Emission Transmission Electron Microscopy (FE-TEM)	JSM 2200FS	JEOL, Japan	Surface Morphology and related Microanalysis
Broadband Impedance Spectrometer	C80	Nova Control	Frequency sweep measurements of dielectric properties and conductivity of materials
Continuous Tape Caster	CAM-L255	Keko Equipment Ltd	Tape casting
Screen printer	MT-320TVC	Micro-tec Co. Ltd.	Screen printing and stencil printing
Spin coater	SPIN150i	SPS Europe	Spin coating of photoresists

Name of The Equipment	Model	Manufacturer	Applications
Thermal Chemical Vapour deposition	---	Ant Ceramics, Mumbai	For the deposition of thin films
Dip coating System	---	Prompt Engineering	For thin film deposition
BET Surface Area Analyser	Nova Touch LX	Quantachrome Instruments	For surface area measurement of nanomaterial powders
Thickness Measurement Unit (TMU)	Talysurf CLI 2000	Taylor Hobson	For surface profiling, thickness measurement of coatings and deposits, roughness parameter
Stereo Microscope	SZX12-TBI-Japan	Olympus	Inspection of PCB, polymers, substrates and real time sample snapshot
Particle Size Analysis	380	Nicomp	To measure the particle size and real time particle size distribution.
X-Ray Tomography	MICRO XCT-400	Carl Zeiss	For ultra-fine analysis of the microstructure, in-situ experimentations such as tensile / compression and temperature variation tests while imaging
HYDERABAD LABORATORY			
Inductively coupled Plasma Mass spectrometer (ICP-MS)	X-Series II	Thermo Fisher Scientific, Germany	Elemental Analysis in liquid (ppb/ppt level)
Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES)	iCAP 6500 series	Thermo Fisher Scientific, Germany	Elemental analysis in liquid to ppm level at Hafnium facility
X-Ray Diffractometer (XRD)	Xpert PRO	Panalytical, Netherlands	Phase and impurities detection in materials
Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES)	Agilent 725	Agilent Technologies India Pvt. Ltd., Bangalore	Elemental analysis in liquid to ppm level at RoHS facility
Gas Chromatography-Mass spectrometer (GC-MS)	DSQ II	Thermo Fisher Scientific, USA	Analysis of Poly brominated compounds in electronic materials
Energy Dispersive X-ray Fluorescence (ED XRF)	ARL Quanta X	Thermo Fisher Scientific, USA	Screening of elemental analysis down to ppm level
Ion Chromatography (IC)	850 IC Professional	METROHM, Switzerland	Estimation of Anions/ Cations
Atomic Absorption spectrometer (AAS)	932AA	GBC, Australia	Elemental analysis at ppm/ ppb level in liquids
Microwave Digestion System for RoHS facility	Multiwave-3000	ANTON PAAR, Vienna	Closed Digestion of samples by Microwave

Name of The Equipment	Model	Manufacturer	Applications
Microwave Digestion System for Hafnium facility	Star D	MILESTONE, Italy	Closed Digestion of samples by Microwave
Water purification System	Purelab Classic	ELGA, U.K.	18.2 MΩ water for analysis at RoHS facility
Carbon Sulphur analyzer	EMIA-920V2	HORIBA, Japan	Estimation of Carbon, Sulphur in Metal Samples
ONH Analyser	ONH-836	LECO, USA	Estimation of Oxygen, Nitrogen and Hydrogen in materials
Water Purification system	SA 67120	Millipore, USA	18.2 MΩ water for analysis
UV Visible Spectrophotometer	UV 2450	SHIMADZU, Japan	Organic & Inorganic Analysis of Elements in liquids (micro level)
TGA/DTA	S-II 7300	S-II, NanoTechnology, Japan	Thermal Characterization of Organic, Inorganic and polymeric samples ≤ 1400° C
ED-XRF	EPSILON I	Panalytical, Holland	Elemental analysis from Na to U, in PCB, intermediates and slag
Fire Assay System	CF-15	Carbolite UK	Estimation of precious metal
Fluorescence Spectrometer	L565	Perkin Elmer, USA	Measurement of fluorescence
Helium leak detector	ASM 340	Pfeiffer Vacuum, France	High vacuum leak testing
Optical Microscope	DSX 510	Olympus, Japan	Microstructural analysis
Gas Chromatograph	Trace 1110	Thermofisher, India	Estimation of volatile compounds in organic molecules
Helium Leak Detector	ASM- 310	Pfeiffer Vacuum, France	Used to detect leak in high vacuum system such as SiC sublimation reactor.
THRISSUR LABORATORY			
DSC / TGA	SDTQ 600	TA Instruments, USA	To study Physicochemical changes with respect to temperature up to 1500° C.
Impedance Analyser	HP4192A	Hewlett-Packard, Japan	To measure inductance, capacitance, resistance, factor and variation of these properties with frequency from 5Hz to 13 MHz.
Supercapacitor Testing Systems (SCTS)	BT-2000	Arbin Instruments, USA	To measure charge-discharge cycles, Cell capacitance and ESR of Supercapacitor test cells at under V=0-10V & I=0.01~1.0A.

Name of The Equipment	Model	Manufacturer	Applications
Multichannel high current Supercapacitor Testing Module	BT-ML-4CH-20A	Arbin Instruments, USA	For testing of supercapacitors (charge-discharge cycle, cell capacitance, ESR) under voltage & current in the range of 0-40V & 0.1~20A.
Gain Phase Analyser	Model 4294A	Agilent Technologies, USA	For impedance analysis of materials in the frequency range 40 Hz to 110 MHz
Electrometer	6517A	Keithley, USA	Measurement of electrical resistivity (10 to 210T) voltage / current, RH, etc.
Vector Network Analyzer	E8263 B	Agilent Technologies, USA	Microwave characterization of Dielectric Resonators, Composite substrates, ferrites, tunable dielectrics etc.
Piezo evaluation system	FE 2000	AixACCT, Germany	For piezoelectric property evaluation.
Thermo Mechanical Analyzer	TMA/SS610 0, SII	Japan	Measurement of thermal expansion coefficient of materials.
UV-Visible Spectrophotometer	Lambda 35	Perkin Elmer, USA	For measuring the absorbance in the UV-Visible region.
Surface Area & Pore size Analyser	Quadrasorb-Evo-KR/MP	M/s Quantachrome Instruments, USA	To analyze Surface area and Pore size distribution of porous materials.
Helium Pycnometer	Ultrapyc 1200 E	M/s Quantachrome Instruments, USA	To determine skeletal density of porous materials.
Rheometer	DHR-2	M/s TA Instruments, USA	Rheological Analysis of Fluids Pastes etc.
FT-IR	Spectrum 10	M/s Perkin Elmer, USA	IR spectroscopy to study the chemical environments of species
SEM with EDS	EVO 18	M/s Carl Zeiss	Microstructural and elemental analysis of materials.
Electrochemical Workstation (EWS)	Aut302N	M/s AutoLab Inc., Netherlands	To study electrochemical behaviour of samples by the CV & FRA technique.
Hall Measurement System	HMS-3000	M/s ECOPIA	Measurement of resistivity, carrier density, mobility and P/N type.
X-ray diffractometer	Ultima IV	Rigaku, Japan	Phase identification of crystalline materials, crystalline phase evaluation, structure studies etc.



