ANNUAL REPORT
2015 - 2016

CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY (C-MET)

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

Content

PREFACE

I am enormously elated to present the Annual Report of C-MET for the year 2015-2016. I took over the command as the Director General (DG) of C-MET on 23rd September 2015. Dr. Debashis Dutta provided unflinching support to C-MET up to 22nd September 2015 as DG (Acting).

This report encompasses the abridged overview of the activities, achievements, output and, thereby, overall scientific advancement of C-MET during 2015-2016. C-MET has been rendering the stupendous service to the nation in the area of materials for niche R&D in electronics technologies for over 26 years. Thus, the organization is in its prime youth and is striving to achieve the defined vision and mission with zestful vigour through its well aligned research and development activities. Major activities at C-MET encompass a wide range of areas which are pertinent to materials in electronics, energy and allied strategic domains. C-MET has been consciously taking rapid strides on the development and realization of *bulk-to-nano* advanced materials and technologies in different spheres of contemporary electronics which helps it to keep in pace with the demands of the modern times.

At this juncture, I would like to elucidate a few notable accomplishments in the financial year 2015-16.

This year, 7 sponsored projects were completed and 8 new externally funded projects have been initiated, while 23 projects are in progress. I am pleased to announce that our budgetary resources from extramural agencies have reached to the tune of Rs. 2070.91 lakhs during this year.

Apart from clinching important projects in our niche areas of expertise, such as, High purity materials, nanomaterials, electronic packaging, microwave materials, sensors and actuators, super capacitors, etc. We could also secure projects in the area of SiC single crystal growth for continuous growth of 2 inch diameter crystal boules in sufficiently large quantities which essentially supports the strategic sector in the country for high temperature and high frequency electronic devices.

Research performance indicators of C-MET for the present period are noted to be remarkable like previous years. This year, we contributed 58 publications in peer reviewed international journals, 36 papers at various national/international conferences, 3 indian patents, 68 Invited Talks/Plenary Lectures/Lectures at various National/International level scientific events and two book chapters. This year scientists and students from C-MET have bagged seven Best Paper Presentation awards in the conferences/symposia. All these awards and honours are testimony of research excellence of C-MET research fraternity.

This year also, we marched ahead with the practice of organization of a major scientific event in conjuction with the Annual Foundation Day of C-MET. C-MET Annual Foundation Day 2016 was celebrated at Thrissur on 8thMarch 2016.

Dr. Aruna Sharma, Hon. Secretary, DeitY delivered the presidential address in the Annual Foundation Day 2016 function (through video conferencing) and stressed the need for import substitution of critical electronic materials on competitive price. Dr. V. K. Saraswat, NITI Aayog Member & Former Director General DRDO delivered the Foundation Day Lecture, which covered extremely wide areas in electronics and computing. The Annual Foundation Day – 2016 was coupled with the National Workshop on Microwave and Terahertz Materials for Homeland Security (NWMTM 2016) at C-MET, Thrissur during 8th - 9th March 2016 to review the requirements of strategic materials for homeland security. The workshop dwelled upon various aspects of Stealth

materials for enabling radar absorbing materials, metamaterials for clocking and antennas, Frequency Selective RADOMS for minimizing the antenna Radar Cross Section (RCS), millimetre wave materials for security scanning and Terahertz materials for medical imaging, through-wall imaging, residual pesticide screening, etc.

We would commit ourselves to follow this trend of organizing a conference along with its Foundation Day next year too. Additionally, C-MET played a crucial role in organizing three important national and international workshops and symposia.

Overall, the report reveals that C-MET's remarkable blending materials development efforts with strategic sector and service rendering initiatives directed to address societal challenges continues. Nevertheless, we still need to realign and refocus some of our R&D activities towards commercial translation and therefore initiated steps in that direction too. Transfer of three technologies to industries this year is an important milestone towards achieving this goal.

It is worth accentuating that the presentations in this Annual Report echo the gleaming ambience induced by motivated co-workers and stimulating projects.

I earnestly anticipate that you will appreciate the achievements of C-MET and will find our reading material interesting, both in this report and on the website. Your suggestions and feedback are always welcome!

On the concluding note, I would like to quote from William Ramsay, a famous scientist that “Progress is made by trial and failure; the failures are generally a hundred times more numerous than the successes; yet they are usually left unchronicled”. C-MET's success is owing to the lessons learnt from failures and with constant perseverance to achieve success in this niche area of activity. We would like the industries to embark upon our progress.

Dr. N.R. MUNIRATHNAM

Director General

Our Proud Moment : Transfer of Technologies

Three technologies developed at C-MET have been transferred to the industries for commercial production during the year 2015-16.

1. Barium Magnesium Tantalate (BMT) dielectric resonators

Super high Q BMT dielectric resonators were jointly developed under indigenization of space materials programme by Centre for Materials for Electronics Technology (C-MET), Thrissur and Vikram Sarabhai Space Centre (VSSC), ISRO, Thiruvananthapuram through a patented and cost effective process methodology (Indian Patent Application No. 2295/CHE/2009). Barium Magnesium Tantalate (BMT) microwave ceramic dielectric resonators are extensively used in space communication, mobile base station and low noise oscillator applications. BMT dielectric resonators were prepared in bulk quantities and space qualification tests have been performed to utilize these strategically important materials for satellite communication applications. In order to ensure the availability of these materials for indigenous applications, BMT technology was transferred to an Ahmedabad based industry namely Sahajanand Laser Technologies Limited. The technology transfer agreement was signed by Dr. Koshy M. George, Deputy Director, VSSC and Dr. Kanhyalal, Director, RF & Microwave Division, Sahajanand Laser Technologies Limited on 25th May 2015 in a function held at VSSC, Thiruvannathapuram.

Each satellite requires about 3000 numbers of dielectric resonators. Hitherto, these have been imported with exorbitant cost. Sometimes, it is also an embargo item. C-MET has developed technology on par or better than imported dielectric resonators and indigenized with almost 1/8th of the imported cost. This is expected to generate several offshoots in near future for the development of state of the art microwave devices.

Technology Transfer function of space qualified BMT ceramics held at VSSC, Thiruvananthapuram

2. Flexible Microwave Substrates

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. Dielectric properties of packaging materials significantly influence the performance of high-speed microwave devices. Electrical characteristics of the microelectronics devices, such as signal attenuation, propagation velocity and cross talk are influenced by the dielectric properties of the packaging substrate. In order to meet future high-speed digital circuit designs, several materials have been developed keeping dielectric loss as minimum. Among them, PTFE-based materials are the ideal choice as base substrates for microwave circuitry with applications extending up to millimeter wave range. Currently the requirements of high frequency circuit boards are fully met through imports. World over only handful of industries are manufacturing these commercially important class of materials and they fall under embargo category.

C-MET has successfully developed a proprietary and patented processing methodology, named as SMECH process, through which microwave circuit boards with user defined dielectric properties can be realized. C-MET has also set up India's first Microwave Substrates pilot plant production facility at Thrissur with the financial support of Department of Atomic Energy (DAE) and regularly supplying ultra low loss microwave substrates to DAE for high power solid state amplifier design. These indigenously developed substrates are superior to their imported counterparts in terms of high dielectric constant (ε_r up to 14.8), ultra low loss tangent (tan δ =0.0018) and temperature stable microwave dielectric properties. Two US patent applications (Nos. 4104,002, 2013 &14228342, 2014) and one Indian patent application (3815/DEL/2012) have been already filed to protect the intellectual property rights of these innovations. The microwave substrates technology was transferred to M/s. Speedlam Electromaterials Private Limited, Hyderabad on 9th October 2015.

The Flexible microwave substrates thus developed can elude expensive imports of similar substrates and can save valuable foreign exchange. The strategic need for high power handling (more than 270 W) substartes have been fully met. This will have several off-shoots in the niche wireless technology area.

Dr. Debashis Dutta, Group Co-ordinator, MeitY handing over the technology transfer document to Shri. Sreekar Reddy, CEO, M/s. Speedlam Electromaterials Private Limited

3. Negative Temperature Coefficient (NTC) Thermal Sensors

NTC Chip thermistors are extensively used for accurate temperature measurement and control in automobiles, medical field and electronic appliances. In automobiles, thermistors are used for temperature measurement of cooling water and oil, temperature monitoring of exhaust gas, cylinder head or braking system, and controlling the air conditioning system. NTC chip thermistors are suitable for temperature measurement in large variety of consumer electronics, such as washing machines, refrigerators, Microwave oven, electric cookers, etc.

In health care sector these are used as disposable thermometers. World over they are replacing mercury glass thermometers for measuring human body temperature. They have accuracy as high as 0.1^0 C and have a fast response time of <5 s, which allows a fast and simple measurement of a patient's body temperature. They are also used in hemodialysis and the body temperature measurement of infants in incubators. Disposable hypodermic needle sensors made using thermistors are especially critical during open-heart surgery and also well-suited for cancer research and treatment

C-MET has developed different NTC compositions, chip thermistors and chip in glass thermal sensors suitable for various temperature ranges of sensing applications. C-MET has developed extremely small sensors of sizes 0.3mmx0.3mmx0.3mm. This technology was developed under a project sponsored and financed by Ministry of Electronics and Information Technology (MeitY) and patent filed jointly by C-MET and MeitY.

These sensors can meet fully the applications mentioned above and can nucleate several other indigenous technologies.

Handing over of the technology transfer document to M/s. DEEM Sensing Technology Pvt. Ltd., Bengaluru

Novel Ongoing Projects at C-MET

1. Development of Li-Ion Batteries: Active Materials Synthesis, Fabrication and Testing of Prototype Cells

Lithium batteries are characterized by high specific energy, high efficiency and long life. These unique properties have made lithium batteries the power sources of choice for the consumer electronics market with a production of the order of billions of units per year.

Fig.1.1 Schematic of the mechanism of Li-ion batteries, a typical button/coin (2032 type) cell and prototype cells fabricated at C-MET

C-MET has initiated and actively working for the development of active materials (cathode and anode) and being created an entire lithium battery fabrication and testing facility for the button/coin type and pouch / rectangular cells under one roof. The facility is being created for the synthesis of active materials (500 gm batch level) using spary dryer.

There is huge market demand for Lithium ion battery in electronic and automobile industry as shown in Fig.1.2.

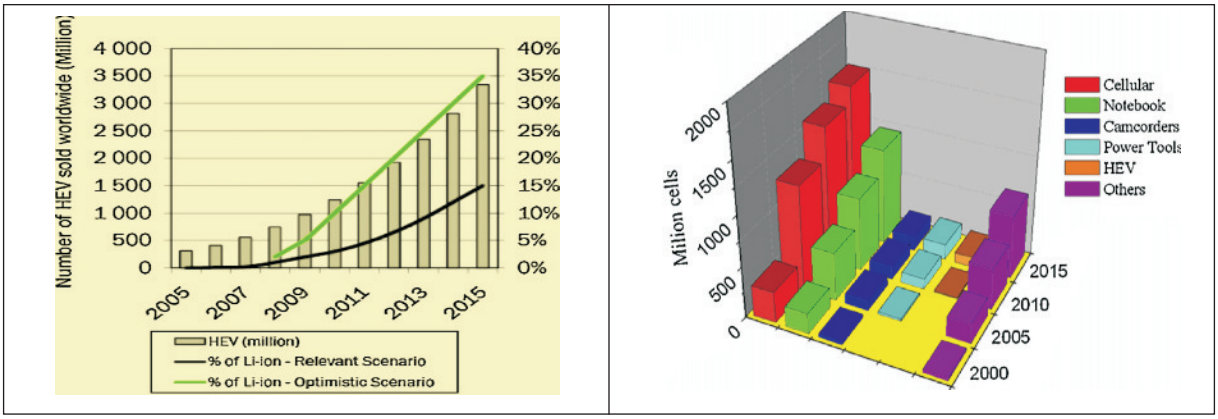


Fig. 1.2 HEV and electronic market evolution

Table1.1: Requirement of Li ion batteries in various applications

Year	Mobile phones in use	Two wheelers	Cars , LMV	Electric vehicles
2015	798 Million	18.5 Million	2.7 Million	2869 units
2020	990 Million	15-20 Million	9.3 - 11.3 Million	6 to 7 Million (projected)

2. Low Temperature Co-fired Ceramic (LTCC) Packaging Technology

The Low Temperature Co-fired Ceramic (LTCC) is a multilayer circuit technology made up of a glass-ceramic dielectric and silver or gold based conductors. Further, most passive components of the circuits consisting of inductors (L), capacitors (C) and Resistors (R) can be integrated in the layers and the dielectric is good enough for building multilayer microwave circuits up to 40 GHz. Today, C-MET possesses full-fledged LTCC fabrication laboratory, set-up through major financial support from National Programme on Smart Materials (NPSM). The facility is housed in a modest 150 m^2 of class 10000 clean room. In past, C-MET has worked closely with more than 20 institutional users from research laboratories, academic institutions and private sector companies across the country to develop various microwave communication circuits, packages for MEMS devices, thin film sensors, integrated gas sensor substrates, microfluidic valves, etc. (Fig.2.1).

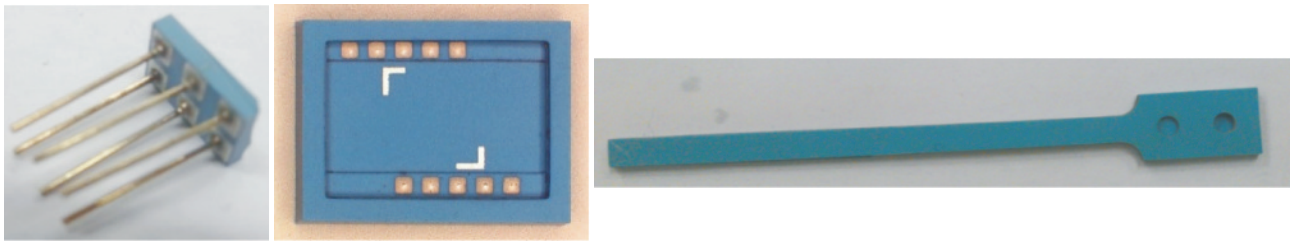


Fig. 2.1 (from L to R): Integrated gas sensor substrate with heater and temperature sensor, LTCC package for MEMS devices and micro cryocooler developed at C-MET

C-MET has also ventured into development of advanced fabrication processes as well as current and futuristic materials. C-MET has developed the process for LASER patterning of patterns (Indian Patent Appl. No. 2335/MUM/2015), processes for direct writing and subtractive patterning (Indian Patent Appl. No. 130/MUM/2015). A distinctive process and machine that allows trimming of buried resistors and a process of making 200µm diameter micro Ball Grid Array (micro BGA) and self-standing columns have been developed indigenously. With these facilities, C-MET is now developing a set up of own tapes and pastes at pilot scale to replace the imported materials. C-MET is also developing ultra-low loss, low-k, mid-k dielectric, ultra-low temperature LTCC, integrable ferrite materials for inductors as well as other high frequency magnetic core devices, oxygen conductor electrolyte for integrated solid-oxide fuel cells in LTCC (Indian Patent Appl. No. 57/MUM/2015 and 1573/DEL/2015). C-MET plans to concentrate upon completing the materials development of novel, integrated inductors and magnetic devices in LTCC. C-MET will also look into development of different types of microfluidic devices, and create integrated SOFC for standalone applications based on the novel ideas of 3-D printed LTCC materials. C-MET is also looking forward to substantial sponsored project funding on High Temperature Co-fired Ceramic (HTCC) technology development.

3. Hafnium Sponge for Strategic Applications

The increase in the number of space flights and the restriction imposed on the supply of strategic materials has necessitated indigenization of materials for space applications. With an aim to indigenize hafnium material for high temperature alloys, VSSC (ISRO) entrusted C-MET, Hyderabad to study the feasibility in the year 2004. C-MET has successfully demonstrated the process, production facility with a capacity of 320 kg per annum of hafnium sponge at Hyderabad laboratory with the financial support of VSSC (ISRO).

A tri-party agreement among C-MET, VSSC and NFC, has ensured the timely supply of raw material, zirconium scrub raffinate, from NFC. C-MET is planning to enter into an MOU with VSSC for the continuous supply of hafnium sponge for space applications.

Optimization of hafnium production facility at pilot plant scale quality control for repeatability and reproducibility are being carried out.

Fig. 3.1 Major process steps in preparation of hafnium sponge

Hafnium alloy material can be made in to structural material for jet engines and missiles. Hafnium is used for control rods for nuclear reactors because of its ability to absorb neutrons (its thermal neutron absorption cross section is nearly 600 times than that of zirconium), excellent mechanical properties coupled with exceptional corrosion-resistance properties. High dielectric constant is 3.9 for silicon oxide, where as for materials such as hafnium dioxide (HfO_2), zirconium dioxide (ZrO_2) and titanium dioxide (TiO_2) they are higher than 3.9. Intel made a significant breakthrough in the 45nm process by using a "high-k" material namely hafnium to replace the transistor's silicon dioxide gate dielectric. These new materials reduced the NMOS gate leakage by >25 times and PMOS gate leakage by more than 1000 times, while simultaneously delivering improved drive current and improved circuit performance. For future space shuttle programme in India, hafnium is an important high temperature ceramic material.

4. Silicon Carbide (SiC) Semi-insulating Single Crystal for High Temperature, High Voltage and High Frequency Electronic Device Applications

Silicon carbide (SiC) single crystal, has emerged as the most mature wide band-gap (WBG) semiconductor since the release of commercial 6H SiC (1991) and 4H SiC (1994) bulk substrates, having to superior material properties such as high hardness, high thermal conductivity, chemical inertness and wide band-gap (Eg~ 2.3 to 3.3 eV), high breakdown electric field strength and high saturation drift velocity. Thus SiC single crystal, owing to these unique combination of physico-chemical and electronic properties, is superior in high power applications, as per Johnson's Figure of Merit (about 100 times higher than that of Si or GaAs). Hence, ultapure SiC single crystal is ideally useful for making smaller and tougher power devices such as thyristors, Schottky diodes, MOSFETs, HEMTs and sensors for harsh environment, capable of operating at high temperature (upto 600^{0}C), voltage (1.5 to 10 kV) and in S band (2 - 4 GHz) applications. SiC is also extensively used as a substrate for GaN electronic devices, in addition to its recent use as blue LEDs.

In view of above strategic and commercial uses of SiC in electronic industry, C-MET, Hyderabad, in collaboration with DMRL & SSPL, with sponsorship from DRDO, has undertaken SiC single crystal growth process to develop SiC Single crystal boules required for substrates to be used in GaN technology, as also to cater India's first ever initiative to develop SiC based electronic devices. Process technology demonstrated to grow 6H and 4H SiC Single Crystals. Separate project is likely to be sanctioned for delivering 32 numbers of SiC defect free single crystals in the next 36 months.