C-MET, PUNE

**AUDITED
FINANCIAL STATEMENTS
FOR THE YEAR
2017-2018**

M/S. P. N. Phadke & Co.

Chartered Accountants

103, Megh Apts, S. No. 39/33, Opp. Ayurved Ras-shala,
Off. Karve Road, Pune - 411 004.

INDEPENDENT AUDITOR'S REPORT TO THE CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY (C-MET)

Report on the Financial Statements

We have audited the accompanying financial statements of **Centre for Materials for Electronics Technology, C-MET**, which comprise the Balance Sheet as at 31st March, 2018, and Income & Expenditure Account for the year then ended, and a summary of the significant accounting policies and other explanatory information.

Management's Responsibility for the Financial Statements

The Management of Centre for Materials for Electronics Technology is responsible for the preparation of these financial statements that give a true and fair view of the financial position and financial performance in accordance with the Accounting Standards applicable to non-corporate entities issued by Institute of Chartered Accountants of India in accordance with the accounting principles generally accepted in India. This responsibility includes the design, implementation and maintenance of internal control relevant to the preparation and presentation of the financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

Auditors' Responsibility

Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with the Standards on Auditing issued by the Institute of Chartered Accountants of India. Those Standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and the disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error.

In making those risk assessments, the auditor considers internal control relevant to the Society's preparation and presentation of the financial statements that give a true and fair view in order to design audit procedures that are appropriate in the circumstances. An audit also includes evaluating the appropriateness of the accounting policies used and the reasonableness of the accounting estimates made by the Management as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

Opinion

In our opinion and to the best of our information and according to the explanations given to us, the aforesaid financial statements read with Annexure to Audit Report and Notes to Accounts (schedule 6) annexed herewith give a true and fair view in conformity with the accounting principles to the extent applicable to the Society:

- a) in the case of the Balance Sheet, of the state of affairs of the Society as at 31st March, 2018; and
- b) in the case of the Income & Expenditure Account, of the deficit of the Society for the year ended on that date;

For P. N. Phadke & Co.

Chartered Accountants

Firm Registration No.107890W

CA V. P. Phadke

Membership No. 100811

(PARTNER)

Place : Pune.

Date : 17.07.2018

ANNEXURE Forming part of the Audit Report
of Centre for Materials for Electronics Technology
for the Year ended 31st March 2018.

1) Fixed Assets pertaining to projects:

At present, the fixed assets pertaining to projects are shown in the books as project expenses. As suggested, project fixed assets are shown separately in the Balance Sheet.

In respect of those assets, which relate to the projects that are completed and the fixed assets which are not likely to be returned to the sponsors, feasibility to dispose off such assets may be assessed.

2) Valuation of Inventory:

Pursuant to the management policy with regard to valuation of lab-wares, chemicals and consumables, the purchases are charged to consumption irrespective of stock thereof at the end of the year. We are of the opinion that the stock at the end of the year may be valued and brought into account.

3) Prior period income and expenditure:

Expenses amounting to Rs. 805/- pertaining to previous year have been accounted for in the current year.

4) During the financial year 2017-18, 7th pay commission has been implemented and paid completely thus the amount in "Schedule 11", in the current financial year is appearing on a higher side.

5) In case of Addition of Assets, that part of a grant through which cost of asset is paid is added to the fund Account. However, in case of sale of asset the fund Account is not credited with the original cost.

6) During the year, GST element of Approximately Rs. 89,000/- paid on cost of Assets is written off.

7) Contingent liability:

Contingent liability not provided in the books of account: -

Particulars	Current Year ₹	Previous year ₹
For Capital goods	Nil	Nil
For Others (In respect of pending Court Matter)	81,533.00	81,533.00

For P. N. Phadke & Co.
Chartered Accountants
Firm Registration No.107890W

CA V. P. Phadke
Membership No. 100811
(PARTNER)

Place : Pune
Date : 17.07.2018

CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY, PUNE
BALANCE SHEET AS AT 31st MARCH, 2018

(Amount ₹)

CORPUS / CAPITAL FUND AND LIABILITIES :	Schedule	As at 31.3.2018	As at 31.3.2017
CORPUS / CAPITAL FUND	1	420,908,360	477,738,865
CURRENT LIABILITIES AND PROVISIONS (Including sponsored project)	2	334,040,454	405,668,623
TOTAL		754,948,814	883,407,488
ASSETS :			
FIXED ASSETS	3	147,464,069	160,790,205
CURRENT ASSETS, LOANS AND ADVANCES	4	607,484,745	722,617,283
MISCELLANEOUS EXPENDITURE (to the extent not written off or adjusted)		-	-
TOTAL		754,948,814	883,407,488
SIGNIFICANT ACCOUNTING POLICIES	5		
NOTES TO ACCOUNTS AND CONTINGENT LIABILITIES	6		

We hereby certify the above balance sheet to be true & correct to the best of our knowledge & belief, subject to notes to accounts and schedules attached hereto.

sd/-
 Dr. N. R. Munirathnam
Director General

sd/-
 G. B. Rao
Sr. Finance Officer

As per our report of even date attached.
For P. N. Phadke & Co.
Chartered Accountants
 F.R. No. 107890W

sd/-
CA V. P. Phadke
 (M.No.: 100811)
 (PARTNER)

PLACE: PUNE
 DATE : 17.07.2018

Centre for Materials for Electronics Technology, Pune

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st MARCH, 2018

(Amount ₹)

INCOME :	Schedule	Current Year 2017 - 18	Previous Year 2016 - 17
Revenue Grants	7	132,425,687	79,767,874
Income from Services	8	5,917,325	17,591,838
Interest Earned	9	28,254,588	35,111,521
Other Income	10	2,180,903	1,501,070
TOTAL (A)		1,68,778,503	133,972,303
EXPENDITURE :			
Establishment Expenses	11	178,959,332	110,404,374
Laboratory and Administrative Expenses etc.	12	33,716,174	33,035,041
Depreciation		20,507,815	23,869,991
TOTAL (B)		233,183,321	167,309,406
Surplus / (Deficit) for the year (A - B)		(64,404,818)	(33,337,103)
Balance transferred to/from Corpus/Capital Fund		(64,404,818)	(33,337,103)

We hereby certify the above Income & Expenditure account to be true & correct to the best of our knowledge & belief, subject to notes on accounts and schedules attached hereto.

sd/-
Dr. N. R. Munirathnam
Director General

sd/-
G. B. Rao
Sr. Finance Officer

As per our report of even dated attached
for **P. N. Phadke & Co.**
Chartered Accountants
F.R. No. 107890W

sd/-
CA V. P. Phadke
(M.No.: 100811)
(PARTNER)

PLACE: PUNE
DATE : 17.07.2018

CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY, PUNE
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st MARCH, 2018

(Amount ₹)

SCHEDULE 1 : CORPUS / CAPITAL FUND :	As at 31.3.2018		As at 31.3.2017	
Balance as at the beginning of the year	434,612,384		384,380,258	
Add: Contribution towards Corpus/Capital Fund	7,574,313		50,232,126	
	442,186,697		434,612,384	
Add / (Less) : Balance of net income / Expenditure transferred from Income and Expenditure Account :				
As per last year	43,126,481		76,463,584	
Add : Surplus / (Deficit) for the year	(64,404,818)		(33,337,103)	
	(21,278,337)	420,908,360	43,126,481	477,738,865
BALANCE AT THE YEAR END		420,908,360		477,738,865

SCHEDULE 2 : CURRENT LIABILITIES AND PROVISIONS :
(Schedules Forming Part of Balance Sheet as at 31st March, 2018)

(Amount ₹)

A. CURRENT LIABILITIES :	As at 31.3.2018		As at 31.3.2017	
1. Sundry Creditors :				
a) For goods & others	1,897,986		59,918	
b) For E.M.D and Deposits	3,657,809	5,555,795	4,295,515	4,355,433
2. Statutory Liabilities :				
Profession Tax / ITDS / GST / Service Tax / GIS		2,176,799		290,668
3. Other Current Liabilities :				
Sponsored Projects	174,465,061		269,647,798	
Other Liabilities	38,663,841	213,128,902	38,232,582	307,880,380
TOTAL (A)		220,861,496		312,526,481
B. PROVISIONS :				
1. Gratuity Payable	63,226,248		47,531,981	
2. Leave Encashment payable	46,626,024		36,430,225	
3. C-MET CPF Trust	-		-	
4. Expenses Payable	3,326,686	113,178,958	9,179,936	93,142,142
TOTAL (B)		113,178,958		93,142,142
TOTAL (A+B)		334,040,454		405,668,623

Centre for Materials for Electronics Technology, Pune
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st MARCH, 2018

SCHEDULE 3 : Fixed Assets : (Amount ₹)

DESCRIPTION	GROSS BLOCK			DEPRECIATION				NET BLOCK		
	As at 1.4.2017	Additions during the year	Deletions/ Adj. during the year	As at 31.03.2018	As at the beginning of the year	For the year	Deletions/ Adj. during the year	Total upto 31.03.2018	AS AT 31.03.2018	As at 31.3.2017
1. BUILDINGS ON FREEHOLD LAND	123,144,631	4,229,266	-	127,373,897	60,943,429	6,431,583	-	67,375,012	59,998,885	62,201,202
2. LAB EQUIPMENT	299,063,328	2,276,487	12,933,365	288,406,450	210,359,801	12,485,252	12,551,452	210,293,601	78,112,849	88,703,527
3. FURNITURE, FIXTURES	12,745,916	437,082	25,336	13,157,662	9,290,443	367,075	22,078	9,635,440	3,522,222	3,455,473
4. OFFICE EQUIPMENT	16,522,136	197,262	220,531	16,498,867	12,718,756	589,234	213,186	13,094,804	3,404,063	3,803,380
5. COMPUTER/PERIPHERALS	11,842,896	434,216		12,277,112	11,262,898	385,322		11,648,220	628,892	579,998
6. ELECTRIC FITTINGS	1,775,384	-	9,660	1,765,724	661,434	111,383	9,542	763,275	1,002,449	1,113,950
7. ELECTRIC SUBSTATION	3,689,196	-		3,689,196	2,994,299	104,234		3,098,533	590,663	694,897
8. AIR CONDITIONERS	813,174	-		813,174	614,088	29,863		643,951	169,223	199,086
9. TUBEWELL	95,494	-		95,494	56,802	3,869		60,671	34,823	38,692
TOTAL OF CURRENT YEAR	469,692,155	7,574,313	13,188,892	464,077,576	308,901,950	20,507,815	12,796,258	316,613,507	147,464,069	160,790,205

Centre for Materials for Electronics Technology, Pune

SCHEDULE 4 : CURRENT ASSETS, LOANS & ADVANCES : (Schedules forming part of Balance Sheet as at 31st MARCH, 2018)

(Amount ₹)

	As at 31.3.2018		As at 31.3.2017	
A. CURRENT ASSETS:				
1. Cash balances in hand		1,373		1,751
2. Bank Balances with Scheduled Banks :				
- On Deposit Accounts	280,510,473		285,818,811	
- On Savings Accounts	74,363,022		100,237,838	
- Project Deposits (Including FLC Margin money)	187,465,762	542,339,257	261,451,040	647,507,689
TOTAL (A)		542,340,630		647,509,440
B. LOANS, ADVANCES AND OTHER ASSETS				
Loans and Advances to Staff	525,796		322,751	
Loans and Advances to Others	36,604,296		47,669,938	
Amount Recoverable	2,516,032		2,003,552	
Advance to Suppliers	3,438,633		4,253,449	
Security and Other Deposits	13,793,623		14,806,294	
Prepaid Expenses	9,622		14,813	
Interest Accrued on FDRs	8,256,113	65,144,115	6,037,046	75,107,843
TOTAL (B)		65,144,115		75,107,843
TOTAL (A+B)		607,484,745		722,617,283

CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY (C-MET), PUNE
Schedules forming part of the Accounts for the year ended 31st March 2018

SCHEDULE: 5 SIGNIFICANT ACCOUNTING POLICIES

1. Accounting Conventions :

The Financial Statements are prepared on *historical cost convention*, going concern, and accrual basis and the same are followed consistently, except for Bonus, which is accounted for on cash basis.