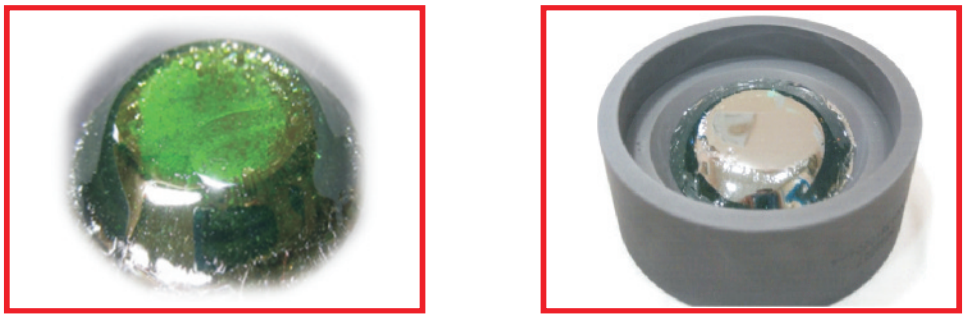


Fig. 4.1 Two inch diameter 6H SiC (L) and 4H SiC (R) single crystals

5. Recovery of Precious Metals from Electronic Waste : Printed Circuit Boards (PCBs)

E-waste comprises of waste generated from used electrical and electronic devices and house-hold appliances which are not fit for their original intended use and are destined for recovery, recycling or disposal with zero environmental hazards. Key factors in the recycling of e-waste are collection, sorting and recovery, recycling and disposal. Even though there are conventional disposal methods for e-waste, these methods have disadvantages from both the economic and environmental viewpoints. As a result, new e-waste management options need to be considered. The electronic recycling has a short history, so there is not yet a solid infrastructure and machinery in place. An entire new economic sector revolves around trading, repairing and regaining materials from redundant electronic devices. It provides a livelihood for the unskilled urban and rural poor, but causes severe risks for humans and the local environment due to environmentally unfriendly and inefficient methods adopted for recovery.

The recycling of waste PCB scraps presents both challenges and opportunities not only to the original equipment manufacturers (OEMs), but also to recyclers.The PCBs constitute to about 10-13% of the total electronic waste by weight.The PCB contains most of the elements found in the periodic table, including precious metals, rare metals, base metals and some toxic elements such as Cr (VI), Pb, Hg, Cd and brominated flame retardants.

Fig. 5.1 Typical process flow diagram of recovery of precious metals from electronic waste

In order to develop the cost-effective environment-friendly solution for e-waste recycling technology, MeitY initiated various R&D initiatives. One such successful initiative was to implement the project entitled "Environmentally Sound Methods for Recovery of Metals from Printed Circuit Boards" jointly by C-MET, Hyderabad and E-parisara, Bengaluru. Under this project, laboratory scale process know-how was developed. Flow sheets for the recovery of various metals were developed. Prior to the commercial exploitation of the processes, technological and economic feasibility have to be ascertained. Hence, a second phase of the project was sanctioned for the establishment of pilot plant operations and demonstration of the efficient processes for the recovery of valuable metals and, also, to extend the facilities for unorganised sector.

6. First Government owned Restriction of Hazardous Substances (RoHS) test Facility : Service to Industry

Restriction of Hazardous Substances (RoHS) impacts the entire electronics industry and many electrical products as well. RoHS directive specifies maximum levels for the following six restricted materials: Lead (Pb): < 1000 ppm, Mercury (Hg): < 1000 ppm, Cadmium (Cd): < 100 ppm, Hexavalent Chromium: (Cr VI) < 1000 ppm, Polybrominated Biphenyls (PBB): < 1000 ppm and Polybrominated Diphenyl Ethers (PBDE): < 1000 ppm.

In order to test the above, C-MET has created an unique RoHS compliant testing facility with the financial support from MeitY. It is NABL accredited laboratory with certificate No. T-1780 in the area of chemical testing. IEC 6231:2008 methods are used predominantly for the analysis in electrical and electronic components. Photographs of some of the instruments used for analysis are shown in Fig. 6.1. C-MET, Hyderabad laboratory has also obtained Laboratory Recognised Scheme (LRS) vide OSL Code No. 613154 for testing of Mercury in Compact Fluorescent lamps, Fluorescent lamps and self ballasted lamps from Bureau of Indian standards (BIS). Mercury was analysed as per IS 15906:2010 method.

Fig.6.1 Important analytical instruments used for RoHS testing

About 18.5 lakh tonnes of E-waste was generated in the year 2015 and is growing with a growth rate of 25 per cent every year. The new rules make the manufacturer responsible to collect E-waste generated out of electrical and electronic equipment and channelise it for recycling or disposal and seek authorization from State Pollution Control Board (SPCB). One way to control this E-waste generation is to control the fresh substances and products entering in to the market containing tolerable toxic substances by implementing an effective RoHS Directive / E-waste management rules 2016 as notified by MoEF & CC, Govt. of India.

C-MET is conducting RoHS awareness program at different parts of the country to educate the Electrical and Electronics Equipment manufacturers. Till now, C-MET has catered to around 120 small scale industries for testing of RoHS elements in their products. C-MET is planning to work with Central Pollution Control Board (CPCB) by providing technical support and training to play a vital role under "Swachh Bharat".

7. Carbon Aerogel and Graphene based Supercapacitors

Recent market surveys on demand potential of Supercapacitors, conducted by ELCINA highlights that demand of supercapacitors would be $8.33 billion by 2025 in the world with CAGR (Cumulative Annual Growth Rate) of 30%, out of which supercapacitors demand for Automobiles and Energy storage sectors would be ~11% and ~30% respectively. In automobile sector, supercapacitors are now widely considered for engine start, assistance for energy recovery at braking, self-start for auto-engines including two-wheelers, etc. electric vehicles (EVx) including mild/full hybrid electric vehicles (HEV), etc., which not only reduce the battery sizes but also enhance battery lives. Apart from automobiles, supercapacitors are also considered for many consumer electronics and home appliances, such as high resolution camera flashes, mobile phones, electronic toys, inverters/UPS, power supplies, machine tools, etc. Use of supercapacitors in solar energy harvesting systems is another upcoming area, where supercapacitor will enable the storage of solar energy produced by solar cells more efficiently.

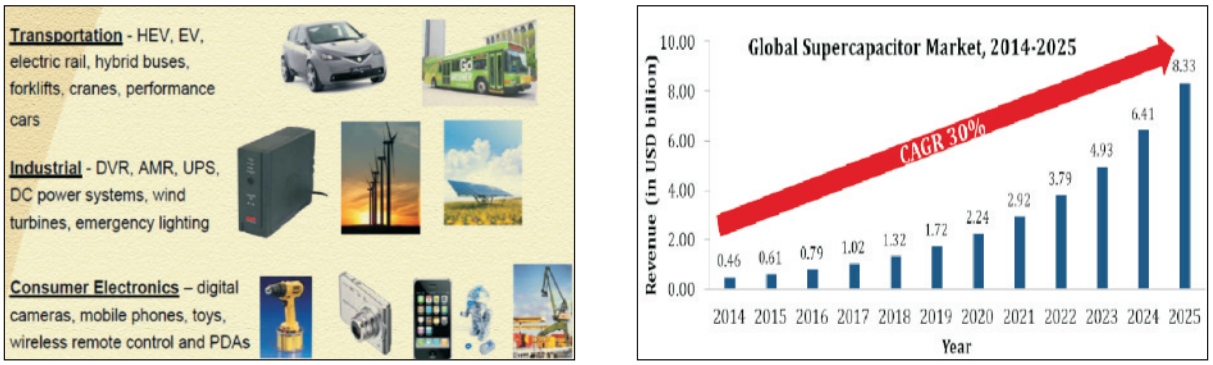


Fig.7.1 Applications and global market demand of supercapacitors

In order to meet the supercapacitors requirement of the country for various applications, development of new & advanced energy storage materials (Aerogels) is one of the important thrust areas of C-MET. Aerogel team of C-MET has developed aerogels suitable for supercapacitor applications, conversion of aerogels into supercapacitor electrode and integration of aerogel electrodes into supercapacitors at pilot plant scale.

The 1st phase of the project, i.e. commissioning of Aerogel Pilot Plant and demonstration of pilot scale production of Aerogel (capacity: 1200 kg/annum) have been completed. Design & Fabrication of other machineries for realising spuercapacitors are being carried out. C-MET, Thrissur has also developed Graphene electrode based supercapacitors.

Fig. 7.2 (a) Photographs of aerogel pilot plant facility and (b) Aerogel based supercapacitors developed at C-MET

8. Development of Indigenous LTCC Tapes

The base for Low Temperature Co-fired Ceramics (LTCC) technology is the glass plus ceramic or glass ceramic based thin flexible tape. C-MET, Pune has pilot plant facility for LTCC technology that relies on starting from imported tape. Realizing the importance of developing indigenous tape for LTCC, currently a project sponsored by C-MET and DST is at an advanced stage. LTCC crystallizable glass plus ceramic system that sinters ~ 850^{0}C has been synthesized.

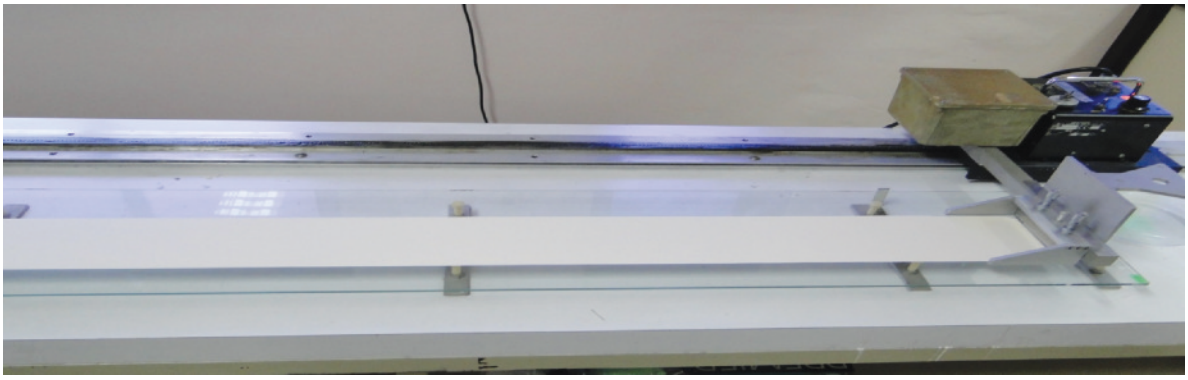
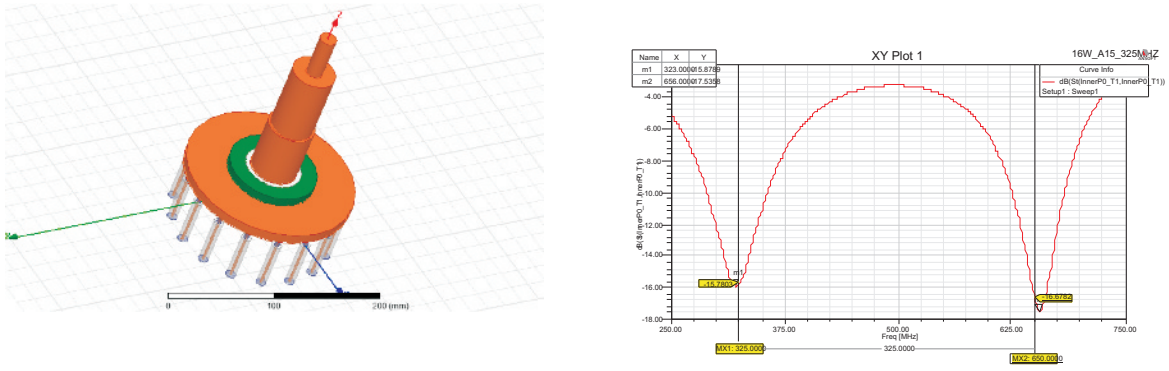


Fig. 8.1 Indigenous LTCC Tapes developed at C-MET, Thrissur

The developed tapes are found to be defect free and having adequate strength and elasticity. The corresponding co-firing metal thick film pastes and pilot plant demonstration of tape casting are envisaged at C-MET, Pune.

9. Development of Indigenous Materials for High Power Microwave and Medical Applications

Based on the successful development of base circuit materials for 270 W solid state amplifier applications, currently C-MET is in the process of realizing microwave circuit boards for 750 W amplifiers. Prototype substrate material for 750 W amplifiers has been successfully developed and the pilot plant production of such novel microwave substrates is being implemented at C-MET, Thrissur. Another remarkable research outcome which finds application in high energy physics is the design and development of novel material systems for dual band linear accelerators by simultaneously using dielectric resonators and cylindrical composite structures. This conceptual idea has been successfully simulated using High Frequency Structure Simulator (HFSS) and implemented in lab scale through dielectric resonator loaded Wilkinson power dividers. The system level evaluation of the dielectric resonator loaded composite structures for power combiner applications is progressing at the user agency viz. RRCAT, Indore. Efforts are also being made to develop biocompatible materials for medical telemetry and hyperthermia applications.



(a) (b)

Fig. 9.1 Simulation results of (a) dielectric resonator loaded composite structures and (b) dual band linear accelerator operating for radial power combiners at 325 and 650 MHz

10. Thermal Sensor Based Monitoring System for the 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. 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. Thermography is a non-invasive, skin surface temperature measurement method for screening of breast cancer; it is economical, fast and do not inflict any pain to the patient.

C-MET has developed a wearable device by using high sensitivity thermal sensors for the early detection and screening of breast cancer. The initial trials were conducted and the results are very promising. This device can be operated with minimum training and is portable and is having low cost. This is a joint project between C-MET, Centre for Development of Advanced Computing (C-DAC) and Malabar Cancer Centre (MCC). Some more R&D work on data acquisition and data transmission devices, reproducibility, repeatability, robustness, etc., are in progress for successful completion of the project.

Fig. 10.1 The wearable device developed by C-MET for screening of breast cancer.

INTRODUCTION to C-MET

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 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.

THE 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.

THE 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.

IMPORTANCE OF 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 over all 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 programs undertaken and carried out during previous plans and current 12th Plan are in accordance with these objectives. Various processes 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

- 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.

- **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 know-how 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.

- To implement projects with output required by industry in immediate future (say up to 5 to 7 years).
  To carry out these activities, basic infrastructure, other facilities and necessary scientific expertise needs to be fully developed especially at pilot plant scale.

- To implement projects which are expected to generate technologies/results which would be commercialized in the period of 5 to 15 years and the products/processes which are required for critical areas covering space, atomic energy, defense, etc. that are essentially small volume high value products.
  In some cases, it may be necessary for C-MET to operate pilot plants or 'Technology Demonstration cum Market Sensitization (TDMS)' units for these products to meet the demand of critical sectors.

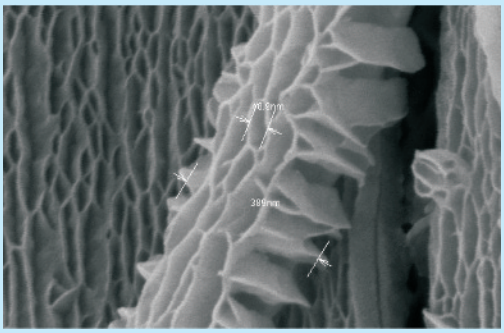
- To develop strong knowledge base

  The technology development activities and pilot plant activities can not be sustained for longer period unless these are backed by internal scientific capability and expertise of required standard. 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 facilities to outside scientists in C-MET. This, in turn, will help in sustaining future activities of C-MET, as also, to achieve the objective of becoming the 'Centre of Excellence'. Moreover, development of strong knowledge base in specialized arena of electronic materials (Gen-next thick film paste for cell phones, materials for renewable energy, E-waste, RoHS, etc) is also essential from the standpoint of Knowledge Process Outsourcing as a global phenomenon.

C-MET'S LABORATORIES AND CORE COMPETENCE

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 Nano-materials / composites



Honey comb like MoS_2 nanostructures

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

E-beam refined Hafnium (Hf) from Hf sponge

- **Thrissur Laboratory**
  Microwave Dielectrics, Multilayer Ceramics, Actuators and Sensors, Nanomaterials and Thin Films

Spray deposited Kesterite thin film

C-MET ORGANIZATION STRUCTURE

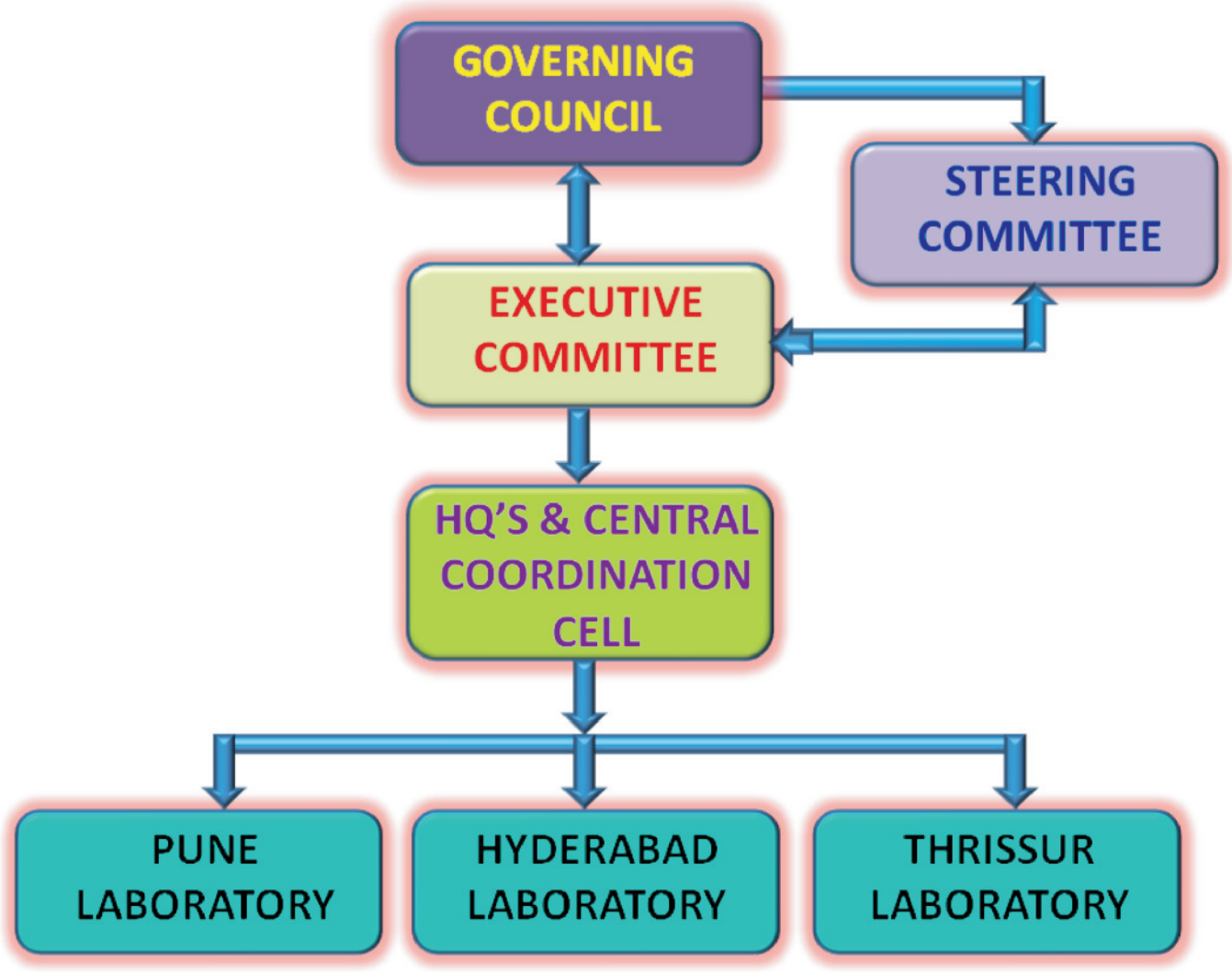


Figure 1 : Organization Chart of C-MET

HUMAN RESOURCE INDICATORS

C-MET team consists of 39 S&T officers, 34 S&T personnel and 35 administrative staff. Among S & T staff, 37 personnel are having Ph. D. degree. Additionally, there are more than 116 Project staff / Ph.D. students working at three laboratories of C-MET.