2. Revenue Recognition :

- Income from operation includes, Income from analysis receipts, overhead receipts and Professional / consultancy services. Income from these activities is accounted for as and when services are rendered.
- Grants are recognized when there is a reasonable assurance that, the grants will be received.
- C-MET being research body, its entire expenditure relates to research activity The expenditure incurred is debited to the appropriate accounts.
- All significant items of incomes and expenses are accounted on accrual basis unless otherwise stated.

3. Fixed Assets :

- Fixed Assets stated in the Balance Sheet are valued at their cost of acquisition inclusive of freight, octroi and other direct and indirect cost in respect thereof.
- Society has been directed to charge depreciation on its assets on the written down value basis vide instructions issued by Ministry of Electronics & Information Technology. Accordingly, depreciation has been charged as per rates prescribed under the Income Tax Act, 1961.
- Fixed Assets procured under the Sponsored projects, being the property of the respective Sponsoring agency, are not accounted under the head C-MET Fixed Assets.

4. Inventory :

As per the policy consistently followed by the Centre, expenditure incurred on consumable stores and spares is charged to revenue account.

5. Foreign Currency Transaction :

Transactions in foreign currency are recorded at the exchange rates prevailing on the date of transactions. Foreign Currency Assets / Liabilities are restated at the rates prevailing at the year end.

Exchange Differences relating to fixed assets are adjusted to the cost of the assets.

Any other exchange difference is dealt with in the Income & Expenditure Account.

6. Prior period and Extraordinary Items :

Prior period income and expenses and extraordinary items, wherever material are disclosed separately. Prior period items include material items of Income or Expenses which arise in the current period as a result of error or omission in the preparation of financial statements of one or more prior periods. It does not include items, which are ascertained and determined during the year.

7. Retirement Benefits :

C-MET has set up Contributory Provident Fund separately. Leave Encashment and Gratuity is accounted for as per the actuarial valuation, liability whereof is as below:

a) **Gratuity** - ₹ 632,26,248/- (Previous year Rs. 475,31,981/-)

b) **Leave Encashment** - ₹ 466,26,024/- (Previous year Rs. 364,30,225/-)

8. Amount equal to capital expenditure is credited to capital fund. Grants for sponsored projects are shown separately. Unspent amount of the sponsored projects is shown as liability.

For **CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY**

sd/-
Dr. N. R. Munirathnam
Director General

sd/-
G. B. Rao
Sr. Finance Officer

For **P. N. Phadke & Co.**
Chartered Accountants
F.R. No. 107890W

sd/-
CA V. P. Phadke
(M. No.: 100811)
(PARTNER)

PLACE: PUNE
DATE : 17.07.2018

CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY (C-MET), PUNE

Schedules forming part of the Accounts for the year ended 31st March 2018

SCHEDULE: 6 NOTES ON ACCOUNTS

1. Current Assets, Loans & Advances: In the opinion of the management, the current assets, loans and advances have a value on realization in the ordinary course of business equal at least to the aggregate amount shown in the Balance Sheet.
2. Foreign Currency Transactions:
 - a) Value of Imports (FOB basis):
Capital Goods: Rs. 3,41,47,192/- (Previous Year Rs. 3,28,56,269/-)
 - b) Expenditure in Foreign Currency: Rs. 1,11,88,529/- (Previous Year Rs. 22,04,588/-)As the information of CIF basis for import of capital goods is not available, values are taken on FOB basis.
3. Estimated amount of contingent liability carried forward towards pending court judgement for medical reimbursement of Thrissur laboratory staff is Rs. 81,533/- (Previous Year Rs. 81,533/-)
4. The Society is an approved institution in terms of sub-section (21) of section 10 of the Income Tax Act, 1961 and is exempt from tax.
5. Since most of the materials/equipments are of technical nature, their allocation between equipments, stores and projects is taken as certified by the management.
6. C-MET, being a scientific Society and not a commercial, industrial or a business entity, the Management is of the opinion that reporting requirements as per AS-17 "Segment Reporting" are not mandatory.
7. The Management of C-MET is of the opinion that being a Scientific Society under Ministry of Electronics and Information Technology, Govt. of India and Societies Registration Act, the disclosure requirement as per AS-18 "Related Party Disclosure" are not applicable.
8. In the opinion of the Management, Accounting Standard 22 for "Accounting for taxes on income" is not applicable to the Society as it is exempt from payment of income tax.
9. Debit and Credit Balances of Personal Accounts are subject to confirmation.
10. Previous year's figures have been regrouped and rearranged wherever necessary.
11. Schedules 1 to 11 are annexed to and form an integral part of the Balance Sheet as at 31st March, 2018 and the Income & Expenditure Account for the year ended on that date.

For CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY

sd/-
Dr. N. R. Munirathnam
Director General

sd/-
G. B. Rao
Sr. Finance Officer

For **P. N. Phadke & Co.**
Chartered Accountants
F.R. No. 107890W

sd/-
CA V. P. Phadke
(M.No.: 100811)
PARTNER

PLACE: PUNE
DATE : 17.07.2018

Centre for Materials for Electronics Technology, Pune

Schedules forming part of Income & Expenditure A/c for the year ended 31st March, 2018

(Amount ₹)

SCHEDULE 7 : REVENUE GRANTS	Current Year 2017-18	Previous Year 2016-17
Grants for Revenue Expenditure	132,425,687	79,767,874
TOTAL	132,425,687	79,767,874
SCHEDULE 8 - INCOME FROM SERVICES	Current Year 2017-18	Previous Year 2016-17
Income from Services:		
Analysis receipts	111,431	873,445
Overhead / Consultancy services / Intellectual Fee	4,997,394	15,619,893
ToT Fee	808,500	1,098,500
TOTAL	5,917,325	17,591,838
SCHEDULE 9 : INTEREST EARNED	Current Year 2017-18	Previous Year 2016-17
On Savings account and Term Deposits :		
a) With Scheduled Banks	28,249,548	35,102,492
b) On Advances to Staff	5,040	9,029
TOTAL	28,254,588	35,111,521
SCHEDULE 10 : OTHER INCOME	Current Year 2017-18	Previous Year 2016-17
Miscellaneous Income	2,180,903	1,501,070
TOTAL	2,180,903	1,501,070

Centre for Materials for Electronics Technology, Pune

Schedules forming part of Income & Expenditure A/c for the year ended 31st March, 2018

(Amount ₹)

SCHEDULE 11 : ESTABLISHMENT EXPENSES	Current Year 2017 -18	Previous Year 2016-17
Salaries and Allowances	127,142,830	87,856,113
Training	28,930	27,298
Leave Travel Concession	389,843	1,379,611
Medical Reimbursement	5,551,884	4,557,297
Leave Encashment	11,499,209	4,461,186
Gratuity	17,856,661	6,287,071
Employer Contribution to CPF	7,879,689	2,933,398
NPS Contribution	6,632,509	766,279
Honorarium	120,500	57,579
Canteen Reimbursement	905,720	902,120
Newspaper & Periodicals	111,067	131,170
CEA Reimbursement	470,731	1,010,481
Membership Fees	18,954	25,695
Recruitment Expenses	68,793	9,076
Transfer TA	282,012	-
TOTAL	178,959,332	110,404,374

Centre for Materials for Electronics Technology, Pune
SCHEDULE 12 : LABORATORY AND ADMINISTRATIVE EXPENSES

(Schedules Forming Part of Income & Expenditure A/c for the year ended 31st March, 2018)

(Amount ₹)

Particulars	Current Year 2017-18	Previous Year 2016-17
Laboratory General expenses	2,423,271	2,106,562
Electricity charges	10,965,704	12,130,772
Water charges	50,289	154,090
Repairs and maintenance:		
On Buildings	116,876	208,419
On Electricals	323,688	319,695
On Laboratory Equipments	232,559	1,358,698
On Office Equipments	313,001	306,858
On Furniture & Fittings	9,380	-
Rates and Taxes	2,587,025	1,499,593
Postage & Telegram Charges	88,952	88,581
Telephone, Telex & Fax charges	365,714	484,531
Printing and Stationary	550,516	615,666
Conveyance	19,802	12,772
Vehicle Hire	1,925,360	1,716,954
TA & DA	1,709,461	1,915,291
Security Expenses	4,693,218	3,744,611
Office & General Expenses	3,128,148	2,460,486
Diesel for Gensets	297,569	223,964
Auditor's Remuneration	132,750	138,250
Audit Expenses	54,910	72,767
Meeting Expenses	733,851	583,835
Gardening Expenses	1,079,781	696,222
Bank charges	37,108	33,061
Advertisement and Publicity	348,278	193,598
Professional & Consultancy Expenses	1,020,508	62,000
Prior period Expenses	805	1,054,382
Workshop/Symposia	-	16,100
Contribution to Sponsored project	200,000	554,930
Assets written off	307,650	191,153
Legal Expenses	-	91,200
TOTAL	33,716,174	33,035,041

Centre for Materials for Electronics Technology - Pune

Bifurcation of Grants for the year 2017-18

(Amount ₹)

Total Grants received during the year 2017-18					140,000,000
PARTICULARS	DATE / VOUCHER No.	PLAN	NON-PLAN	TOTAL	
Grants received for the year 2017-18					
1. Sanction letter no.2(4)/2017-EMCD dtd. 1.8.2017	11.8.2017 / BRV-58	70,000,000	-	70,000,000	
2. Sanction letter no.2(4)/2017-EMCD dtd. 1.8.2017	25.10.17 / BRV-87A	64,000,000	-	64,000,000	
3. Sanction letter no.2(4)/2017-EMCD dtd. 1.8.2017	29.12.17 / BRV-106	6,000,000	-	6,000,000	
	Total Grants receipts	140,000,000	-	140,000,000	
Expenditure for the year 2017-18					
Capital Expenditure		7,574,313	-	7,574,313	
Revenue Expenditure		132,425,687	-	132,425,687	
	Total	140,000,000	-	140,000,000	

Centre for Materials for Electronics Technology, Pune

DETAILS OF PROJECT BALANCES AS ON 31st March, 2018

(Amount ₹)

S. No.	Project Name	Opening Balance as on 1.4.2017	Receipts during the year 2017-18	Payments during the year 2017-18			Closing Balance as on 31.3.2018
				Fixed Assets	Other Expenses	Total	
	1	2	3	4	5	6 = (4+5)	7 = (2+3-6)
	PUNE						
1	SP26 Micro-cantilever proj.	80	-	-	80	80	
2	SP28 Solar light photocatalyst	(211,501)	-	-	-	-	(211,501)
3	SP30 LTCC Project-BARC	27	618,000	-	618,027	618,027	-
4	SP33 Devp. of LTCC Sys for Cryocooler Appl	39,961	-	-	39,961	39,961	-
5	SP39 Devp. of Optical Isolators	(5,431)	5,431	-	-	-	-
6	SP41 UGC-JRF- J M Mali	63,629	-	-	-	-	63,629
7	SP42 Bismuth Sulphide quantum Dot glass	372,657	17,470	-	390,127	390,127	-
8	SP43 In House Devp of Photoconducting Paste	-				-	-
9	SP45 Devp of LTCC Materials for GPA	24,325,038		22,255,116	905,414	23,160,530	1,164,508
10	SP46 CSIR-SRF-Ms. Bhirud	36,518				-	36,518
11	SP47 CSIR-JRF-Mr. Pandit	374,927			173,901	173,901	201,026
12	SP48 INSPIRE FACULTY AWARD- Dr. Chauhan	263,648			266,424	266,424	(2,776)
13	SP49 Devp. of Active Material	5,212,870		1,753,134	3,543,874	5,297,008	(84,138)
14	SP50 CSIR-JRF-MS A F Shaikh	36,625	11,666		48,291	48,291	-
15	SP51 Devp. of Visible Light	192	809,009		809,201	809,201	-
16	SP52 Fab. of Microwave Components	378,141				-	378,141
17	SP53 INDO-UKIERI Programme with NCL	(88,179)	88,179			-	-
18	SP54 Prototype Devp of Fuel Cell	891,027	42,075		936,242	936,242	(3,140)
19	SP55 Inspired Faculty Award-D R Patil	527,012	1,444,804	229,000	1,403,320	1,632,320	339,496
20	SP57 Devp of Nanostructured PdTe	37,660	248,940		296,200	296,200	(9,600)