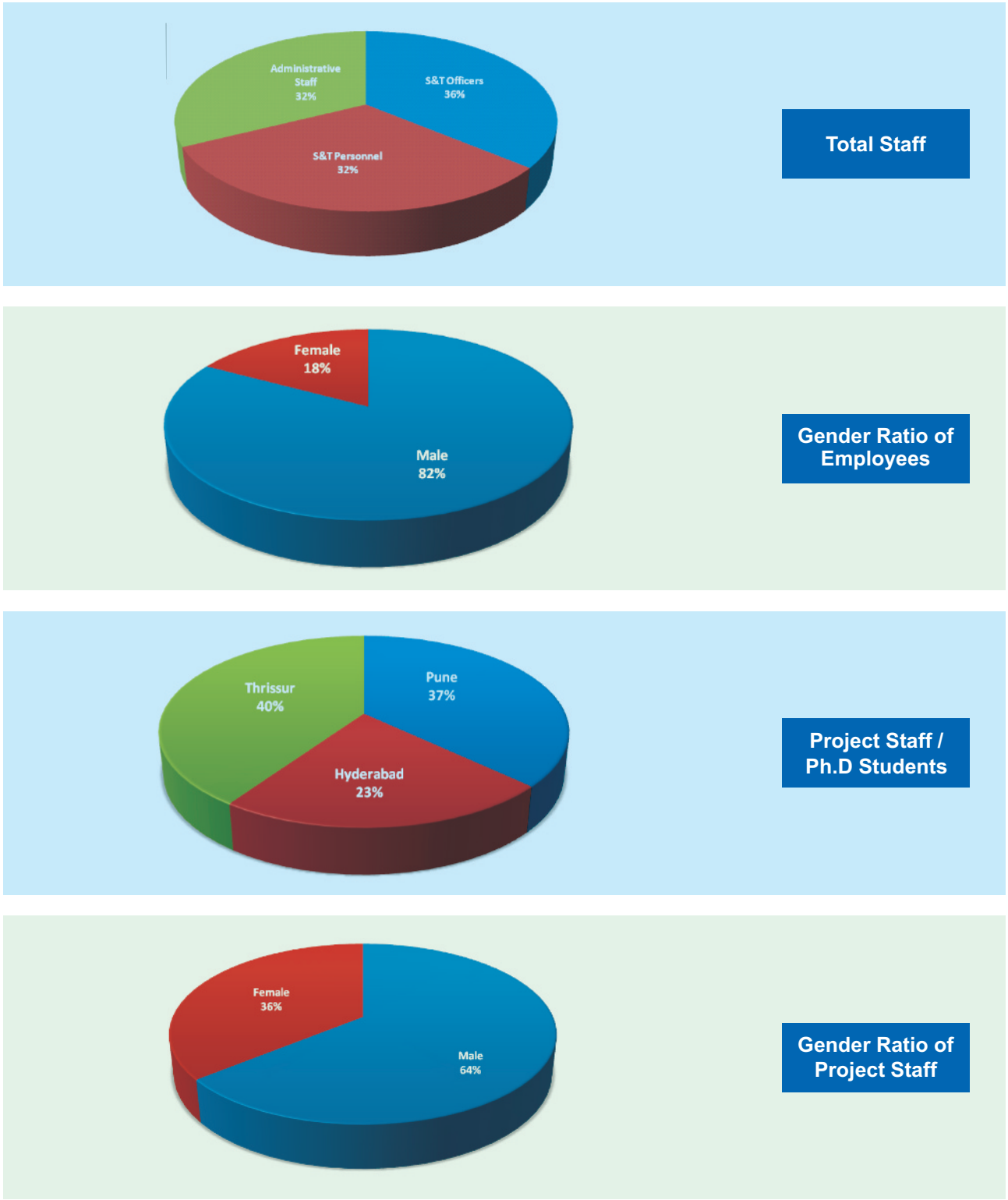


Figure 2 : Human Resource Indicators of C-MET

TECHNICAL ACTIVITIES & PROGRESS DURING 2015-16

During the year 2015-2016, 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, DRDO, DAE, etc.
- Technical services
- Materials characterization services

Core Program :

It was proposed to have a 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 integration.

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

No.	Core Program	Selection Criteria	Broad Objectives
1	Integrated Electronics Packaging	LTCC is the logical extension of Thick film materials research already being done at C-MET and this is the only LTCC facility in the country	• Development of process at prototype level indigenous materials, circuits and devices in Low temperature co-fired ceramic (LTCC) and support strategic sector. • Indigenous development of LTCC materials and tape.
2	Nano-materials and Devices	• Development of Transparent Conducting Oxide based Plasmonic materials and devices. • Synthesis of nanomaterials by plasma. • Nanomaterials for conventional and optical sensors • Nanostructures for solar hydrogen production, solar cells, fuel cells and thermoelectric cells	• To develop 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.
3	Ultra High Purity Materials & Compound Semiconductors	Ultra high pure materials & compound semiconductor crystals / substrates are basic building blocks for strategic, high frequency, high temperature with standing electronic devices	• Development of process technologies for ultra high pure materials such as hafnium, cadmium, selenium, germanium, etc. for strategic device applications. • Development of critical compound semiconductor single crystals for strategic device applications
4	Materials for Renewable Energy	• Import substitution to meet Renewable energy input material requirements. • Solar hydrogen production	• Develop process technology and supply of materials for solar energy and other renewal energy industries.

No.	Core Program	Selection Criteria	Broad Objectives
		by semiconductors • Materials for Li ion rechargeable battery • Solar cell material and devices • Thermoelectric materials and devices	• Develop semiconductor nanostructures for photocatalytic H_2 generation by water and H_2S splitting • Develop nanoscale cathode, anode and allied materials for different battery applications • Develop materials and fabrication of solar cells
5	Piezo-sensors and Actuators	Sensors/Actuators: Known piezo ceramics show strain ~0.1%. Single crystals will show ~1 %. However difficult to grow and highly expensive. Hence need for textured ceramics that show better properties at affordable cost	• Actuators: (a) To grow seed crystals of perovskite structure (b) Textured piezo ceramic through tape casting
6	Electronic Waste and RoHS	The hazardous toxic substances have become menace in India threatening environment and human existence. Hence safe recycling and testing as per rules is necessary.	• E-waste : Development of pilot plant technology for environmentally safe recycling of E-waste and extraction and recovery of precious metals • ROHS : Characterization of electronic and other materials and products as per NABL requirements and certification of the products for reducing toxicity in waste electrical and electronics equipments and products.

A brief description of various activities being undertaken at C-MET with respect to the above core programs is provided below :

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 8 new grant-in-aid projects and technical services projects during the year.

C-MET earned an external funding (IEBR) to the tune of Rs. 2702.14 lakhs during the year 2015-16. The unit wise sponsored project funding pattern is depicted in Figure 3.

SPONSORED PROJECTS 2015-2016

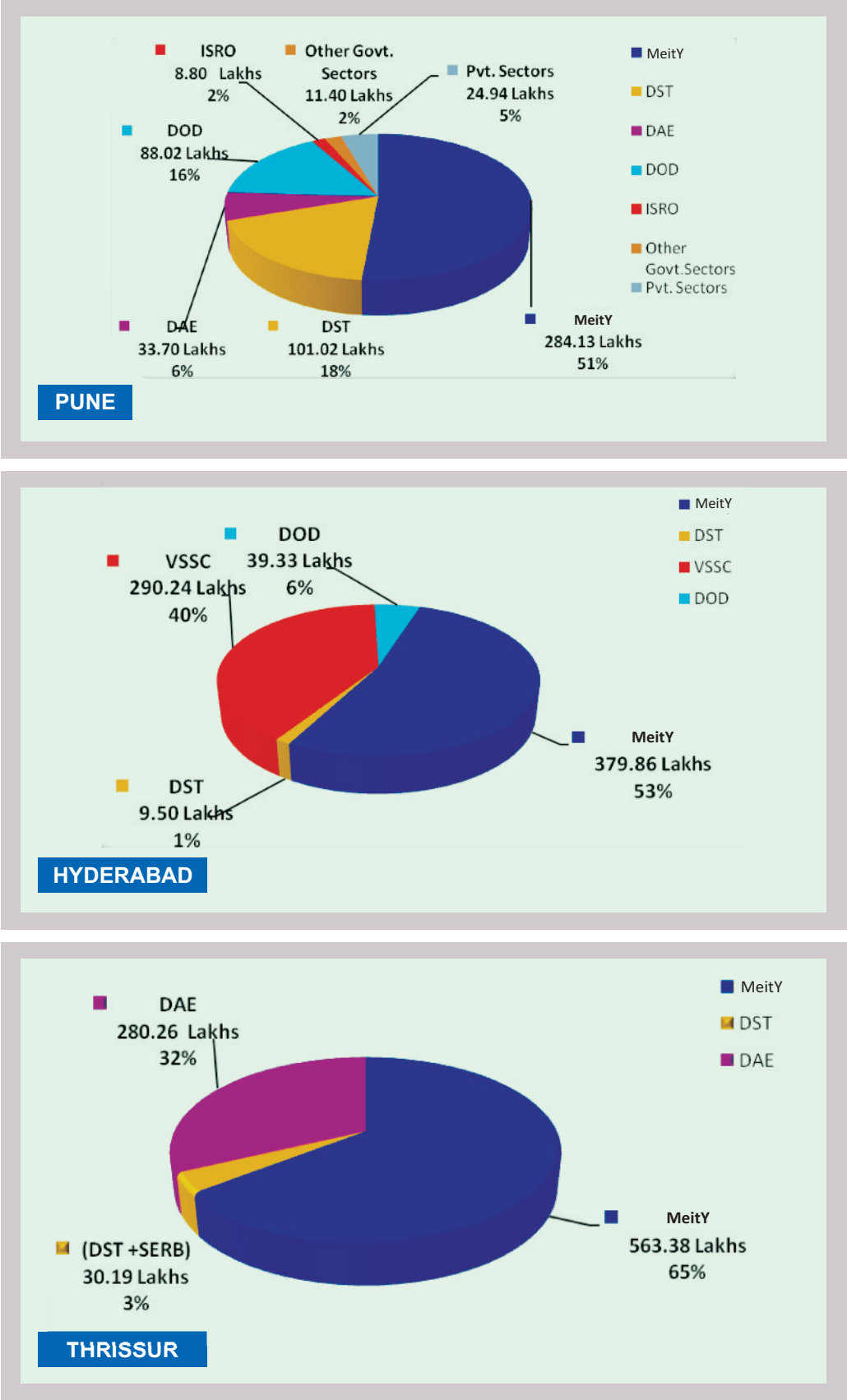


Figure 3 : Sponsored Projects at C-MET Pune, Hyderabad and Thrissur

The growth in IEBR is graphically shown in Figure 4

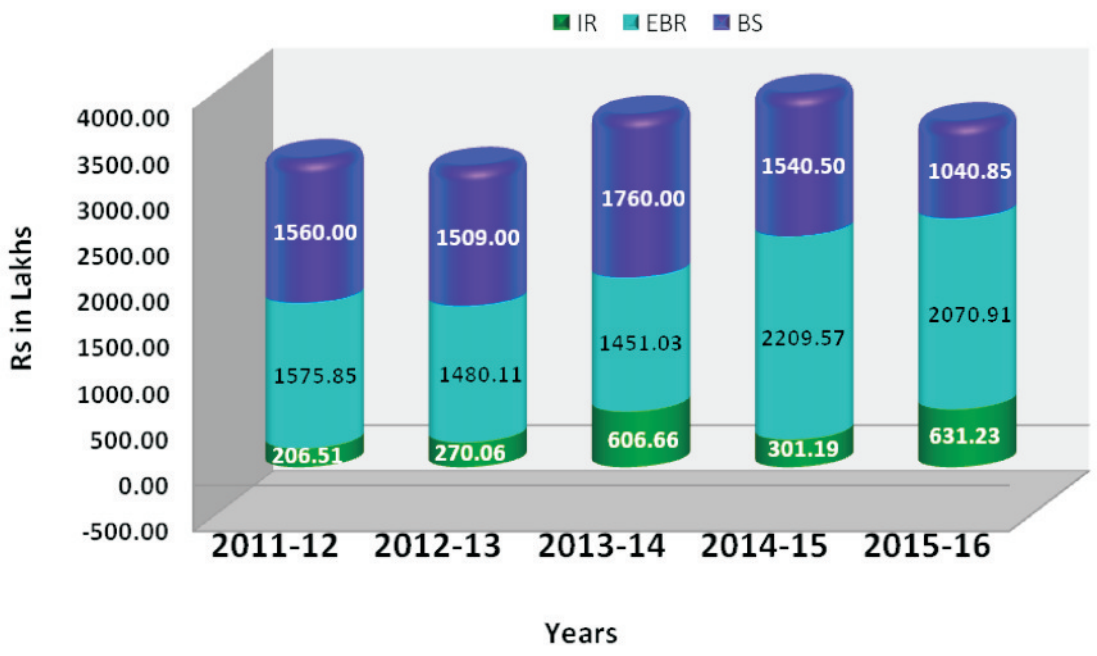


Figure 4 : External Funding (IEBR) of C-MET since 2011-2012

C-MET has also been enhancing its intellectual output in terms of publications, conference papers, Indian and foreign patents and invited talks as seen in Figure 5 and Figure 6. The trend clearly evidences better scientific recognition of the R&D capability of C-MET scientists.

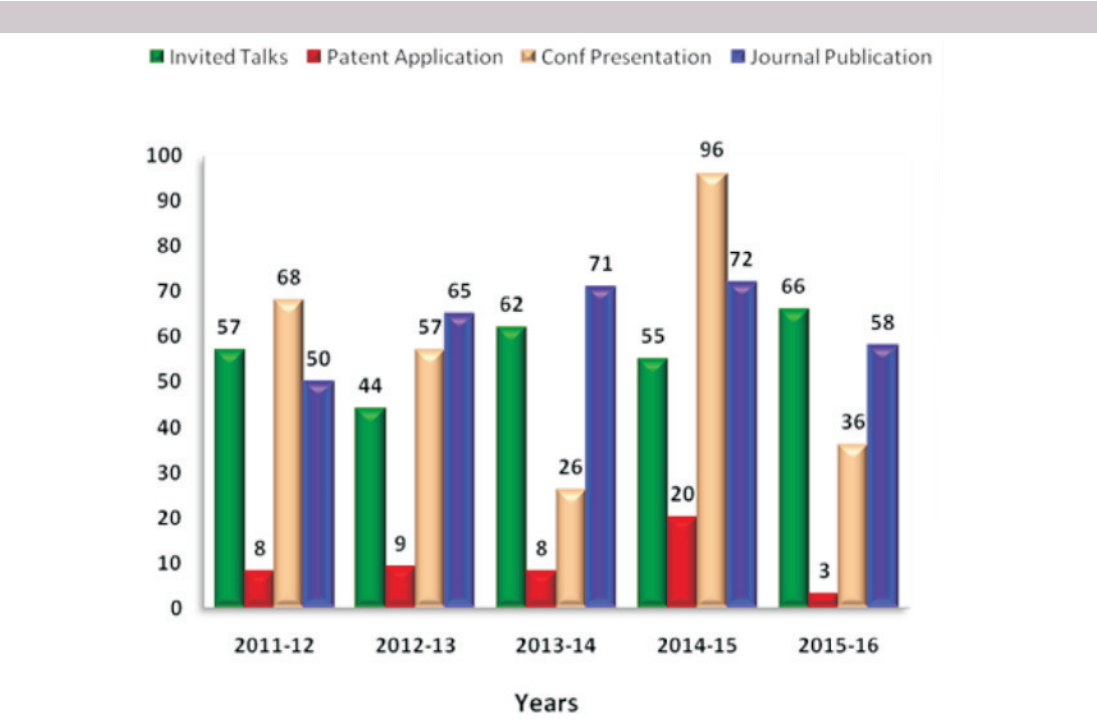


Figure 5 : Intellectual Output of C-MET since 2011-2012

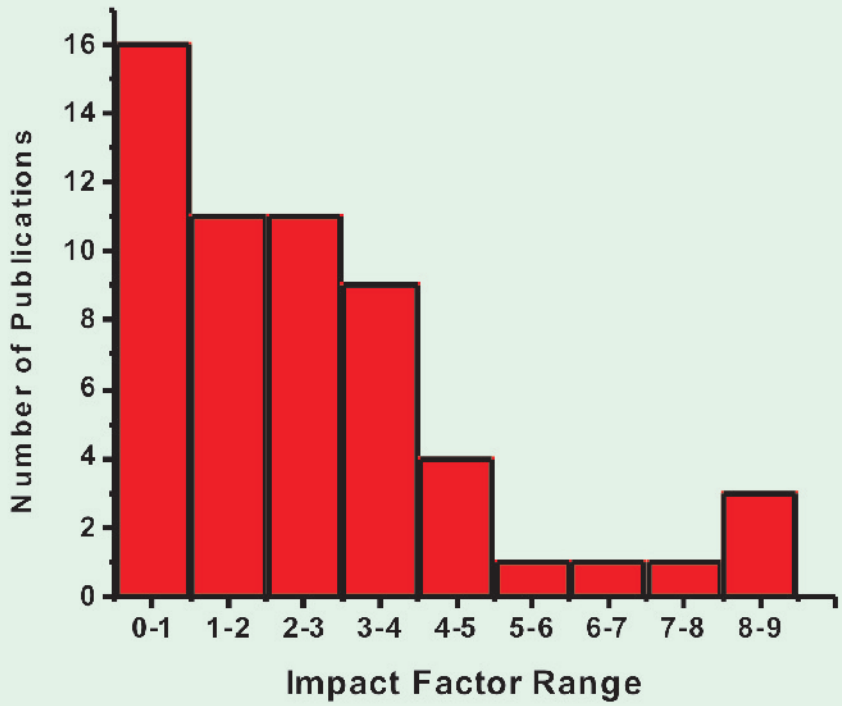


Figure 6 : Publications in Peer-reviewed Journals with Impact Factors

Materials Characterization Services

The expertise and infrastructure developed at C-MET during the previous years, were effectively utilized by providing materials characterization services to outside organizations which included private industries, R&D institutes, strategic sectors and others. C-MET generated internal revenue of Rs. 10.17 lakhs from materials characterization services and rendering RoHS & allied services.