Centre for Materials for Electronics Technology, Pune

DETAILS OF PROJECT BALANCES AS ON 31st March, 2018

(Amount ₹)

S. No.	Project Name	Opening Balance as on 1.4.2017	Receipts during the year 2017-18	Payments during the year 2017-18		Closing Balance as on 31.3.2018
				Fixed Assets	Other Expenses	
1		2	3	4	5	7 = (2+3-6)
21	SP58 Synth and Charact of Condor Polymer	283,844	7,043	9,500	281,387	-
22	SP59 Proof of Patternable Thick film	4,471,401	91,251	2,470,116	800,061	1,292,475
23	SP60 Devp. of Electrolyte systems	3,774,457	97,666	1,040,874	869,961	1,961,288
24	SP61 FAB of 2D Heterostructures	2,625,000	101,614	451,415	586,684	1,688,515
25	SP62 SERB Young Scientist Dr Khupse	1,290,000		13,999	895,953	380,048
26	SP63 Flexible Solidstate supercapacitor	-	660,473		379,766	280,707
27	SP64 Novel nanosthong perf anode mat	-	3,926,600		352,561	3,574,039
28	SP65 Synth of Nanosized ANI Ceramic	-	1,567,000		175,610	1,391,390
29	SP66 Dev. of NanostrMng Ferrite	-	1,238,400		214,619	1,023,781
30	SP67 Integrated low-cost water sensors	-	545,400		-	545,400
31	TS07 LTCC Packages for MEMS-JCDA	670,447			670,447	-
32	TS09 LTCC Packages thin film devices	460,498			460,498	-
33	TS10 Devp. Of Microwave Components in LTCC	3,187			3,187	-
34	TS11 Study on Synthesis of nano	24,650			24,650	-
35	TS12 LTCC Based Circuits Fittings	(11,714)			-	(11,714)
36	TS13 LTCC Based Magnetic Sensors	2,701,825	2,736,000	86,004	2,311,317	3,040,504
37	TS14 Low Temp Co-Fired Ceramic	207,663	937,500		1,145,163	-
38	TS15 Devp of Microcrystalline	1,354,620	459,826		963,152	851,294
39	CSIR SRF Y. Sethi		20,000		19,995	5
40	INSA Sr Sci. Dr. S Kulkarni		400,000		399,637	363
41	DST Sub expert com. Meeting on					

Centre for Materials for Electronics Technology, Pune

DETAILS OF PROJECT BALANCES AS ON 31st March, 2018

(Amount ₹)

S. No.	Project Name	Opening Balance as on 1.4.2017	Receipts during the year 2017-18	Payments during the year 2017-18			Closing Balance as on 31.3.2018
				Fixed Assets	Other Expenses	Total	
	1	2	3	4	5	6 = (4+5)	7 = (2+3-6)
	Engg & Tech Dev.		850,000		-	-	850,000
	TOTAL (a)	50,110,779	16,924,347	28,309,158	19,985,710	48,294,868	18,740,258
	HYDERABAD :						
42	SP28 Ultrapure Crystalline Germanium for detector & Opto -DAE	1,255,756			1,255,756	1,255,756	-
43	SP29 Sustainability & upgradn. of RoHS-Test Lab	4,788,900			4,788,900	4,788,900	-
44	SP30 Synth & photocatalytic activity of bulk & nanosized metal titanite	104,213			104,213	104,213	-
45	SP31 GALLIUM-DST	4,915,373			59,229	59,229	4,856,144
46	SP32 E-WASTE-PCBs-DeitY	35,544,202	9,920,000	977,786	24,762,918	25,740,704	19,723,498
47	SP33 DRDO/SSPL/CARS/Cd & Te	735,072	2,300,000	97,000	1,500,910	1,597,910	1,437,162
48	SP34 Photosensitizers for visible light-SERB	798,955	1,000,000		918,360	918,360	880,595
49	SP35 SIC / DMRL	53,982,797		4,670,220	12,046,533	16,716,753	37,266,044
50	SP36 CFLs & FLs / DST	1,646,625		600,000	893,308	1,493,308	153,317
51	SP37 Recycling scrap Germanium DRDO SSPL	7,013,279		226,675	2,838,454	3,065,129	3,948,150
52	SP38 Ultra High Pure Zn BRNS IGCAR	2,178,236			367,716	367,716	1,810,520
53	TS-01 Hafnium VSSC	2,730,800	12,333,841		11,161,837	11,161,837	3,902,804
	TOTAL (b)	115,694,208	25,553,841	6,571,681	60,698,134	67,269,815	73,978,234

Centre for Materials for Electronics Technology, Pune

DETAILS OF PROJECT BALANCES AS ON 31st March, 2018

(Amount ₹)

S. No.	Project Name	Opening Balance as on 1.4.2017	Receipts during the year 2017-18	Payments during the year 2017-18			Closing Balance as on 31.3.2018
				Fixed Assets	Other Expenses	Total	
1		2	3	4	5	6 = (4+5)	7 = (2+3-6)
	THRISSUR:						
54	SP45 LTCC Materials for Gen. purpose applications	242,192	-	-	394,826	394,826	(152,634)
55	SP49 Devp. of thin film solar cell with earth-abundant kesterite absorber material	106,772			106,772	106,772	-
56	SP51 Thermal sensor based monitoring system for early detection of breast cancer	1,114,802	242,000	-	1,487,212	1,487,212	(130,410)
57	SP52 Transition metal doped TiO ₂ Nanomaterials for photocatalytic Gen. of Hyd by Water-Splitting	32,210	387,242	-	394,660	394,660	24,792
58	SP53 Devp. of Microwave substrates for 750 W solid state amplifiers	2,663,547	1,825,060	232,173	4,247,879	4,480,052	8,555
59	SP54A Pilot Scale Production of Aerogel Super Capacitors for Electronic Application	63,438,770	3,964,108	8,722,635	1,805,730	10,528,365	56,874,513
60	SP54B Pilot Scale Production of Aerogel Super Capacitors for Electronic Application	17,714,868	3,426,406	13,290,340	1,004,052	14,294,392	6,846,882
61	SP55 A1 internal electrode based ULTC for Microwave Electronic Packaging Application	202,235	999,794	116,686	1,115,196	1,231,882	(29,853)
62	SP56 Power Packs with Aerogel Supercapacitors & Fractional order modeling	12,388,095	1,609,916	2,305,288	1,142,469	3,447,757	10,550,254
63	SP57 Textured PMN-PT based Piezoceramics	275,288	857,330	-	627,064	627,064	505,554