LABORATORYWISE TECHNICAL PROGRESS DURING 2015-16

A) Core projects

The consolidated progress in respect of core projects is furnished below:

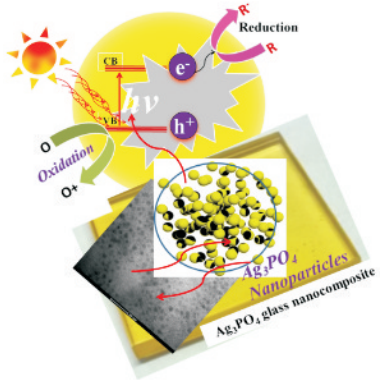
No.	Title of the Project	Funding Agency	Total Outlay ₹ (Lakhs)	Achievements for 2015-2016
	C-MET, Pune			
1	To develop CNT based composite lead-free solders for bumping applications	MeitY	62.00	• Lead- free co-deposition bath with metallized CNTs dispersed in the electrolyte was developed • Electrodeposition of composite films carried out. • Characterization of films are being carried out.
2	WS_2-glass nanocomposite for gamma ray shielding	MeitY	60.00	• Procurement of capital Equipments has been initiated. • Optimization of the host glass is completed. • Characterization of host glass is completed. • Optimization of WS_2 - glass nanocomposite is in progress.
3	Synthesis of transition metal doped hollow glass microspheres for hydrogen storage applications	MeitY	53.00	• Optimized the synthesis of Ta_2O_5 nanorods. • Silica based xerogels were successfully synthesized. The parameters were also optimized for gram scale synthesis of xerogels.
4	Development of aluminum (Al), alumina (Al_2O_3) and copper (Cu) mono-dispersed nanopowders by using transferred arc thermal plasma reactor (TAPR) with plasma emission spectroscopy	MeitY	60.00	• Copper and copper oxide nanopowders were synthesized under different reaction conditions • Feasibility study was performed to synthesize nano iron powder by TAPR technique • Process conditions were optimized for the synthesis of copper nanopowders at 250 g/hr scale
	C-MET, Hyderabad			
5	Studies on the recovery of cobalt from spent Li ion batteries	MeitY	98.00	• Characterization of various types of Li ion batteries completed. • Cobalt dissolution and precipitation experiments completed.
6	Establishment of silicon carbide (SiC) single crystals wafer process technology for electronic devices application	MeitY	638.65	• Specifications finalized for wire saw cutting machine for cutting SiC single crystal boule.

No.	Title of the Project	Funding Agency	Total Outlay ₹ (Lakhs)	Achievements for 2015-2016
7	Process development for the extraction of rare earth oxides (yttrium, europium & terbium) from the spent fluorescent lamps	MeitY	54.72	• Experiments conducted and separated mixed rare earth oxides from phosphor powders.
8	Design and fabrication of indigenous induction zone refiner for purification of "Ge".	MeitY	160.00	• Specifications finalized for inductive zone refining system.
	C-MET, Thrissur			
9	Development of NTC thermistors for radiosonde & meteorological Balloon application	MeitY	64.62	• NTC chip thermistors which can be used in the temperature range of -85^{0}C to 50^{0}C were developed.
10	Magneto-dielectric substrates for miniaturised antenna application	MeitY	91.31	• Prepared phase pure CoW type hexaferrite ($BaCo_2Fe_{16}O_{27}$) though solid state ceramic route through multiple calcination. • Prepared Zn substituted analogue of W-type hexaferrite ($Ba(Zn_xCo_{1-x})_2Fe_{16}O_{27}$) for enhanced permeability. • Prepared MD substrates by dispersing the filler in PP and PEEK matrices. The MD substrate can be used for miniaturising RF circuits.
11	Development of thin film waveguides for optical amplification applications	MeitY	167.00	• Highly transparent, uniform ferroelectric thin films based on $(Ba_{1-x}Sr_x)TiO_3$ have been prepared having good contrast in refractive indices.
12	Development of transparent conducting oxide based plasmonic materials and devices	MeitY	109.24	• Transparent conducting oxide thin films were prepared by spin coating. Real and imaginary parts of dielectric constant were extracted from spectroscopic ellipsometer and infrared reflectance spectra. Negative values were observed in the near IR region for the real part of the dielectric constant, from the wavelength 1649.49 nm

B) Sponsored Projects

i) Completed Grant-in-Aid Projects :

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

No.	Title of the Project	Funding Agency	Total Outlay ₹ (Lakhs)	Achievements for 2015-2016
	C-MET, Pune			
1	Novel solar light driven bismuth sulphide quantum dot-glass nanocomposite photocatalyst for hydrogen generation.	DST	25.76	• Optimization of hydrogen generation process and generation of hydrogen gas using optimized conditions is completed • Project Completion Report is submitted to DST, New Delhi.
2	Development of the prototype photoreactor for the hydrogen production from H_2S Under natural sunlight	MNRE	22.40	• The prototype photoreactor has been developed successfully. • Trials of hydrogen production from H_2S under natural sunlight have been completed. • Project Completion Report prepared and submitted to MNRE.  **Ag_3PO_4 nanoparticles in glass nanocomposite photocatalyst for H_2 production from waste H_2S**
3	In-house development of photo-conducting paste (using semiconductor nanostructures) for exploration in photo patternable thick film technology for advanced optoelectronic applications	MeitY	90.00	• Detailed technology document and product cost calculation in respect of photopatternable paste and photosensor completed. • Following two prototypes were developed and demonstrated in the laboratory- a) Automatic car light dimmer b) High speed digital objects counter. • Transfer of Technology (ToT) work is in progress.

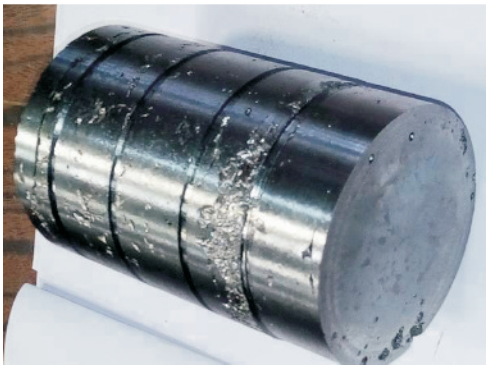
No.	Title of the Project	Funding Agency	Total Outlay ₹ (Lakhs)	Achievements for 2015-2016
	C-MET, Hyderabad			
4	Development of CdS/CdTe thin film solar cells by electrochemical technique using indigenously produced starting materials	DST	68.20	Project successfully completed in collaboration with IIEST, Shibpur, Kolkatta.
	C-MET, Thrissur			
5	Development of graphene based transparent electrodes for thin film acoustic actuators and sensors	BRNS	20.15	• Graphene- PVDF thin film acoustic actuators and sensors were developed. • Demonstrated PVDF- graphene thin film transducers as thin film speakers and microphones
6	Development of low loss and medium permittivity composite dielectrics for radial power combiners	BRNS	42.80	• Delivered 25 number of miniaturized composite dielectric structures for radial power combiner • Carried out system level evaluation at user agency (RRCAT, Indore) and found that the return loss is 2dB which is better than commercially available ones. • Dual band dielectric resonator loaded radial combiner design is successfully designed in HFSS.
7	Development of nanostructured titania photoanode for dye sensitised solar cell applications	DST-SERB	10.79	• Different nanostructures such as titania nanotube, rod sheet are prepared through hydrothermal method and used for DSSC applications. • The efficiency of DSSC achieved so far is in the range of 4-5%

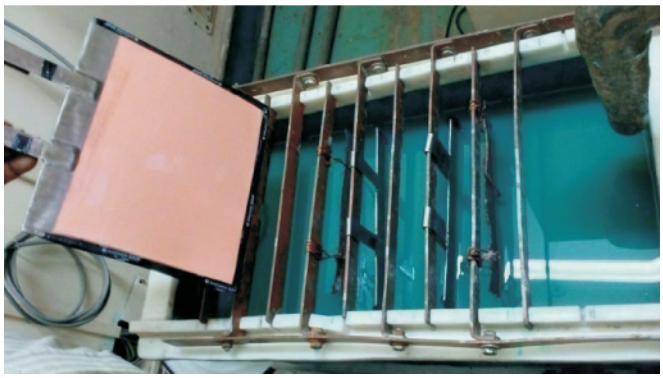
ii) On-going Grant-in-Aid Projects:

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

No.	Title of the Project	Funding Agency	Total Outlay ₹ (Lakhs)	Achievements for 2015-2016
	C-MET, Pune			
1	Development of LTCC materials for general purpose applications	DST & C-MET	441.568	• Developed screen printable Ag and Ag-Pd pastes compatible with C-MET and imported LTCC tapes at intermediate scale. • Developed Ag and Ag-Pd based via filling pastes compatible with C-MET and imported tapes at intermediate scale.
2	Development of magnetic coil based induction sensors	BARC	127.00	• Designed and fabricated the Mark-I sensor in consultation with BARC. • Handed over 10 such sensors to BARC and the sensors have passed all the inward qualification tests.
3	Prototype development of fuel cell using nano functional materials	MeitY	31.68	• Synthesis of Pt and Pt-Ni nanoparticles in 9:1, 8:2 and 7:3 ratios is completed. • Characterization of prepared samples is completed and sent to NIT, Warangal for further analysis. • As per NIT, Warangal report, required amount of Pt-Ni (7:3) is synthesized and characterized. • Carbon-Pt/Ni composite has been synthesized.
4	Development of visible light active titanium oxynitride and tantalum oxynitride photo catalysts for H_2O Splitting	DRDO	44.03	• A sol-gel method for the preparation of TiON at 10 gm batch level has been developed. • The characterization equipment Gas Chromatograph has been procured and installed. • The photo-reactor set-up for H_2O splitting has been developed and installed in laboratory.
5	Development of active materials (cathode and anode) for high energy density lithium-ion cell/ battery with fabrication of prototype cell	MeitY	498.05	• Trials were performed for the scaling up (500gm) of $LiCoO_2$ using Spray dryer. • Optimization of parameters such as concentrations of precursors, temperature and flow rate for 500gm batch was completed. • Trials were performed for the Scaling up of $LiFePO_4$ by solvothermal method (up to 15 gm). • Trials were also performed for the synthesis of $LiFePO_4$/carbon and $LiFePO_4$/graphene composites for reducing the resistance and improving the electrochemical performance. • Prepared the electrodes of the synthesized samples using Active material: Carbon black: Kynar binder (80:10:10) in NMP (N-Methyl-2-pyrollidone) on carbon paper and performed electrochemical characterization using aqueous electrolyte at different

No.	Title of the Project	Funding Agency	Total Outlay ₹ (Lakhs)	Achievements for 2015-2016
				scan rates using the electrochemical work station. • Patent on SHC as anode material is submitted to patent cell at MeitY, New Delhi.
6	Development of nano-structured PdTe powder for thermoelectric application	BRNS	19.00	• As suggested by funding agency, PbTe and Bi_2Te_3 were synthesized by hydrothermal route at 10 gm batch level with the help of optimized reaction parameters. • PVP, PEG and CTAB were used as capping agents in various concentrations. • Synthesized materials were tested for their phase purity by XRD and found that XRD are well matching with the standard peaks. • Further physico-chemical characterization like FESEM, TEM etc. is in progress.
7	Efficient waste water treatment using novel catalyst	INDO-UKIERI, (DST)	4.91	• N-ZnO and N-ZnO/graphene samples have been synthesized and characterized. • Two optimized samples with and without graphene have been sent to University College London (UCL), London, UK for waste water purification testing.
	C-MET, Hyderabad			
8	Establishment of extended pilot plat facility at C-MET Hyderabad for preparation of 320 kg hafnium sponge	VSSC	2591.14	• Indian Chemical council Award for Excellence in Chemical Plant Design and Engineering Presented to VSSC for Establishment of Hafnium Plant in association with C-MET, Hyderabad. • 35 kgs of hafnium sponge shredded to small pieces for EB refining. 16 kg material handed over to MIDHANI and 14.5 kg is ready for transfer. EB refined hafnium is meeting VSSC specifications. • Effluent Treatment Plant commissioned, 1000 kg of sodium nitrate prepared. • 156 kg hafnium oxide prepared. • Hafnium process technology demonstrated to quality control team of VSSC. • 87 kg hafnium oxide-coke briquettes prepared. • Three chlorination demonstration trails conducted and prepared 72 kg of hafnium tetrachloride. • Four demonstration trials conducted for Kroll reduction and distillation and prepared 16 kg of hafnium sponge. • Designed and fabricated a new cooling system for chlorination setup.

No.	Title of the Project	Funding Agency	*Total Outlay* ₹ *(Lakhs)*	Achievements for 2015-2016
				 **Electron Beam Refined Hafnium from Hf Sponge**
9	Purification of germanium	DST	23.90	• Specifications finalized for inductive zone refining system. • Purification experiments on germanium were optimized.
10	Sustainability and up -gradation of Government owned Restricting of Hazardous Substances (RoHS) test laboratory	MeitY	322.22	• Analysed more than 1000 samples for RoHS elements and other trace impurity analysis received from various parts of India. • Microwave Digestion System (MDS) procured from M/s Milestones and installed; SOPs prepared for operation and maintenance as per NABL norms. • Rs. 10.10 lakhs earned as revenue has been generated by extending the characterization services. • Received recognition from BIS under Laboratory Recognition Scheme (LRS) for testing Mercury (Hg) in CFLs using IS15906 method with Licence no: 6131514. • Two advtisements on RoHS testing facility were published in ELCINA and CEAMA magazines. • Application sent to NABL Secretariat for renewal of NABL accreditation which is expiring on June 26, 2016. • The sixth meeting on RoHS awareness was conducted on April 17, 2015 at CII, Ahmedabad where 65 industry representatives benefitted.
11	Synthesis and photocatalytic activity of bulk and nano sized metal titanates	DST-SERB	31.15	• GC-TCD procured from M/s. Thermo Fisher Pvt. Ltd. • The R & D work on tellurites is communicated. • The R & D work on metal titanates and water splitting is in progress.

No.	Title of the Project	Funding Agency	Total Outlay ₹ (Lakhs)	Achievement for 2015-2016
12	Design & development of System for Preparation of GaN	DST	67.88	• Crystal growth system designs finalized for GaN growth. • Mixing and homogenization experiment [Ga, Na, NaN(3)] completed - XRD & ICPMS analysis are in progress.
13	Environmentally sound methods for recovery of metals from PCB- Phase II	MeitY	1127.00	• Nearly 500 Kg of raw material in the form of shredded PCB's has been procured through various sources. • Carried out 8 batches of experiments during the period that include pyrolysis, smelting, electrolysis, anode mud processing and recovery of gold and silver • Flux compositions, temperature, crucible composition were optimised for smelting operations and produced ~10 kg of copper. • Copper anode bars were electro refined to separate gold, silver and palladium. ~ 5 kg pure copper prepared. • Extracted few grams of Gold and Silver through hydrometallurgical route. • A novel approach based on pyro-metallurgy is being developed to reduce the liquid effluents for anode mud. • Fire assay and electro-gravimetry experiments conducted for estimation of precious metals and purity of copper, respectively. • Four major equipments namely, ED-XRF, 1000A Rectifier, Microwave Digestion and Fire Assay System were procured, installed and commissioned. • Architectural and structural drawings prepared and budgetary offer obtained from fabricators for Mechanical Shed. The Preliminary Estimate (PE) for revised plan sought from BSNL and CPWD. PE received from BSNL and MoU would be signed soon.  **Electro-Refining Setup for the recovery of Copper from E-Waste**

No.	Title of the Project	Funding Agency	Total Outlay ₹ (Lakhs)	Achievement for 2015-2016
	C-MET, Thrissur			
14	Development & setting-up of pilot scale production of aerogel supercapacitors for electronic applications	MeitY & DST	2210.66	• Created infrastructure for commissioning Aerogel Production Pilot Plant & other machineries • Fabricated New Aerogel Production Pilot Plant and successfully commissioned Plant for operation • Produced several batches of organic aerogel in 8-10 kg/batch and the properties were found to have suitable for supercapacitor electrodes.
15	Development of graphene based transparent electrodes for thin film acoustic actuators and sensors	BRNS	20.15	• Graphene- PVDF thin film acoustic actuators and sensors were developed. • Demonstrated PVDF- graphene thin film transducers as thin film speakers and microphones
16	Development of graphene super capacitors for power electronics	MeitY	75.72	• Developed graphene supercapacitors having capacitance in the range of 1- 70 F • Graphene supercapacitors showed higher energy and power densities • Plant lay out for the synthesis of graphene for super capacitors was designed.
17	Development of thermal sensor based monitoring system for early detection & screening of breast cancer	MeitY	139.25	• Using highly accurate NTC thermistor probes, wearable devices for the early detection and screening of breast cancer were developed. • Initial clinical trials using these wearable devices showed promising results
18	Development of titania aerogel photo anode for dye sensitized solar cell application	DST	44.50	• Developed photo-anodes for dye sensitized solar cell using nanocrystalline porous titania aerogel having surface area of 150-250 m^2/g. • Fabricated DSSC test cell using titania aerogel photo-anodes and achieved current conversion efficiency in the range of 4-5 %.
19	Development of thin film solar cell with earth-abundant kesterite absorber	DST	45.83	• Developed phase pure kesterite (CZTS) thin film absorber from earth abundant materials through spin/dip coating and spray techniques that meets all the properties, required for photovoltaic. • The films (thickness ~1.5 μm) exhibited band gap of ~1.5eV with absorption coefficient of $>10^4 cm^{-1}$ and hole conc. of $\sim 10^{18}/cm^3$. • Coating of Al doped ZnO films on CdS/ CZTS/ Mo/ Soda lime glass device structure by solution process for fabricating solar cell is under progress.