Centre for Materials for Electronics Technology, Pune

DETAILS OF PROJECT BALANCES AS ON 31st March, 2018

(Amount ₹)

S. No.	Project Name	Opening Balance as on 1.4.2017	Receipts during the year 2017-18	Payments during the year 2017-18			Closing Balance as on 31.3.2018
				Fixed Assets	Other Expenses	Total	
	1	2	3	4	5	6 = (4+5)	7 = (2+3-6)
64	SP58 Magneto-Dielectric Substrates of Miniaturized Antenna Application	5,365,900	54,576	4,861,872	275,144	5,137,016	283,460
65	SP59 Transparent conducting oxides and Metal Nitrides as low Plasmonic materials in near IP and visible Frequencies	-	1,755,028	-	447,576	447,576	1,307,452
66	SP60 Transparent conducting oxides based fibre optic plasmonic hydrogen and ammonia sensors	-	2,731,383	-	91,896	91,896	2,639,487
67	SP61 Nano NTC Composition Based submillimeter sized thermal sensors for low Temp. apps	-	2,500,000	-	-	-	2,500,000
68	DISHA Ferroelectric Ceramic-Polymer Composites for embedded capacitor	250,000	696,157	-	475,325	475,325	470,832
69	JRF/PDF JRF Grant in aid	48,132	583,126	-	583,573	583,573	47,685
	TOTAL (c)	103,842,811	21,632,126	29,528,994	14,199,374	43,728,368	81,746,569
	GRAND TOTAL (a+b+c)	269,647,798	64,110,314	64,409,833	94,883,218	159,293,051	174,465,061

Centre for Materials for Electronics Technology, Pune
RECEIPTS AND PAYMENTS FOR THE YEAR ENDED 31st March, 2018

(Amount ₹)

RECEIPTS	Current Year 2017-18	Previous Year 2016-17	PAYMENTS	Current Year 2017-18	Previous Year 2016-17
<u>I. Opening Balances</u>			<u>I. Payments</u>		
a) Cash in Hand	1,751	9,710	Establishment Expenses	153,043,855	103,533,348
b) Bank Balances:	647,507,689	594,560,188	Administrative Expenses	32,435,421	32,397,380
<u>II. Grants Received</u>			<u>II. Project Payments</u>		
From MeitY (G.o.I):			Sponsored Projects	122,359,378	101,955,343
Capital Grants	7,574,313	5,778,967			
Revenue Grants	132,425,687	124,221,033			
<u>III. Interest On deposits</u>			<u>III. Fixed Assets</u>		
On Bank deposits	25,952,121	32,280,545	Purchase of Fixed Assets	7,574,313	50,423,279
			Capital Work in progress	-	-
<u>IV. Other Income</u>			<u>IV. Other Payments</u>		
Analysis Income	142,616	832,195	Loans & Advances to staff and others	7,393,159	27,775,655
Miscellaneous receipts	9,010,746	63,341,243			
<u>V. Other Receipts</u>			<u>V. Closing Balances</u>		
Sponsored Project receipts	40,432,477	127,498,876	a) Cash in Hand	1,373	1,751
Loans & Advances from staff and others	2,099,356	15,071,688	b) Bank Balances:	542,339,257	647,507,689
TOTAL	865,146,756	963,594,445	TOTAL	865,146,756	963,594,445

**Statement showing comments of the Statutory Auditors on the accounts of
C-MET for the year 2017-2018 and C-MET's replies thereto**

S.No.	Brief Subject	Auditor's Comments	C-MET Reply									
1.	Fixed Assets pertaining to projects	<p>At present, the fixed assets pertaining to projects are shown in the books as project expenses. As suggested project fixed assets are shown separately in the Balance Sheet.</p> <p>In respect of those assets, which relate to the projects that are completed and the fixed assets which are not likely to be returned to the sponsors, feasibility to dispose off such assets may be assessed.</p>	<p>Actual amount of Fixed Assets procured out of the projects is separately accounted for & indicated in the schedule. Also, individual head-wise expenditure is separately maintained and sent to Sponsoring Agency. In addition, project Fixed Assets register is also maintained.</p> <p>Ownership and title of project fixed assets rests with the project sponsoring agency. Fixed Assets pertaining to completed projects are disposed off as soon as sponsoring agency consents their disposal.</p>									
2.	Valuation of Inventory	Pursuant to the management policy with regard to valuation of lab-wares, chemicals and consumables, the purchases are charged to consumption irrespective of stock thereof at the end of the year. We are of the opinion that the stock at the end of the year needs to be valued and brought into account.	Consumable materials like lab-ware, chemicals etc. are purchased according to actual & current needs and immediately sent to the respective laboratory for use. Hence there is no retaining store system. Therefore, valuation of consumable stores by the storekeeper is not feasible.									
3.	Prior period income and expenditure	Expenses for ₹ 805/- of previous year have been accounted for in the current year.	For information only.									
4.	During the financial year 2017-18, 7 th pay Commission has been implemented and paid completely thus the amount in "Schedule 11", in the current financial year is appearing on a higher side.		For information only.									
5.	In case of Addition of assets, that part of a grant through which cost of asset is paid is added to the fund Account. However in case of sale of asset the fund Account is not credited with the original cost.		For information only.									
6.	During the year, GST element of approximately Rs 89000/- paid on assets is written off.		For information only.									
7.	Contingent Liability	<p>Contingent liability not provided in the books of account :-</p> <p style="text-align: right;">In ₹</p> <table><tr><td>Particular</td><td>Current Year</td><td>Previous Year</td></tr><tr><td>For Capital goods</td><td>Nil</td><td>Nil</td></tr><tr><td>For Others</td><td>81,533.00</td><td>81,533.00</td></tr></table>	Particular	Current Year	Previous Year	For Capital goods	Nil	Nil	For Others	81,533.00	81,533.00	For information only.
Particular	Current Year	Previous Year										
For Capital goods	Nil	Nil										
For Others	81,533.00	81,533.00										

[illegible]

[illegible]

Steering and Executive Committee of C-MET (2017-2018)

STEERING COMMITTEE

Dr. V. K. Saraswat **Chairman**

Former secretary, Defence R&D
Member Niti Aayog, Room no.113,
Niti Aayog building, Parliament street,
New Delhi - 110 001
(from 31st October 2017 onwards)