No.	Title of the Project	Funding Agency	Total Outlay ₹ (Lakhs)	Achievement for 2015-2016
20	Development of LTCC Material for general purpose applications	DST	36.629	• LTCC tape composition at lab level optimized. • Various batches of 7" x 7" tapes were made and sent to C-MET Pune for testing and evaluation. • Three C-MET (Pune) staffs were trained on Tape Casting.
21	Development of transition metal doped TiO_2 nanomaterials for photo-catalytic H_2 generation by water splitting	BRNS	23.90	• Prepared nano-sized TiO_2 and Fe, Co, Ni and Cu (0.001, 0.01 and 0.1 M) doped TiO_2 and they were characterized • Photosensitive activities of as-prepared materials were tested towards the degradation of methylene blue by using immersion type photo-reactor. • UV-spectroscopic analyses confirm the high activity of materials under visible irradiation. Testing and optimization of water splitting reaction parameters is in progress.
22	Al internal electrode based ultra low temperature co-fired ceramics (ultra-LTCC) for microwave electronic packaging applications	BRNS	24.56	• Synthesized barium vanadate based single phase composition and up-scaling of the batch size is in progress. • As an alternative system, synthesized Single phase Bi-Mo-O system that sinters at ~600^0 C. • Dielectric properties were measured in MHz and Microwave region. • Optimization of higher batch size, based on Bi-M-O composition is being carried out.
23	Development, production and supply of microwave substrates for 750 W solid state amplifiers	BRNS	196.00	• Developed ultra low loss microwave substrates having ε_r=3.5 and tan δ=0.0018 at 10 GHz for 750 W solid state amplifier design. • Produced 100 number of copper cladded substrates through SMECH process meeting all targeted specifications for delivery to user agency.

iii) Newly Initiated Grant-In-Aid Projects During 2015-16

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

No.	Title of the Project	Funding Agency	Total Outlay ₹ (Lakhs)	Achievement for 2015-2016
	Pune			
1	Development of pressure sensors in LTCC	M/s Eaton Technol-ogies	35.83	• Fabricated non-contact pressure sensors based on LC and optical methods • Submitted the first version to the sponsoror for testing
2	Synthesis and characterization of conducting polymer/ nanostructured WO_3 hybrid for low temperature NOx detection	ISRO	14.41	• Hirarchical WO_3 samples have been synthesized by hydrothermal method using variety of capping agents. • Various polymers such as polyaniline, polypyrole, polythiophene were synthesized. • The composites of WO_3 with various polymers have been prepared. • The samples were characterized using characterization techniques like UV-Visible, XRD, FESEM, Particle size distribution analysis etc. • Initial trials for gas sensing were conducted on the WO_3 samples with various gases and organic vapours such as NOx, LPG, ammonia, acetone, ethanol and methanol
3	Proof of concept development of photo patternable thick film thermistor composite materials for temperature sensor applications	ARDB, DRDO	64.62 Lacs	• Literature review on synthesis of ferrite and TiO_2 is completed. • Experimental work on synthesis of $CuFe_2O_4$ using co-precipitation method are done. • A mask designed and fabricated.
	Hyderabad			
4	Development of ultra purification process for high scale production of 7N grade Te & Cd	SSPL, DRDO	76.93	• Design of the heater for accommodating bigger quartz tube finalized and one heater fabricated. Initiated trial runs. • Zone refining experiments using existing zone refiners (02 No's) on Te & Cd being carried out. Two batches of experiments completed. • The high pure material analysed using ICP MS for elemental impurities. An analytical method established to determine crucial impurity 'Se' at ppb level. All other impurities are below detection limits.
5	Ru(II) & Ir (III) polypyridine dyads complexes with long lived IL excited state as	DST	37.00	• Project initiated. • Synthesis of Ru(II) & Ir (III) based complexes started.

No.	Title of the Project	Funding Agency	Total Outlay ₹ (Lakhs)	Achievement for 2015-2016
	photosensitizer for visible switches, photocatalytic applications			
6	Silicon carbide (SiC) single crystal bulk growth process development	DMRL (DRDO)	998.74	• Project sanctioned on 1st October 2015. • Draft MoU submitted to DRDO for signing between C-MET & DMRL for release of funds.
	Thrissur			
7	Design & development of power-packs with aerogel supercapacitors & fractional order modelling	BRNS	190.61	• Prepared supercapacitor electrode materials from hydrogels by drying gels under ambient conditions followed by carbonization. • Evaluated crystal structure and surface properties of as-prepared materials that showed surface area of ~300 m^2/g, which increased to 620 m^2/g upon chemical treatment.
8	Textured PMN-PT based piezo ceramics	DST	31.13	• Project initiated. • Formation of oriented S3T7 is attempted through molten salt synthesis.

IMPORTANT EVENTS

The 6th - RoHS Awareness Industry Meet

The 6th - RoHS awareness Industry meet was held at Ahmedabad, in collaboration with CII, Ahmedabad chapter on 17th April 2015. One of the objectives of the RoHS project is to educate the Indian Industries on RoHS Directive to implement it strictly and also to improve the revenue generation for sustenance. About 65 participants from industry, academics and R & D have attended.

Fig. 1 The 6th - RoHS awareness Industry Meet at CII, Ahmedabad

National Technology Day Celebration 2015

C-MET Thrissur laboratory celebrated the National Technology day 2015 on 11th May, 2015. Shri Anantha Narayanan, Distinguished Scientist and Former Director, NPOL (DRDO), Kochi delivered the Technology Day Lecture on '*Experiments in empowering industries using indigenous technology – an NPOL experience'.* In his talk, he described how NPOL, a defence R&D lab in Kerala has leveraged technologies developed by it for facilitating the transition of some industries from loss making ones to profit making. He also emphasized the need of centrally funded R&D units to develop strategies to handhold state funded industries through development and transfer of technology leading to overall growth of the state. Several researchers, scientists/faculties and local industry personal also visited C-MET during the NTD celebration. They witnessed the products developed by C-MET scientists and had close interaction with respective C-MET scientists. C-MET was opened to public on that day to exhibit the cutting edge technologies/products developed here.

National Workshop on Supercapacitors 2015

One-day National Workshop on Supercapacitors (NWS 2015) was conducted at Centre for Materials for Electronics Technology (C-MET), Thrissur on 9th October 2015. The workshop highlighted the insights on Supercapacitors, the areas of its existing & potential applications, Supercapacitor materials and their utilization for supercapacitors, their manufacturing processes, technology of making supercapacitor electrodes and supercapacitors from different materials etc.

Fig. 2 Inaugural function of the National Workshop on Supercapacitors (NWS 2015)

Dr. Debashis Dutta, Group Coordinator, DeitY inaugurated the workshop and appreciated C-MET in organizing this workshop having high relevance to the country that focused storage and utilization of energy. He mentioned that MeitY is keen to see the involvement of Indian industries, especially the manufacturing sectors towards the Make in India Program and this workshop will be making the bonding between the research institutions and industries stronger. Padmabhushan Professor V K Aatre (Former Scientific advisor to Raksha Mantri), Shri P Sudhakar (CMD, ECIL, Hyderabad) and Shri Arun Sachdeva (Sr. Director, MeitY), Dr. Rajeev Sharma (Member Secretary, DST) presided over the function. More that 200 delegates including industrialists, scientists, academicians, researchers and media personnel from various parts of the country participated in this workshop. Prof. Aatre delivered the keynote address and he highlighted the R&D efforts of the country including C-MET on efficient energy production/storage systems. He emphasized the Govt's initiatives on suitable program in this area and encouraged industries to come forward towards effective fulfilment of 'Make in India Program'. Dr. N. C. Pramanik, Scientist, C-MET presented the achievements of C-MET on the development of carbon aerogel and aerogel based supercapacitors for energy storage and other applications. He explained in detail about supercapacitors from the basics and also the novelty of indigenous process adopted in supercapacitor technology, and achievements made so far by C-MET. Several Industry participants, such as M/s Tata Motors, SPEL Technology (Pune), ECIL (Hyderabad), Active Char (Cochin), M/s KLUG (Hyderabad), made presentations and discussed about the country's present scenario.

Two Day National Workshop on MEMS and Microsystems

C-MET, Pune participated in organizing a two-day National Workshop on MEMS & Microsystems' jointly with MAEER's Maharashtra Institute of Technology, Pune, MAEER's Arts, Commerce and Science College, Pune, under the auspices of Institute of Smart Structures and Systems (ISSS), Pune Chapter. This workshop was held on 12th and 13th February 2016 at Maharashtra Institute of Technology, Pune. This workshop was aimed at educating and initiating college teachers as well as students to the micro-world of Micro Electro Mechanical Systems (MEMS) and Microsystems. The workshop was inaugurated by Dr. Guruprasad, Director, R & D Engineers, Pune, who was the Guest of Honour. Principal MAEER's MIT Pune, Dr. L. K. Khirsagar presided over the inauguration. Distinguished faculty from Indian Institute of Technology, Bombay, Indian Institute of Science, Bangalore, Agharkar Research Institute, Pune, C-MET, Pune, R & D E (Engrs), Pune gave a complete overview of the different topics concerning MEMS, their applications, design and packaging. 45 teachers and 30 students from all over the country participated in the workshop.

Fig. 3 Inaugural function of the workshop on MEMS and Microsystems

National Science Day Celebration

C-MET, Pune

India celebrates National Science Day with great enthusiasm on 28thof February every year to venerate the invention of the Raman Effect in India by the Indian physicist, Sir Chandrasekhara Venkata Raman on the same day in the year 1928. In order to commemorate the National Science Day, and to understand the glimpses of science behind the recent discovery of gravitational waves, C-MET, Pune organized a National Science Day lecture by Dr. Jayant Naralikar, a world renowned astrophysicist, on the topic "Some important Challenges from the Cosmos". During his lecture, he discussed about two most important ideas related to the topic, namely, (i) whether life exists elsewhere beyond the Earth and (ii) on what information the gravitational waves will bring. He hinted that life exists beyond earth and hoped that the discovery on gravitation waves will not only enhance, the fundamental knowledge of matter and wave interaction but also understanding of creation of the universe as a whole. Dr. B. B. Kale felicitated Prof. Naralikar with a souvenir for a wonderful lecture.

Fig. 4 Visit of Prof. Jayant Narlikar on Science Dayto C-MET, Pune

C-MET, Thrissur

C-MET Thrissur laboratory celebrated the National Science day 2016 on 26th February 2016. Several products, developed in different labs were displayed and exhibited to the researcher, students and others. They had close interaction with C-MET scientists during their visit to respective laboratories. In the afternoon, Dr. Karunanidhi, Scientist G, RCI, Hyderabad delivered the National Science Day Lecture on 'Make in India' theme.

Annual Foundation Day 2016

C-MET Annual Foundation Day 2016 was conducted at Thrissur on 8th March 2016. Dr. Aruna Sharma, Hon. Secretary, MeitY delivered the Presidential Address through video conferencing and stressed the need for import substitution of critical electronic materials on competitive price. She opined that the success of 'Make in India' program is heavily dependent on Indian R & D sectors and all the stake holders have to work together in a cohesive manner to make this programme a grand success. She also conveyed the C-MET fraternity that Secretary, Defence Production has already assured to replace imported defense electronic materials, if materials having equivalent specifications can be made available. Dr. Sharma appreciated the efforts made by C-MET in transferring couple of technologies to industries and stressed the importance of putting MeitY logo similar to that of ISI marks in such products for more visibility of the research outcomes. She also suggested improving the marketing skills so that many indigenously developed products will come to limelight. Secretary urged the immediate need to bring up medical electronics area which can reach to masses. She expressed utmost satisfaction over the achievements made by C-MET in this area and requested C-MET to organize an International Seminar cum Exhibition on medical electronics.

Fig. 5 Inaugural function of the Annual Foundation Day 2016 and The National Workshop on Microwave and Terahertz Materials for Homeland Security (NWMTM 2016)

Dr. V.K. Saraswat, NITI Member & Former Director General DRDO delivered the Foundation Day Lecture. The presentation of Dr. Saraswat covered extremely wide areas in electronics as well as computing. Dr. Saraswat highlighted the current problem in the country with respect to electronics as a large gap between system engineering and research. He opined that India is having fairly strong hands on system engineering but limited capability on device manufacturing. Dr. Saraswat shared his concern of late entry into market pushing us behind in cost-effectiveness. He also discussed various challenges faced by the defence electronics sector.

Fig. 6 Foundation Day lecture at Annual Foundation Day 2016 and NWMTM 2016

National Workshop on Microwave & Tera Hertz Materials for Homeland Security (NWMTM 2016)

The National Workshop on Microwave and Terahertz Materials for Homeland Security (NWMTM 2016) was conducted at Centre for Materials for Electronics Technology (C-MET), Thrissur during 8-9 March 2016 in conjunction with C-MET Annual Foundation Day (AFD-2016) to review the requirements of strategic materials for homeland security. This includes stealth materials for enabling radar absorbing materials (RAMs), metamaterials for clocking and antennas, frequency selective RADOMS for minimizing the antenna Radar Cross Section (RCS), millimetre wave materials for security scanning and Terahertz materials for medical imaging, through-wall imaging, residual pesticide screening, etc.

Dr. B. R. K. Reddy, Technology Director, RCI, Hyderabad delivered the Keynote Address for the NWMTM 2016. This workshop was convened to bring together scientists, technologists and entrepreneurs actively engaged in the area of microwave and terahertz materials and to understand and propagate ideas on technological challenges that need to be overcome to realize the full potential of these materials for homeland security.

Fig. 7 Inaugural function of the National Workshop on Microwave and Terahertz Materials for Homeland Security

International Conference on Functional Eco-Friendly Smart Emerging Materials

International Conference on 'Functional Eco-friendly Smart Emerging Materials (FESEM-2016)' was held during 10th-12th March 2016 at YASHADA in Pune. The Conference was organized by PDEA's Baburaoji Gholap Mahavidyalaya Sangvi, Pune in collaboration with Chonnam National University (CNU), South Korea, Centre for Materials For Electronics Technology (C-MET), Pune and All India Rubber Industry Association (AIRIA), Pune Chapter. The FESEM-2016 was aimed to provide a forum of high profile and internationally renowned researchers from academics and industries working in the area of smart materials. The conference covered the major themes like energy, environment, chemistry, biotechnology, health and medicine, materials, polymers, and sensors. FESEM-2016 began with Pre-conference Meet on 10th March 2016. The meeting was chaired by renowned industrialist and scientist, Dr Ashok Joshi, Executive Director, Technological Holdings Ltd, USA. The discussion was held on smart material for the benefit of the society. FESEM conference was inaugurated with auspicious hands of Dr. Vijay Bhatkar on 11th March 2016. Key Note Address was given by Dr. K N Ganesh (Director, IISER, Pune) and the inaugural Function was chaired by Advocate Sandeep Kadam (Hon Secretary, PDEA, Pune). During the conference, 13 lectures (Plenary and Invited talk) have been delivered by eminent personalities from abroad as well as India. There were 12 oral presentations and 126 poster presentation by researchers in the conference. 7 industries have participated in the product exhibition.

Handing-over of First Batch of Hafnium Sponge to VSSC/MIHDANI

First batch of hafnium sponge produced in the pilot plant of C-MET, Hyderabad using electron beam (EB) melting was handed over to Mishra Dhatu Nigam (MIDHANI) and VSSC for further processing. This material after e-beam melting will be used for making high temperature withstanding composition and subsequently to the device fabrication.

Fig. 8 Ceremony to hand-over the first batch of Hafnium Sponge

DISTINGUISHED VISITORS

- Shri S. R. Lohakare, Managing Director, National Peroxide Limited, Mumbai and Member, Indian Chemical Council visited C-MET, Hyderabad on 17th August 2015 for consideration of Hafnium Plant for ICC Annual Award -2014.
- Dr. P. Murugaraj, Senior Research Scientist, School of Science, Swinburne University of Technology, Hawthorm, Australia visited C-MET Thrissur on 19th June 2016 and delivered a lecture on "Formation of carbon nanostructure arrays within polymer and role of inter phase region surrounding the nanostructures on electron transport process".
- Dr. Pedro Gomez Romero from Catalina Institute of Technology, Barcelona Spain visited C-MET, Pune on 1st December 2015.

Fig. 9 Visit of Dr. Pedro Gomez Romero from Catalina Institute of Technology, Barcelona Spain

- Dr. Luiza Cintra Campos and Dr. Lena, University College, London, UK visited C-MET, Pune under Bilateral program INDO-UK, DST from 7th to 15th Nov 2015 and delivered a lecture on "Efficient water purification systems".

Fig. 10 Visit of Dr. Luiza Cintra Campos, University College, London, UK to C-MET, Pune

PUBLICATIONS

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51. Structure-magnetic property correlations in nickel-polymer nanocomposites,K. P. Murali, H. Sharma, P. M. Raj, D. Mishra, M. Goyal, K. Silver, E. Shipton, R. Tummala, Journal of Materials Science: Materials in Electronics, 27 (2016) 154.

52. Pd loaded TiO_2 nanotubes for the effective catalytic reduction of p-nitrophenol, C. M. Divya, V. Kalarivalappil, W. Wunderlich, S. Pillai, S. Hinder, V. Kumar, K. V. Baiju, Catalysis Letters, 146 (2016) 474.

53. Titania nanotube arrays surface- modified with ZnO for enhanced photocatalytic applications, N. Manoj, K. V. Vijila, K. V. Baiju, V. Kumar, Matrials Research Bulletin, 77 (2016) 35.

54. Synthesis and microwave dielectric properties of $A_{16}V_{18}O_{61}$ (A = Ba, Sr and Ca) ceramics for LTCC applications, E. K. Suresh, K. Prasad, N. S. Arun, R. Ratheesh, Journal of Electronic Materials, 45 (2016) 2996.

55. Stability studies of PbS sensitised TiO_2 nanotube arrays forvisible light photocatalytic applications by X-ray photoelectron spectroscopy (XPS), N. B. Rahna, V. Kalarivalappil, M. Nageri, S. C. Pillai, S. J. Hinder, V. Kumar, B. K. Vijayan, Materials Science in Semiconductor Processing, 42 (2016) 303.

56. Parameters for improving titania as photo-catalysis material, W. Wunderlich, B. K. Vijayan, S. Winardi, R. R. Mukti, Materials Today: Proceedings, 3 (2016) 662.

57. Influence of lithium doping on the correlated ferromagnetic ordering and red shift of band gap in weakly Mn-doped ZnO nanoparticles, M.K. Satheesan, V. Kumar, Jouranl of Materials Science: Materialsin Electronics, 27 (2016) 6522.

58. A promising $RVO_4:Eu^{3+},Li^{+}@SiO_2$ (R = Gd, Y and Gd/Y) red-emitting phosphor with improved luminescence (cd/m^2) and colour purity for optical display applications,U. Rambabu, N. R. Munirathnam, B. S. Reddy, S. Chatterjee, Luminescence, 31 (2016) 141.

ii) IN INTERNATIONAL AND NATIONAL CONFERENCES

1. Materials for low temperature solid oxide fuel cell integration in low temperature co fired ceramic (LTCC) structures, S. Kulkarni, V. Giramkar, S. Duttagupta, G. Phatak, National Workshop on Energy Storage Devices, organized by Institute of Engineers (Pune Section), Pune, 5th September 2015.

2. Fbrication of thermoelectric generator in low temperature co-fired ceramic (LTCC), S. Adhyapak, S. Kulkarni, V. Giramkar, S.Joseph, G. Phatak, 7th ISSS National Conference on MEMS, Smart Materials, Structures and Suystems at Naval Physical and Oceanographic Laboratory, Kochi, 23rd-25th September 2015.

3. Nanostructured $CdIn_2S_4$/graphene composites for Photocatalytic solar hydrogen production from water, M. A. Mahadadalkar, A. P. Bhirud, J. D. Ambekar, S. D. Naik, P. V. Adhyapak, B. B. Kale, International

Conference on Synthetic and Materials Chemistry (ICSMC-2015), Mumbai University, Mumbai, 26th-28th November 2015.

4. Development of Cu_2ZnSnS_4 (CZTS) absorber by spray pyrolysis for thin film solar cell applications, P.Saritha, P.Prabeesh, I. P. Selvam, S. N. Potty, UGC sponsored National Seminar on Advanced materials, Sri Vyasa NSS College, Wadakkanchery, 29th-30thOctober 2015.