Prof. T. R. N. Kutty **Member**

Emeritus Professor, IISc
No. 48, HMT Layout, 7th Cross / 7th Main
Rebindranath Tagore Nagar (PO)
Bangalore - 560 012
(Chairman upto 31st Oct. 2017 & member from
31st Oct. 2017)

Dr. Debashis Dutta **Member**

Group Coordinator (R&D Electronics),
Ministry of Electronics & Information Technology
Electronics Niketan, 6, CGO Complex,
New Delhi -110 003 (up to 31st December 2017)

Shri. Arvind Kumar **Member**

Group Coordinator (R&D Electronics),
Ministry of Electronics & Information Technology
Electronics Niketan, 6, CGO Complex,
New Delhi - 110 003
(from 01st January 2018 onwards)

Prof. S. B. Krupanidhi **Member**

Materials Research Centre
Indian Institute of Science
Bangalore - 560 012 (up to 31st October 2017)

Dr. J. Narayana Das **Member**

Chief Controller (R&D) DRDO (Retd),
Sarovar, D - 4, Fact Nagar, Tripunithura,
Kochi (Cochin) - 682301 (up to 31st October 2017)

Dr. S. Aravamuthan **Member**

Dy. Director
PPCM, VSSC
I. S. R. O. (P.O.) Thiruvananthapuram - 695 014
(up to 31st October 2017)

Dr. Murali Sastry **Member**

CEO,
IITB-Monash research Academy,
IIT, Powai, Mumbai - 400 076
(up to 31st October 2017)

Prof. N. S. Gajbhiye **Member**

Professor in Chemistry
Department of Chemistry
Indian Institute of Technology Kanpur
Kanpur - 208016 (31st October 2017 onwards)

Prof. Baldev Raj **Member**

Director
National Institute of Advanced Studies (NIAS)
Indian Institute of Science Campus,
Bangalore - 560 012 (31st October 2017 onwards)

Dr. Arun Kumar Bhaduri **Member**

Distinguished Scientist and Director
Indira Gandhi Centre for Atomic Research (IGCAR)
Kalpakkam - 603102, Tamil Nadu
(31st October 2017 onwards)

Shri P. Sudhakar **Member**

OSD to DAE & Former CEO, ECIL
ECIL admin. building
Electronics Corporation of India Ltd (ECIL)
Hyderabad-500 062 (31st October 2017 onwards)

Prof. (Dr.) Sanjay K. Nayak **Member**

Director General
Central Institute of Plastics Eng. and Technology
(CIPET)
Chennai - 600 032 (31st October 2017 onwards)

Dr. Hemanth Darbari

Director General **Member**
Centre for Development of Advanced Computing
Pune University Campus, Ganeshkhind,
Pune - 411 008

Dr. N. R. Munirathnam **Member - Convener**

Director General
Centre for Materials for Electronics Technology
Panchawati, Off Pashan Road, Pune - 411 008

EXECUTIVE COMMITTEE

Dr. N. R. Munirathnam **Chairman**

Director General
Centre for Materials for Electronics Technology
Panchawati, Off Pashan Road, Pune - 411 008

Smt. Swarna Lata **Member**

Scientist G/HOD, EMDC Division,
Ministry of Electronics & Information Technology
Electronics Niketan, 6 CGO Complex
New Delhi - 110 003

Shri R. P. Pradhan **Member**

Director (Societies)
Ministry of Electronics & Information Technology
Electronics Niketan, 6, CGO Complex,
New Delhi-110 003 (up to 18th December 2017)

Shri Trilok Chandra **Member**

Director (Societies)
Ministry of Electronics & Information Technology
Electronics Niketan, 6, CGO Complex,
New Delhi-110 003 (19th December 2017 onwards)

Ms. Anuradha Mitra **Member**

Ministry of Electronics & Information Technology
Electronics Niketan, 6, CGO Complex,
New Delhi - 110 003

Smt. C. K. Bajaj **Member**

DFA (Finance)
Ministry of Electronics & Information Technology
Electronics Niketan, 6, CGO Complex,
New Delhi - 110 003

Dr. B. B. Kale **Member**

Director
Centre for Materials for Electronics
Technology Panchawati, Off Pashan Road,
Pune - 411 008

Dr. R. Ratheesh **Member**

Director
Centre for Materials for Electronics Technology
Hyderabad - 500 051

Dr. N. Raghu **Member**

Director
Centre for Materials for Electronics Technology
Thrissur - 680 771

Dr. Tanay Seth **Member**

Programme Co-ordinator
Centre for Materials for Electronics Technology
Panchawati, Off Pashan Road,
Pune - 411 008

Shri G. B. Rao **Member**

SFO
Centre for Materials for Electronics
Technology Panchawati, Off Pashan Road,
Pune - 411 008

Smt. Radha Jaisimha **Member Secretary**

Registrar
Centre for Materials for Electronics Technology
Panchawati, Off Pashan Road,
Pune - 411 008 (from 5th June 2017 onwards)



Inaugural Function of the Annual Foundation Day 2018

CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY (C-MET)

From Left : Dr. D. S. Prasad, Convener, ICASMD 2018; Prof. Victor Veliadis, Professor in Electrical Engineering, North Carolina State University, USA; Dr. G. Satheesh Reddy, Scientific Advisor to Raksha Mantri, Government of India; Dr. R. Chidambaram, Principal Scientific Advisor, Government of India; Dr. N. R. Munirathnam, Director General, C-MET; Dr. S. B. Krupanidhi, Emeritus Professor, IISc, Bengaluru; Dr. R. Ratheesh, Director, C-MET, Hyderabad.

CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY (C-MET)

www.cmet.gov.in



Headquarters

Panchawati, Off Pashan Road,
Pune - 411 008
Tel: +91(020) 25898141, 25899273
Fax: +91(020) 25898085, 25898180
Email: rathnam@cmet.gov.in



Hyderabad Laboratory

IDA Phase II, Cherlapally, HCL (PO),
Hyderabad - 500 051
Tel: +91(040) 27265673, 27262437, 27260327
Fax: +91(040) 27261658
Email: ratheesh@cmet.gov.in



Pune Laboratory

Panchawati, Off Pashan Road,
Pune - 411 008
Tel: +91(020) 25898390, 25899273
Fax: +91(020) 25898085, 25898180
Email: bbkale@cmet.gov.in



Thrissur Laboratory

Mulangunnath Kavu, Athani (PO),
Thrissur- 680 581
Tel: +91(0487) 2201156-59, 2201757
Fax: +91(0487) 2201347
Email: raghu@cmet.gov.in