5. Silicon Carbide (SiC) for next generation electronic innovations – Single crystal bulk growth and challenges, S. Mahajan, M. V. Rokade, S. T. Ali, N. R. Munirathnam, S. Deb, D. V. S. Rao, L. Durai, V. V. Bhanuprasad, A. K. Garg, International Workshop on Physics of Semiconductor Devices (IWPSD-2015), held at IISc, Bangalore during 7th-10th December 2015.

6. Hydrothermal Synthesis of Nanosized (Fe, Co-Ni)-TiO_2 for Solar Hydrogen Generation, K. R. Anju, T. Radhika, Souvenir-International Conference on Nano Materials and Nanotechnology (Nano 2015), held at KSR College, Tiruchengode during 7th-10thDecember 2015.

7. Nanostructured anatase titania spheres as light scattering layer in dye-sensitized solar cells, K. S. Swathy, P. A. Abraham, N. Rani Panicker, N. C. Pramanik, K. S, Jacob, International Conference on Advances in Chemical Engineering (ICAChe-2015), held at Govt Engineering College Thrissur during 9th-11th December 2015.

8. Compact UWB MIMO Antenan with WiMAX and WLAN Rejection, S. Joseph, S. P. Amma, K. A. Amal, A. K. Mondal, R. Ratheesh, IEEE International Microwave and RF Conference (IMaRC), 2015, Hyderabad during 10th-12th December 2015.

9. Synthesis of Cu_2ZnSnS_4 (CZTS) nanoparticles using water-in-oil microemulsion, K. Divya, P. Prabeesh, I. P. Selvam, S. N. Potty, UGC sponsored Colloquium on Exotic Materials and Its implication in Societal Life, Sri Vyasa N. S. S. College, Vyasagiri, Wadakkancherry, 17th-18thDecember 2015.

10. Effect of loss tangent on the performance of octagonal ultra wideband antenna, M. Dony, O. Rahul, R. Ratheesh, A. Jain, IEEE Electromagnetic Conference (AEMC 2015), 18th-21th December 2015.

11. Role of co-catalyst in achieving enhanced photocatalytic solar hydrogen production with $CdIn_2S_4$, M. A. Mahadadalkar, A. P. Bhirud, P. V. Adhyapak, B. B. Kale, National Seminar on Advances in Materials Chemistry and Applications (NSAMCA-2015), C.K.T College, Panvel, 21st-22ndDecember 2015.

12. $SrTiO_3$ and $Sr_2(Sr_{n-1}Ti_nO_{3n+1})$ [Ruddleseden Popper Series] Materials for Thermoelectric Heat Energy Recovery, K. Hasna, T. Radhika, N. Raghu, International Conference, Matcon 2016, CUSAT, 14th-16th January 2016.

13. Hydrothermal synthesis of nanosized N-TiO_2 and Fe-N-TiO_2 as photosensitive materials for solar hydrogen generation, K. C. Nimitha, K. R. Anju, T. Radhika, International Conference, Matcon 2016, CUSAT, 14th-16th January 2016.

14. Review on potential of nanostructured Nb_2O_5 as photo-anode material for DSSCs, N. Mohite, M. T. Sarode, S. Rane, K. C. Mohite, International Conference on Environmental Systems and Sustainable Development (ESSD-16), C.T. Bora College, Shirur, 15th-16th January 2016.

15. Improved charge transfer mechanism in nano-structured platinum loaded $CdIn_2S_4$ for enhanced photocatalytic solar hydrogen production from water, M. A. Mahadadalkar, A. P. Bhirud, R. S. Sonavane, J. D. Ambekar, P. V. Adhyapak, B. B. Kale, National Symposium of Chemical Research Society of India (CRSI-2016), Punjab University, Chandigadh, Punjab, 5th-7thFebruary 2016.

16. A novel SnO/SnO_2 coupled semiconductor nanosystem for photocatalytic applications, A. Roy, Y. Waghadkar, S. Arbuj, G. Umarji, M. Shinde, R. Chauhan, S. Rane, National Conference on Materials for Energy Conversion and Storage (NCMECS-2016), Department of Chemistry and Department of Physics, Mahatma Phule College, Pimpri, Pune, 12th-13th February 2016.

17. Synthesis of highly crystalline nanosized TiO_2 at low temperature for photocatalytic hydrogen generation, B. S. Chavan, S. S. Arbuj, S. B. Rane, National Conference on Materials for Energy Conversion and Storage (NCMECS-2016), Department of Chemistry and Department of Physics, Mahatma Phule College, Pimpri, Pune, 12th-13th February 2016.

18. Titania aerogel based photoanodes for dye-sensitized solar cells, K. S. Swathy, P. A. Abraham, N. Rani Panicker, S. Rajasekaran, N. C. Pramanik and K. S. Jacob, 4th International Conference on Frontiers in Nano Science and Technology, COCHIN NANO 2016, Cochin University of Science and Technology, 20th- 23rd February 2016, Cochin, India.

19. Extraction of dielectric function from ellipsometry and reflectance spectra, V. Naveen, P. Prabeesh, I. P. Selvam, S. N. Potty, National Photonics Symposium and Annual Workshop, NPSAW – 2016, 26th-28th February 2016.

20. Zinc silver antimonate as visible light photocatalyst for H_2 evolution from H_2S splitting, S. A. Mahapure, R. Marimuthu, J. D. Ambekar, B. B. Kale, National Seminar and Workshop on Nanotechnology: Today and Tomorrow (INNERVATE 2016), organized by Jankidevi Bajaj College of Science, Wardha, 28th-29th February 2016.

21. Fabrication of kesterite absorber films by spray pyrolysis: Effect of annealing temperature on the phase formation, P. Prabeesh, P. Saritha, I. P. Selvam, S. N. Potty, International Conference on Materials Science and Technology (ICMTech), University of Delhi, 1st-4thMarch 2016.

22. Development of CZTS thin-films on glass and Mo coated glass substrates by solution process, P. Prabeesh, I. P. Selvam, S. N. Potty, International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT) - 2016, Chennai, 3rd-5thMarch 2016.

23. Optimization of low melting glass compositions using taguchi method for ultra low temperature co-fired ceramic applications, R. Deshmukh, V. Chaware, S. Kulkarni, G. Phatak, 19th National Seminar on Physics and Technology of Sensors (NSPTS-19), Shri Guru Gobind Singji Institute of Engineering and Technology, Nanded, 3rd-5th March 2016.

24. Metallization of CNT for composite CNT-lead-free solder bumps for MEMS application, S. Mahapure, V. Sawant, V. D. Giramkar, S. Joseph, G. Phatak, 19th National Seminar on Physics and Technology of Sensors (NSPTS-19), Shri Guru Gobind Singji Institute of Engineering and Technology, Nanded, 3rd-5th March 2016.

25. Synthesis of $LiCoO_2$ as cathode material via combustion method for lithium-ion battery applications, U. Chothe, M. V. Kulkarni, B. B. Kale, National Conference on Advanced Materials and Applications (NCAMA- 2016), held at Fergusson College, Pune, 4th-5th March 2016.

26. Solvent dependant preparation of Fe_2O_3/Fe_3O_4 nanoparticles and improved capacitance as a supercapacitor, P. R. Kulkarni, S. S. Jadhav, H. M. Gholap, R. P. Panmand, M. V. Kulkarni, B. B. Kale, National conference on Advanced Materials and Applications (NCAMA- 2016) held at Fergusson college, Pune on 4th-5th March 2016.

27. Growth of the Bi_2X_3 (X=S and Te) quantum dots / rods in glass: An unique highly stable nanosystem with its novel functionality for high performance magneto optical devices, R. P. Panmand, B. B. Kale, S. W. Gosawi, International Conference on Functional Eco-friendly Smart Emerging Materials (FESEM-2016), held at B. G. Gholap College, Sangavi, Pune, 10th-12th March 2016.

28. 2D MoS_2 honeycomb and 3D marigold $CdMoS_4$ for hydrogen production under visible light, S. R. Kadam, D. J. Late, R. P. Panmand, B. B. Kale, International Conference on Functional Eco-friendly Smart Emerging Materials (FESEM-2016), held at B. G. Gholap College, Sangavi, Pune, 10th-12th March 2016.

29. Sol-gel synthesis of titanium oxynitride for environmental remediation and H_2 generation under visible light, S. K. Khore, N. V Tellabatti, S. P. Takle, S. Naik, S. K. Apte, J. D. Ambekar, B. B. Kale, R. S

Sonawane, International Conference on Functional Eco-friendly Smart Emerging Materials (FESEM-2016), held at B. G. Gholap College, Sangavi, Pune, 10th-12th March 2016.

30. Synthesis of $LiCoO_2$ as cathode material with superior performance for lithium-ion battery applications, U. Chothe, M. V. Kulkarni, B. B. Kale, International Conference on Functional Eco-friendly Smart Emerging Materials (FESEM-2016), held at B. G. Gholap College, Sangavi, Pune, 10th-12th March 2016.

31. Synthesis and characterization of nanostructured lithium iron phosphate ($LiFePO_4$) as cathode material for Li-ion battery applications, A. Ambalkar, U. Chothe, A. Gunjal, B. B. Kale, M.V. Kulkarni, International Conference on Functional Eco-friendly Smart Emerging Materials (FESEM-2016), held at B. G. Gholap College, Sangavi, Pune, 10th-12th March 2016.

32. Rapid synthesis of anode material, lithium titanium oxide ($Li_4Ti_5O_{12}$) for High Energy Li - ion Battery, S. S. Patil, M. V. Kulkarni, B. B. Kale, International Conference on Functional Eco-friendly Smart Emerging Materials (FESEM-2016), held at B. G. Gholap College, Sangavi, Pune, 10th-12th March 2016.

33. Heterogeneous semiconductor photocatalysis: Fundamentals and applications towards energy and environmental remediation, S. S. Arbuj, S. B. Rane, International Conference on Functional Eco-friendly Smart Emerging Materials (FESEM-2016), held at B. G. Gholap College, Sangavi, Pune, 10th-12th March 2016.

34. Pomegranate and hollow sphere structured nanoarchitectures of hierarchical zinc oxide as efficient photoanodes in dye-sensitized solar cells, R. Chauhan, M. Shinde, S. Gosavi, S. Rane, International Conference on Functional Eco-friendly Smart Emerging Materials (FESEM-2016), held at B. G. Gholap College, Sangavi, Pune, 10th-12th March 2016.

35. Photoconductive UV detection sensor using hydrothermally grown doped ZnO nanopowder, Y. Waghadkar, G. Umarji, R. Chauhan, S. Gosavi, S. Rane, International Conference on Functional Eco-friendly Smart Emerging Materials (FESEM-2016), held at B. G. Gholap College, Sangavi, Pune, 10th-12th March 2016.

36. Magneto-optic evaluation of antiferromagnetic α-Fe_2O_3 nanoparticles coated on a quartz substrate, S. Balasubramanian, R. Panmand, G. Kumar, S. M. Mahajan, B. B. Kale, Proc. SPIE 9758, Quantum Dots and Nanostructures: Growth, Characterization, and Modeling XIII, 97580O, San Francisco, California, United States, 15th March, 2016.

III) PATENTS APPLIED

1. Conductive solid oxide fuel cell electrolyte composition and a method for preparing the same, invented by Shrikant Kulkarni, Siddharth Duttagupta, Girish Phatak, Indian Patent Application No. 1573/DEL/2015.

2. A Non-conductive substrate with tracks formed by sand blasting, invented by Girish Phatak, Shrikant Kulkarni, Vijaya Giramkar, Shany Joseph, Indian Patent Application No. 130/MUM/2015.

3. Composition, thermistor and methods thereof, invented by Seema Ansari, Muralidharan Malamal Neelanchery, Sunny Erukulam Kochappan and Dayas Kalaparamban Rapai, Indian Patent Application No. 1343/DEL/2015.

IV) INVITED LECTURES BY C-MET SCIENTISTS

1. Dr S. N. Potty delivered a lecture on “Nanophotonics” in the AICTE sponsored Faculty Development Programme on Recent Advances in Nanoscience and Nanotechnology at Amal Jyothi College of Engineering, Kanjirappally on 23rd April 2015.

2. Dr. V. N. Mani delivered a lecture on “Role of gallium arsenide optoelectronic materials and devices for select advanced applications-a bird's eye” in National Conference on Advanced Functional Materials, SRM University, Chennai during 8th-9thMay 2015.

3. Dr. G. J. Phatak delivered a lecture on"MEMS Packaging and Integrated Microsystems" at Ramdeobaba College of Engineering, Nagpur on 22nd April 2015.

4. Dr. B. B. Kale delivered a Guest Lecture on "Overview of nanostructured Materials nanocomposites" at Sungkyun Advanced Institute of Nanotechnology (SAINT), Sungkyunkwan University (SKKU), Suwon, South Korea on 22nd May 2015.

5. Dr. S. N. Potty delivered a lecture on "Polymer nanocomposites" in the National Seminar on Emerging Trends in Nanomaterials at Sree Sankara Vidyapeetom College, Valayanchirangara, Perumbavooron, 9th July 2015.

6. Dr. S. N. Potty delivered a lecture on "Nanophotonics" in the Faculty Development Programme on "Nanotechnology Applications in Engineering" at Mar Athanasius College of Engineering, Kothamangalam on 13th July 2015.

7. Dr. S. N. Potty delivered a lecture on "Nanophotonics" in the Faculty Development Programme on "Nanotechnology Applications in Engineering" at Mar Athanasius College of Engineering, Kothamangalam on 13th July 2015.

8. Dr. K. P. Murali delivered a talk on "Nanotechnology Applications in Engineering", Faculty development program for Electrical and Electronics Engineering Departments, Mar Athanasius College of Engineering, Kothamangalam on 13th July 2015.

9. Dr S. N. Potty delivered a lecture on "Thin film solar cells with kesterite absorber" in the inaugural programme of the yearlong celebrations of International Year of Light at Department of Physics, Cochin University of Science and Technology on 21st July 2015.

10. Dr. B. B. Kale delivered a Guest Lecture on "Overview of quantum dot based glassy materials for energy application" at Korea Research of Chemical Technology (KRICT), Dejaon, South Korea on 22nd July 2015.

11. Dr. V. N. Mani delivered a talk on "Role of gallium arsenide optoelectronic materials and devices for select advanced applications-a bird's eye" at National Conference on Emerging Trends of Advanced Functional Materials, KL University of Vijayawada, 3rd-4thAugust 2015.

12. Dr. N. R. Munirathnam has delivered an invited talk on "Cellular phones waste Management in India" 3rd National Conference on Applied Physics and Materials Science (APMS) conference held at Department of Physics, Vasavi Engineering College, Hyderabad during 7th - 8thAugust 2015.

13. Dr. N. R. Munirathnam has delivered an invited lecture on "Ultra high Purification of Semiconductor Materials for Optoelectronic Devices" in a National Conference entitled "Recent Advances in Smart Materials & Probing Techniques (RASMPT)" at Telengana University, Nizambad during 21st - 22nd August 2015.

14. Dr. B. B. Kale delivered an Invited Talk on "Strategies for efficient energy storage materials in workshop on Energy Storage Devices at Institution of Engineers, Pune on 5th September 2015.

15. Dr. B. B. Kale delivered an Invited Talk on "Energy materials" at Center for Energy and Resources Development, Mechanical Engineering Department, Indian Institute of Technology (Banaras Hindu University), Varanasi on 21st September 2015.

16. Dr. B. B. Kale delivered a Guest Lecture on "Energy materials" at Center for Energy and Resources Development, Mechanical Engineering Department, Indian Institute of Technology (Banaras Hindu University), Varanasi on 21st September 2015.

17. Dr. N. Raghu delivered a talk on "Materials to Technology - Piezo as an Example", National Conference-7, ISSS, NPOL, Kochi, 23rd to 25th September 2015.

18. Dr. K. P. Murali delivered a talk on "Advanced Electronic materials for strategic sector", Visiting faculty program at Mechanical Engg. dept., Govt. Engineering College, Thrissur on 7th October, 2015.

19. Dr. R. Ratheesh delivered an Invited Lecture on “ULTCC Materials for wireless Communication applications” at Department of Electronics and Communication, Sahrdaya Engineering college, Kodakara on 7th October, 2015.

20. Dr. U. Rambabu delivered an Invited Talk on “Look for alternative materials as per Restriction of Hazardous Substances (RoHS) Directive” at UGC Sponsored National Conference on Need and Role of Nano Sciences in the Present Era, organized by Dept. of Physics, Pinnamaneni Siddhartha College, Vijayawada during 7th-8th October, 2015.

21. Dr. N. C. Pramanik delivered a talk on “Achievement of C-MET on the development of aerogels & aerogel supercapacitors for energy storage & other applications” on 9th October 2015 in One day National Workshop on Supercapacitor (NWS 2015), held at C-MET, Thrissur on 9th October 2015.

22. Dr. M. D. Shinde delivered an Invited Talk on “Introduction to Electron Microscopies” at One Day Workshop on Characterization of Materials by Various Techniques at Yashwantrao Chavan Institute of Science, Satara on 10th October 2015.

23. Dr. G. G. Umarji delivered an Invited Talk on “Introduction to X-ray Photoelectron Spectroscopy” at One Day Workshop on Characterization of Materials by Various Techniques at Yashwantrao Chavan Institute of Science, Satara, India on 10th October 2015.

24. Dr. S. S. Arbuj delivered an Invited Talk on “UV-visible Spectroscopy” in One Day Workshop on Characterization of Materials by Various Techniques at Yashwantrao Chavan Institute of Science, Satara, India on 10th October 2015.

25. Dr. P. V. Adhyapak delivered an Invited Talk on “Thermal characterizations” in One Day Workshop on Characterization of Materials by Various Techniques at Yashwantrao Chavan Institute of Science, Satara, India on 10th October 2015.

26. Dr. K. S. Jacob delivered a talk on “Solar Cell- Future solutions to Energy crisis”, Department of Physics, Little Flower College Thrissur, 16th October 2016.

27. Dr. R. Ratheesh delivered Invited Talk on “Novel ceramics and composites for microwave communication applications” in the National Seminar on Advanced Materials at Sri Vyasa N.S.S. College, Wadakkanchery on 29th October, 2015.

28. Dr. S. N. Potty delivered a lecture on “Transparent Conducting Oxides” in the UGC sponsored National Seminar on Advanced Materials at Sri Vyasa NSS College, Wadakkanchery on 29th October 2015.

29. Dr. U. Rambabu, delivered an invited talk on “Restriction of Hazardous Substances (RoHS) awareness, Compliance, Indian Scenario, testing & certification as per E-waste rules” at National Conference on Materials Science (NCMS-2015) organized by Department of Physics, S.K. University, Anantapur, during November 13 – 14, 2015.

30. Dr. T. Radhika delivered a talk on “Research Methodology - A Graduate Level Approach”, at Department of Chemistry, N. S. S. College, Ottapalam, 18th November 2015.

31. Dr. N. Raghu delivered a talk on “Smart Piezo Ceramic for Power Generation Application”, CEP, RCI, Hyderabad, 18th November 2015.

32. Dr. B. B. Kale delivered an Invited Talk on “Nanostructured Materials for energy applications” at Utility of Basic Sciences for Engineers, B. S. Anangpuria Institute of Technology & Management, Alampur, Faridabad on 21 November 2015.

33. Dr. M. V. Kulkarni delivered an Expert Talk on "Nanomaterials & Polymer Nanocomposites for Multifunctional Applications", in National level conference on Nano Science and its Applications to Engineering at Department of Core Engineering and Engineering Sciences, Maharashtra Institute of Technology, Pune, on 4th December 2015.

34. Dr. U. Rambabu delivered an invited talk on “Restriction of Hazardous Substances (RoHS) awareness” a CPCB Sponsored Training Program on “Batteries and Electronic Waste Management - Rules and Practical Aspects” from at ESCI Campus, Gachibowli, Hyderabad, 7th-11thDecember, 2015.

35. Dr. K. P. Murali delivered an Invited Talk on “Novel Electronics Materials: C-MET Thrissur Outlook”, in 4th International Conference on Emerging Trends in Engineering, Science and Technology (ICETEST – 2015), Govt. Engg College, Thrissur, 9th-11thDecember 2015.

36. Dr. R. Ratheesh delivered invited talk on “Materials for wireless communication applications:-past, present and future” at St. Thomas College, Ranni in connection with National Seminar on Design and Properties of Nanomaterials for Emerging Technologies on 10th December 2015.

37. Dr. S. N. Potty delivered a lecture on “Basics of X-ray diffraction” in the Seminar on Materials Science and Characterization (SMC-15) at Government College, Nedumangadu, Thiruvananthapuram on 15th December 2015.

38. Dr. S. N. Potty delivered a lecture on “Solar cell absorber films” in the UGC sponsored National Conference on Modern Optics & Material Science (NCMOMS-2015) at Farook College, Kozhikode on 18th December 2015.

39. Dr. N. R. Munirathnam has delivered an invited talk on “Electron Beam Melting of Refractoiry Metals” in one day conference entitled “High Temperature Materials” at Vikram Sarabai space Centre (VSSC), Thiruvananthapuram during 21stDecember 2015.

40. Dr. V. N. Mani delivered a talk entitled “Role of gallium arsenide optoelectronic materials and devices for select advanced applications-a bird's eye” in International Conference on Functional Materials and Microwaves (ICFMM-2015) at Dr. Babasaheb Ambedkar Marathwada University, Aurangabad during 28th-30thDecember 2015.

41. Dr. K. V. Baiju delivered an Invited Talk on “Nanomaterials for energy and environment” at Seminar organized by Dept. of Chemistry, Govt. College for Women, Thiruvananthapuram, on Current Developments in Material Sciences” during 6th-7thJanuary 2016.

42. Dr. R. Ratheesh delivered Invited Lecture on “Flexible composite laminates for wireless communication applications” at Hindustan University in the National Conference on Recent Advances in Smart Materials on 8thJanuary 2016.

43. Dr. G. J. Phatak delivered a lecture on “The changing face of electronics: Past, Present and Future”, Lecture at “PHYL-79” Abasaheb Garware College, 9th January 2016.

44. Dr. T. Seth delivered a talk on “Nano synthesis Techniques (Physical Methods)” at Government Polytechnic, Pune on 12th January 2016.

45. Dr. P. V. Adhyapak delivered an Invited Talk on “Characterization of Nanomaterials”, at Government Polytechnic, Pune on 13th January 2016.

46. Dr. V. Kumar delivered a Keynote Address on “Chemistry of Materials” at UGC sponsored National Seminar on Organic Chemistry organized by Department of Chemistry, St. Joseph's College, Irinjalakudar on 28th January 2016.

47. Dr. S. T. Ali was invited as Chief Guest and delivered IEEE Memorial Lecture on the occasion of John Bardeen's Birth Anniversary i.e. on 30th January 2016 entitled “Materials & Life” at Vignan Bharathi Institute of Technology (VBIT), Hyderabad.

48. Dr. P. V. Adhyapak delivered an Invited Talk on “Nanomaterials: Synthesis characterization and applications” at KAANMS Arts Comm. & Sci. College, Satana, Nashik on 2nd February 2016.

49. Dr. N. R. Munirathnam has delivered an invited lecture on “High semiconductor materials and Processing” on the occasion of Golden Jubilee lecture series at Yashvantrao Chevan Institute of Science, Satara, Maharashtra on 3rd February 2016.

50. Dr. V. N. Mani delivered a Valedictory Address on “Advanced semiconductor crystals and devices for electronic applications- a bird's eye view'” in the National Conference on Contemporary Research in Materials Science (CRAMS-2016), Karpagta Vinayaga College of Engineering & Technology, Padalam, 5th February 2016.

51. Dr. M. V. Kulkarni delivered an Invited Talk on “Nanomaterials and Polymer Nanocomposites: Synthesis, Characterization and Multifunctional Applications” in State level conference on "Green Approach in Material Chemistry (GAMC-2016)" sponsored by BCUD, Savitribai Phule Pune University, organized by Dept. of Chemistry, BJS'S ASC college, Wagholi, Pune on 9th February 2016.

52. Dr. V. Kumar delivered Invited Lecture on “Chemistry of Materials” at Prof. V. A. Joseph Endowment lecture at Dept. of Chemistry, Sacred Heart's College, Thevara, Ernakulam on 9th February 2016.

53. Dr. B. B. Kale delivered an Invited Talk on “Development of quantum dots in glassy phase”, in National conference on Functional Glasses /Glass-Ceramics and Ceramics (NCFGC-2015), Department of Applied Physics, V.N.I.T., Nagpur on 11th February 2016.

54. Dr. M. V. Kulkarni delivered an Invited Talk on “Nanomaterials and Nanocomposites for Advanced Energy Conversion and Storage” in National Conference on Materials for Energy Conversion and Storage (NCMECS-2016), jointly organized by Department of Chemistry and Department of Physics, Rayat Shikshan Sanstha's Mahatma Phule Mahavidyalaya, Pimpri, Pune on 13th February 2016.

55. Dr. G. J. Phatak delivered a lecture on “MEMS packaging and microsystems in LTCC” in Workshop on MEMS and Microsystems, Organized by ISSS, (Pune Chapter), MIT College of Engineering, Pune, 13th February 2016.

56. Dr. B. B. Kale delivered an Invited Talkon “Strategies to curtail the environmental pollution” in International Conference on Impact of Chemical Research on Environment (ICRE 2016), held at New Arts, Commerce and Science College, Parner, Ahmadnagar on 17th-18th February 2016.

57. Dr. B. B. Kale delivered an Invited Talk on “Nanostructured materials” in INNERVATE 2016 held Jankibai Bajaj College, Vardha on 28th February 2016.

58. Dr. B. B. Kale delivered a Science Day Lecture on “Overview of Nanostructured Materials” at HEMRL, Pune on 29th February 2016.

59. Dr. B. B. Kale delivered an Invited Talk on “Nanostructured Materials for Electronics” in Conference ELECTRONICA -2016 at New Arts Science College Ahmednagar on 3rd March 2016.

60. Dr. G. J. Phatak delivered a lecture on “Electronic Packaging and Microsystems for the Future” in 19th National Seminar on Physics and Technology of Sensors (NSPTS-19), Shri Guru Gobind Singji Institute of Engineering and Technology (SGGSIE&T), Nanded during 3rd-5th March 2016.

61. Dr. B. B. Kale delivered an Invited Talk on “Overview of lithium ion batteries and strategies” in National Conference on Advanced Materials and Applications (NCAMA-2016) held at Department of Physics, Fergusson College, Pune on 4th-5th March 2016.

62. Dr. B. B. Kale delivered an Invited Talk on Invited talk on “Nanoscience and Nanotechnology” in conference on Utility of Basic Sciences at Yashavantrao Chavan College, Satara on 9th March 2016.

63. Dr. B. B. Kale delivered an Invited Talk on “Nanocomposites for advanced applications” in 2nd National Conference on Advances in Mechanical Engineering Techniques (AMET 2016), held at MIT, Kothrud Campus on 17th March 2016.

64. Shri A. Kumar presented Key Note Address on the topic “Preparation of Hafnium metal for Advanced Space Applications – An Overview” at OP Jindal University, Raigarh, at the 2nd International Conference on “Advances in Steel, Power and Construction Technology on 17th March 2016.

65. Dr. B. B. Kale delivered an Invited Talk on “Overview of Nnaostructured Materials for energy application” in conference on Energy and Environment, held at Bharati Vidhyapeeth, Pune on 27th March 2016.

66. Dr N. R. Munirathnam has delivered an invited talk on “High Pure Materials for Homeland Security” in National Conference entitled “Materials for Specific Applications (MFSA-2016) held at Gokaraju Rangaraju Institute of Engineering and Technology on 29th - 30th March 2016.

V) AWARDS AND HONOURS

1. P. Saritha, P. Prabeesh, I. P. Selvam, S. N. Potty bagged First Prize in the poster session for the paper “Development of Cu_2ZnSnS_4(CZTS) absorber by spray pyrolysis for thin film solar cell applications”, at UGC sponsored National Seminar on Advanced materials, Sri Vyasa NSS College, Wadakkanchery, 29th-30th October 2015.

2. K. Divya, P. Prabeesh, I P. Selvam, S. N. Potty bagged Second Prize in the poster session for the paper entitled“ Synthesis of Cu_2ZnSnS_4 (CZTS) nanoparticles using water- in- oil microemulsion”, UGC sponsored Colloquium on Exotic Materials and Its implication in Societal Life, Sri Vyasa N S S College, Vyasagiri, Wadakkancherry, 17th-18th December 2015.

3. M. A. Mahadadalkar, A. P. Bhirud, P. V. Adhyapak, B. B. Kale received Best Oral Presentation Award for the paper entitled “Role of co-catalyst in achieving enhanced photocatalytic solar hydrogen production with $CdIn_2S_4$” at National Seminar on Advances in Materials Chemistry and Applications (NSAMCA-2015), C.K.T. College, Panvel, 21st-22nd December 2015.

4. K. S. Swathy, P. A. Abraham, N. R. Panicker, S. Rajasekaran, N. C. Pramanik, K. S. Jacob received the Best Oral Presentation Awardfor the paper entitled “Titania aerogel based photoanodes for dye-sensitized solar cells” in 4th International Conference on Frontiers in Nano Science and Technology, COCHIN NANO 2016, Cochin University of Science and Technology, 20th- 23th February 2016, Cochin.

5. V. Naveen, P. Prabeesh, I. P. Selvam, S. N. Potty bagged the Best Paper Presentation Award for the paper “Extraction of dielectric function from ellipsometry and reflectance spectra” at National Photonics Symposium and Annual Workshop, NPSAW – 2016, 26th-28th, Feb 2016.

6. R. Chauhan, M. Shinde, S. Gosavi and S. Rane received The Best Poster Presentation Award (1st position) for the poster entitled “Pomegranate And Hollow Sphere Structured Nanoarchitectures of Hierarchical Zinc Oxide As Efficient Photoanodes in Dye-Sensitized Solar Cells” at an International Conference on Functional Ecofriendly Smart Emerging Materials (ICFESEM-2016), organized by PDEA'S Baburaoji Gholap College, Pune, 10th-12th March 2016.

7. Indian Chemical Council (ICC) Award for Excellence in Chemical Plant Design and Engineering was conferred on VSSC for Establishment of hafnium Plant in Association with C-MET. The citation reads “VSSC in association with the Centre for Materials for Electronics Technology (C-MET), Hyderabad has established a Chemical plant for the separation of Hafnium from Zirconium scrub raffinate. Hafnium is an important alloying element for super alloys. The establishment of Hafnium sponge production facility is a major step-forward in the indigenous production of super alloys required for high temperature applications”.

VI) BOOK CHAPTERS

1. Synthesis of Hafnium Oxide Nano Particles Using controlled Precipitation Method, B. Shiva, Raghu C. Reddy, K. Sri Gowri, S. Devaki Rani, K. Srinivasa Vadayar, Arbind Kumar and N. R. Munirathnam, Published as Souvenir on International Conference on Nanomaterials and Nanotechnology, Volume-1, viz., Synthesis and Fabrication of Nanomaterials, pp 181-184, edited by V. Rajendran K.E. Geckeler, et.al., Bloomsbury Publishers (New Delhi, London, Oxford, New York, Sydney), ISBN: 978-93-85436-76-5 (2015).

2. Book Chapter entitled “Electronic Applications of Polyurethane and Its Composites” by Seema Ansari and M. N. Muralidharan in the book “Flexible and Stretchable Electronic Composites”, Springer International Publishing, Switzerland, 2016.

PLANS AND PROSPECTS

During the year, 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 through the sponsored projects.

3. Continue the technical services, materials characterization services to industries for creating more scope for consultancy projects and RoHS certification and allied services for improvement in cash earnings.

4. Be a front runner in R&D of Electronics 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 applied research.

6. Creation of fourth unit of C-MET with mission to conduct interdisciplinary R & D for meeting the electronic materials challenges pertaining to fifth generation stealth technology for homeland security, novel materials for Tera Hertz security screening, metamaterials for strategic sector, materials for millimeter wave communications, substrate integrated waveguide materials and systems, miniaturized frequency selective RADOMS for strategic sector and for wireless communication systems.

ACKNOWLEDGMENT

Centre for Materials for Electronics Technology is grateful to the Ministry of Electronics & Information Technology (MeitY), Government 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, VSSC (ISRO), DST, DRDO, DAE, EATON Pvt Ltd., etc.

The guidance and proactive support of the Honourable Chairman, Vice-Chairman and Members of the Governing Council of C-MET has 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 the Honourable Chairman, Vice-Chairman and Members of the Governing Council, Chairman and Members of the Steering Committee as well as Members of the Executive Committee.

I place on record very special thanks to all the Officers and Staff members of Electronic Materials and Components Development (EMCD) Programme, Finance Division, Autonomous Bodies Coordination Division and the other divisions of the Ministry of Electronics and Information Technology, for their precious support and prompt co-operation for implementing C-MET's programs. I am also obliged to our bankers, Punjab National Bank, Canara Bank and Indian Overseas Bank at Pune, Hyderabad and Thrissur for rendering timely services. It is our pleasure to have been working with Statutory Auditors, P. N. Phadke & Co., Charted Accountants and P. N. Phadke & Co., Charted Accountants & Internal Auditors and I acknowledge their meticulous work.

I earnestly owe all the staff members 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, PUNE

Name of The Equipment	Model	Name of The Manufacturer	Applications
UV-VIS Spectrometer	UV-3600	Shimadzu, Japan	Spectroscopic Chemical Analysis
Photo luminescence Sectrometer	RF-5301	Shimadzu, Japan	Luminescence studies of organic, inorganic and polymeric compounds
Potentiostat/ Galvanostat	PGstat 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 (FTIR)	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 (GF-AAS)	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

MAJOR CHARACTERISATION EQUIPMENTS AVAILABLE AT C-MET, HYDERABAD

Name of The Equipment	Model	Name of The Manufacturer	Applications
RoHS Equipment			
Inductively coupled Plasma Mass spectrometer (ICP-MS)	X-Series II	THERMO FISHER SCIENTIFIC, Germany	Elemental Analysis in liquid (ppb/ppt level)
Inductively Couples Plasma Optical Emission Spectrometer (ICP-OES)	Agilent 725	AGILENT TECHNOLOGIES INDIA PVT. LTD., Bangalore	Elemental analysis in liquid at ppm level at RoHS facility
Gas Chromatograph Maas spectrometer (GC-MS)	DSQ II	THERMO FISHER SCIENTIFIC, USA	Analysis of Poly bromibated compounds in electronic materials
Energy Dispersive X-ray Flourescence (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
Graphite Furnace Atomic Absorption spectroscopy (GF AAS)	GF3000/932 AA	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
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
Other Equipment			
Inductively Couples Plasma Optical Emission Spectrometer (ICP-OES)	iCAP 6500 series	THERMO FISHER SCIENTIFIC, Germany	Elemental analysis in liquid at ppm level at for Hafnium facility
X-Ray Diffractometer (XRD)	Xpert PRO	PANALYTICAL, Netherlands	Phase and impurities detection in materials
Metallurgical Microscope	LABORLUX 12 ME ST	LEICA, Germany	Morphological and Structural Analysis of Materials
Carbon Sulphur analyzer	EMIA-920V2	HORIBA, Japan	Estimation of Carbon, Sulphur in Metal Samples
Micro Hardness Tester	HMV	SHIMADZU, Japan	Measuring Brinell Rockwell, Diamond Hardness
ONH Analyser	ONH-836	LECO, USA	Estimation of Oxygen, Notrogen 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 , Nano Technology, Japan	Thermal Characterization of Organic, Inorganic and polymeric samples ≤ 1400 °C
ED-XRF	EPSILON I	Panalytical, Holland.	Elemental analysis Na to U, in PCB, intermediates, slag
Fire Assay System	CF-15	Carbolite UK	Estimation of precious metal

MAJOR CHARACTERISATION EQUIPMENTS AVAILABLE AT C-MET, THRISSUR

Name of The Equipment	Model	Name of The Manufacturer	Applications
DSC/TGA	SDTQ600	TA Instruments, USA	To study Physicochemical changes with respect to temperature upto 1500^0C
Impedance Analyser	HP4192A	Hewlett-Packard, Japan	To measure inductance, capacitance, resistance, factor and variation of these properties with frequency from 5Hz to 13 MHz.
BET Surface area Analyser	Nova 1200	Quantachrome, USA	Measurements of surface area of nano powders
Supercapacitor Test Systems	BT-2000	Arbin Instruments, USA	Measurement of capacitance, ESR, charge-discharge cycle
Gain Phase Analyser	Model 4294A	Agilent Technologies, USA	For impedance analysis of materials in the frequency range 40hz to 110MHz
Vector Network Analyzer (VNA)	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/SS6100, 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
BET surface Area Analyser	Quadrasorb-Evo-KR/MP	M/s Quantachrome Instruments	Surface area and Pore size distribution of porous materials
Helium Pycnometer	Ultrapyc1200E	M/s Quantachrome Instruments	To determine skeletal density of porous materials
Rheometer	DHR-2	M/s TA Instruments	Rheological Analysis of Fluids, Pastes etc
FTIR	Spectrum 10	M/s Perkin Elmer	IR spectroscopy to study the chemical environments of species
SEM with EDS	EVO 18	M/s Carl Zeiss	Microstructural and elemental analysis of materials

C-MET, PUNE

AUDITED
FINANCIAL STATEMENTS
FOR THE YEAR
2015-2016

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, 2016, 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, 2016; 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

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

Place : Pune.
Date : 01/07/2016

ANNEXURE Forming part of the Audit Report
of Centre for Materials for Electronics Technology
for the Year ended 31st March 2016.

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 sponsorers, 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 67,788.73 pertaining to previous year have been accounted for in the current year.

4) 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

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

Place : Pune
Date : 01/07/2016

CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY, PUNE.

BALANCE SHEET AS AT 31st MARCH, 2016

(Amount ₹)

CORPUS / CAPITAL FUND AND LIABILITIES :	Schedule	As at 31.3.2016	As at 31.3.2015
CORPUS / CAPITAL FUND	*1*	460,843,842	469,592,259
CURRENT LIABILITIES AND PROVISIONS (Including sponsored project)	*2*	400,820,267	328,977,151
TOTAL		**861,664,109**	**798,569,410**
ASSETS :			
FIXED ASSETS	*3*	134,428,070	152,804,952
CURRENT ASSETS, LOANS AND ADVANCES	*4*	727,236,039	645,764,458
MISCELLANEOUS EXPENDITURE (to the extent not written off or adjusted)		-	-
TOTAL		**861,664,109**	**798,569,410**
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/-
V. P. Phadke
(PARTNER)
(M.No.: 100811)

PLACE: PUNE
DATE : 01/07/2016

Centre for Materials for Electronics Technology, Pune.

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st MARCH, 2016

(Amount ₹)

INCOME :	Schedule	Current Year 2015 - 16	Previous Year 2014 - 15
Revenue Grants	7	102,056,137	59,484,332
Income from Services	8	19,977,802	8,339,337
Interest Earned	9	28,312,918	34,366,644
Other Income	10	342,458	532,133
TOTAL (A)		**150,689,315**	**102,722,446**
EXPENDITURE :			
Establishment Expenses	11	102,238,927	105,323,168
Laboratory and Administrative Expenses etc.	12	38,821,923	57,692,373
Depreciation		22,320,745	18,312,523
TOTAL (B)		**163,381,595**	**181,328,064**
Surplus / (Deficit) for the year (A - B)		(12,692,280)	(78,605,618)
Balance transferred to/from Corpus/Capital Fund		(12,692,280)	(78,605,618)

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

PLACE: PUNE
DATE : 01/07/2016

CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY, PUNE

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st MARCH, 2016

(Amount ₹)

SCHEDULE 1 : CORPUS / CAPITAL FUND :	As at 31.3.2016		As at 31.3.2015	
Balance as at the beginning of the year	380,436,396		285,870,728	
Add: Contribution towards Corpus/Capital Fund	3,943,863		94,565,668	
	384,380,259		380,436,396	
Add / (Less) : Balance of net income / Expenditure transferred from Income and Expenditure Account :				
As per last year	89,155,863		167,761,481	
Add : Surplus / (Deficit) for the year	(12,692,280)		(78,605,618)	
	76,463,583	460,843,842	89,155,863	46,95,92,259
BALANCE AT THE YEAR END		**460,843,842**		**46,95,92,259**

SCHEDULE 2 : CURRENT LIABILITIES AND PROVISIONS :

(Schedules Forming Part of Balance Sheet as at 31st March, 2016)

(Amount ₹)

A. CURRENT LIABILITIES :	As at 31.3.2016		As at 31.3.2015	
1. Sundry Creditors :				
a) For goods & others	182,589		209,958	
b) For E.M.D and Deposits	2,606,800	2,789,389	3,395,365	3,605,323
2. Statutory Liabilities :				
Profession Tax / ITDS / Service Tax / GIS		262,826		161,012
3. Other current Liabilities :				
Sponsored Projects	292,277,220		231,833,143	
Others Liabilities	24,294,438	316,571,658	18,335,384	250,168,527
TOTAL (A)		**319,623,873**		**253,934,862**
B. PROVISIONS :				
1. Gratuity Payable	43,842,949		39,858,809	
2. Leave Encashment payable	34,391,000		31,274,765	
3. C-MET CPF Trust	455,942		1,119,651	
4. Expenses Payable	2,506,503	81,196,394	2,789,064	75,042,289
TOTAL (B)		**81,196,394**		**75,042,289**
TOTAL (A + B)		**400,820,267**		**328,977,151**

Centre for Materials for Electronics Technology, Pune

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st MARCH, 2016

SCHEDULE 3 : Fixed Assets :

(Amount ₹)

DESCRIPTION	GROSS BLOCK				DEPRECIATION				NET BLOCK	
	As at 1.4.2015	Additions during the year	Deletions/ Adj. during the year	**As at 31.03.2016**	As at the beginning of the year	For the year	Deletions/ Adj. during the year	**Total upto 31.03.2016**	**AS AT 31.03.2016**	As at 31.3.2015
1. BUILDINGS ON FREEHOLD LAND	82,170,843	65,000		82,235,843	51,199,061	3,101,962		54,301,023	27,934,820	30,971,782
2. LAB EQUIPMENT	290,045,294	2,045,608		292,090,902	178,250,062	16,947,681		195,197,743	96,893,159	111,795,232
3. FURNITURE, FIXTURES	12,451,882	111,924		12,563,806	8,507,994	405,022		8,913,016	3,650,790	3,943,888
4. OFFICE EQUIPMENT	14,455,470	1,167,816		15,623,286	11,503,280	560,832		12,064,112	3,559,174	2,952,190
5. COMPUTER/PERIPHERALS	10,800,726	467,676		11,268,402	9,411,415	1,065,704		10,477,119	791,283	1,389,311
6. ELECTRIC FITTINGS	1,079,926	-		1,079,926	519,806	56,012		575,818	504,108	560,120
7. ELECTRIC SUBSTATION	3,689,196	-		3,689,196	2,727,400	144,270		2,871,670	817,526	961,796
8. AIR CONDITIONERS	749,574	63,600		813,174	543,234	35,721		578,955	234,219	206,340
9. TUBEWELL	73,255	22,239		95,494	48,962	3,541		52,503	42,991	24,293
TOTAL	415,516,166	3,943,863	-	419,460,029	262,711,214	22,320,745	-	285,031,959	134,428,070	152,804,952

Centre for Materials for Electronics Technology, Pune

SCHEDULE 4 : CURRENT ASSETS, LOANS & ADVANCES :

(Schedules forming part of Balance Sheet as at 31st MARCH, 2016)

(Amount ₹)

	As at 31.3.2016		As at 31.3.2015	
A. CURRENT ASSETS:				
1. Cash balances in hand		9,710		10,627
2. Bank Balances with Scheduled Banks :				
- On Deposit Accounts	251,628,773		273,456,400	
- On Savings Accounts	98,291,734		79,627,645	
- Project Deposits (Including FLC Margin money)	244,639,682	594,560,189	204,364,448	557,448,493
TOTAL (A)		**594,569,899**		**557,459,120**
B. LOANS, ADVANCES AND OTHER ASSETS				
Loans and Advances to Staff	286,800		863,522	
Loans and Advances to Others	51,966,382		43,417,248	
Amount Recoverable	239,869		1,417,253	
Advance to Suppliers	52,828,368		2,696,082	
Security and Other Deposits	23,240,106		35,612,670	
Prepaid Expenses	17,889		16,288	
Interest Accrued on FDRs	4,086,726	132,666,140	4,282,275	88,305,338
TOTAL (B)		**132,666,140**		**88,305,338**
TOTAL (A + B)		**727,236,039**		**645,764,458**

CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY (C-MET)

Schedules forming part of the Accounts for the year ended 31st March 2016

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 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** **- ₹ 4,38,42,949/-** **(Previous year ₹ 3,98,58,809/-)**

b) **Leave Encashment** **- ₹ 3,43,91,000/-** **(Previous year ₹ 3,12,74,765/-)**

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

PLACE: PUNE
DATE : 01/07/2016

CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY (C-MET)

Schedules forming part of the Accounts for the year ended 31st March 2016

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. 3,54,76,154/- (Previous Year Rs. 10,14,33,952/-)

   b) Expenditure in Foreign Currency : Rs. 23,10,691.16 (Previous Year Rs. 94,25,844/-)
   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 Communications 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 at31st March, 2016 and the Income & Expenditure Account for the year ended on thatdate.

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

PLACE: PUNE
DATE : 01/07/2016

Centre for Materials for Electronics Technology, Pune

Schedules forming part of Income & Expenditure A/c for the year ended 31st March, 2016

(Amount ₹)

SCHEDULE 7 : REVENUE GRANTS	Current Year 2015-16	Previous Year 2014-15
Grants for Revenue Expenditure.	102,056,137	59,484,332
TOTAL	**102,056,137**	**59,484,332**

SCHEDULE 8 - INCOME FROM SERVICES	Current Year 2015-16	Previous Year 2014-15
Income from Services:		
Analysis receipts	1,075,464	1,845,385
Overhead / Consultancy Services / Int. Fee	17,300,338	6,493,952
ToT Fee	1,602,000	-
TOTAL	**19,977,802**	**8,339,337**

SCHEDULE 9 : INTEREST EARNED	Current Year 2015-16	Previous Year 2014-15
On Savings account and Term Deposits :		
a) With Scheduled Banks	28,292,131	34,310,390
b) On Advances to Staff	20,787	56,254
TOTAL	**28,312,918**	**34,366,644**

SCHEDULE 10 : OTHER INCOME	Current Year 2015-16	Previous Year 2014-15
Miscellaneous Income	342,458	532,133
TOTAL	**342,458**	**532,133**

Centre for Materials for Electronics Technology, Pune

Schedules forming part of Income & Expenditure A/c for the year ended 31st March, 2016

(Amount ₹)

SCHEDULE 11 : ESTABLISHMENT EXPENSES	Current Year 2015 -16	Previous Year 2014-15
Salaries and Allowances	83,077,710	74,995,827
Bonus	233,481	223,528
Training	-	103,565
Leave Travel Concession	436,325	1,221,527
Medical Reimbursement	4,609,351	4,181,555
Leave Encashment	3,512,048	8,144,375
Gratuity	4,355,528	9,784,009
Employer Contribution to CPF & Interest	3,552,529	4,131,416
Honorarium	80,362	45,000
Canteen Reimbursement	944,680	949,180
Newspaper & Periodicals	83,738	98,059
CEA Reimbursement	1,284,603	1,377,842
Membership Fees	42,037	39,504
Recruitment Expenses	26,535	-
Transfer TA	-	27,781
TOTAL	**102,238,927**	**105,323,168**

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, 2016)

(Amount ₹)

Particulars	Current Year 2015-16	Previous Year 2014-15
Chemicals	607,985	19,180
Laboratory Consumables	2,335,784	2,875,794
Laboratory General expenses	5,465,119	2,364,190
Electricity charges	9,222,906	11,234,162
Water charges	168,319	272,523
Repairs and maintenance :		
On Buildings	284,029	587,420
On Electricals	503,577	314,142
On Laboratory Equipments	1,417,496	210,211
On Office Equipments	424,784	383,173
On Furniture & Fittings	7,004	3,090
Rates and Taxes	1,373,030	1,353,809
Postage & Telegram Charges	102,138	116,846
Telephone, Telex & Fax charges	501,392	515,575
Printing and Stationery	720,458	486,362
Conveyance	29,123	12,621
Vehicle Hire	1,499,263	2,859,620
TA & DA	1,485,502	3,097,747
Security Expenses	4,098,565	3,340,394
Office & General Expenses	5,244,285	3,671,951
Diesel for Gensets	386,723	499,738
Auditor's Remuneration	107,175	103,854
Audit Expenses	82,944	106,072
Meeting Expenses	1,197,433	976,409
Foreign Tour Expenses	-	383,421
Gardening Expenses	663,019	1,178,848
Bank charges	12,690	8,110
Advertisement and Publicity	129,692	340,455
Professional & Consultancy charges	32,345	1,055,035
Prior Period Expenses	67,789	1,164,749
Foundation Day Expenses	515,768	92,572
Workshop/Symposia	7,000	-
TOT Expenses	661	436,828
Contribution to Sponsored project	126,925	17,625,000
Assets written off	-	2,472
Legal Expenses	1,000	-
TOTAL	**38,821,923**	**57,692,373**

Centre for Materials for Electronics Technology, Pune

DETAILS OF PROJECT BALANCES AS ON 31st March, 2016

(Amount ₹)

Sr. No.	Project Name		Opening Balance as on 1.4.2015	Receipts during the year 2015-16	Payments during the year 2015-16			Closing Balance as on 31.3.2016
					Fixed Assets	Other Expenses	Total	
	1		2	3	4	5	6 = (4+5)	7 = (2+3-6)
	PUNE							
1	SP22	TiO2 Phosphate Glass	5,214	-	-	-	-	5,214
2	SP24	X-ray Absorbing -DIT	202,371	-	-	-	-	202,371
3	SP26	Micro-cantilever proj.	80	-	-	-	-	80
4	SP28	Solar light photocatalyst	(211,501)	-	-	-	-	(211,501)
5	SP29	Q-semiconductor Glass	(801,779)	166,952	-	-	-	(634,827)
6	SP30	LTCC Project-BARC	27	-	-	-	-	27
7	SP32	Adv. Process capabilities in LTCC	593,516	-	-	-	-	593,516
8	SP33	Devp. Of LTCC Sys for Cryocooler Appl	11,066	-	-	-	-	11,066
9	SP36	Solar Hydrogen production	(26,870)	-	-	-	-	(26,870)
10	SP37	CSIR-ES-Dr. Mulla	175,626	92,766	-	268,392	268,392	-
11	SP39	Devp. Of Optical Isolators	(5,431)	-	-	-	-	(5,431)
12	SP40	Devp of Prototype X-ray Apron	2,861,329	136,925	-	2,814,455	2,814,455	183,799
13	SP41	UGC-JRF- JM Mali	287,200	-	-	223,571	223,571	63,629
14	SP42	Bismuth Sulphide quantum Dot glass	508,799	14,119	-	150,261	150,261	372,657
15	SP43	In House Devp of Photoconducting Paste (DIT)	(60,020)	1,092,957	73,294	784,213	857,507	175,430
16	SP44	Devp of Photo-Reactor	142,270	-	-	142,477	142,477	(207)
17	SP45	Devp of LTCC Materials for GPA	29,373,420	10,001,124	11,312,901	(7,092,481)	4,220,420	35,154,124
18	SP46	CSIR-SRF-Ms. Bhirud	166,118	12,000	-	141,600	141,600	36,518
19	SP47	CSIR-JRF-Mr. Pandit	8,924	459,201	-	434,126	434,126	33,999
20	SP48	Inspire Faculty Award- Dr.(Ms) Chauhan	1,085,264	685,730	-	1,314,782	1,314,782	456,212

Centre for Materials for Electronics Technology, Pune

DETAILS OF PROJECT BALANCES AS ON 31st March, 2016

(Amount ₹)

Sr. No.	Project Name		Opening Balance as on 1.4.2015	Receipts during the year 2015-16	Payments during the year 2015-16			Closing Balance as on 31.3.2016
					Fixed Assets	Other Expenses	Total	
	1		2	3	4	5	6 = (4+5)	7 = (2+3-6)
21	SP49	Devp. Of Active Material	27,229,787	26,254,757	2,011,738	27,505,150	29,516,888	23,967,656
22	SP50	CSIR-JRF-MS A F Shaikh	277,988	254,800	-	502,675	502,675	30,113
23	SP51	Devp. Of Visible Light	2,270,721	170,902	1,270,632	707,819	1,978,451	463,172
24	SP52	Fab. Of Microwave Components	180,196	24,068	-	204,264	204,264	-
25	SP53	INDO-UKIERI Programme with NCL	280,162	12,379	-	182,389	182,389	110,152
26	SP54	Prototype Devp of Fuel Cell	569,832	1,065,800	-	939,727	939,727	695,905
27	SP55	Inspired Faculty Award-D R Patil	978,359	888,680	-	1,287,315	1,287,315	579,724
28	SP56	UGC-JRF-Trupti Nirmale	77,425	334,975	-	384,327	384,327	28,073
29	SP57	Devp of Nanostructured PdTe	483,951	749,585	-	845,526	845,526	388,010
30	SP58	Devp of Nanostructured PdTe	-	880,000	-	173,733	173,733	706,267
31	SP59	Synth and Charact of Condtor Polymer	-	5,361,000	-	256,460	256,460	5,104,540
32	TS04	Scaleup of colour Glass	217,922	-	-	-	-	217,922
33	TS07	LTCC Package for MEMS-JCDA	(221,612)	3,296,350	-	1,609,430	1,609,430	1,465,308
34	TS09	LTCC Packages thin film devices	711,246	2,630,623	-	2,742,427	2,742,427	599,442
35	TS10	Devp. Of Microwave Compenents in LTCC	3,187	-	-	-	-	3,187
36	TS11	Study on Synthesis of nano	45,869	-	-	309	309	45,560
37	TS12	LTCC Based Circuits Fittings	(1,786)	-	-	9,927	9,927	(11,713)
38	TS13	LTCC Based Magnectic Sensors	4,679,104	13,163	15,000	3,648,008	3,663,008	1,029,259
39	TS14	Low Temp Co-Fired Ceramic	-	2,493,750	-	1,260,983	1,260,983	1,232,767
		TOTAL (a)	**72,097,974**	**57,092,606**	**14,683,565**	41,441,865	56,125,430	73,065,150

Centre for Materials for Electronics Technology, Pune

DETAILS OF PROJECT BALANCES AS ON 31st March, 2016

(Amount ₹)

Sr. No.	Project Name	Opening Balance as on 1.4.2015	Receipts during the year 2015-16	Payments during the year 2015-16			Closing Balance as on 31.3.2016
				Fixed Assets	Other Expenses	Total	
	1	2	3	4	5	6 = (4+5)	7 = (2+3-6)
	HYDERABAD						
40	SP21 Ultrahigh quality Silicon carbide… for adv. Electronics devices	323,352		-	-	323,352	323,352
41	SP22 Establishment of extended pilot plan…annum hafnium sponge	527,554	29,035,141	2,361,700	18,335,354	20,697,054	8,865,641
42	SP25 Gallium -DST	50,484	-	-	50,484	50,484	-
43	SP27 CdS/cdTe Thin film Solar Cells	740,353	350,000	-	1,090,353	1,090,353	-
44	SP28 Germanium -DAE	1,385,286	-	-	129,530	129,530	1,255,756
45	SP29 RoHS-TEST LAB-DIT	3,307,254	10,093,000	1,596,735	6,859,885	8,456,620	4,943,634
46	SP30 SERB-SP	840,229	600,000	675,000	760,000	1,435,000	5,229
47	SP31 GALLIUM-DST	5,627,060	-	76,650	357,701	434,351	5,192,709
48	SP32 E-WASTE-PCBs-DeitY	22,145,322	27,893,000	5,177,548	6,438,250	11,615,798	38,422,524
49	SP33 DRDO/SSPL/CARS/Cd & Te	-	2,300,000	-	248,530	248,530	2,051,470
50	SP34 Photosensitizers for visible light -SERB	-	1,633,333	-	-	-	1,633,333
	TOTAL (b)	**34,946,894**	**71,904,474**	**9,887,633**	**34,593,439**	**44,481,072**	**62,370,296**
	THRISSUR						
51	SP39 Devp.of Light Polymer	(16,259)	16,259	-	-	-	-
52	SP44 Devp. of Nanostructured titania…applications	144,342	-	-	144,342	144,342	-
53	SP45 Devp. of LTCC materials ….applications	326,431	830,136	5,100	953,884	958,984	197,583
54	SP46 Devp of Titania Aerogel…Solar cell appl.	414,011	208,120	-	468,197	468,197	153,934
55	SP47 BRNS(AS)	301,256	648,831	149,060	677,471	826,531	123,556

Centre for Materials for Electronics Technology, Pune

DETAILS OF PROJECT BALANCES AS ON 31st March, 2016

(Amount ₹)

Sr. No.	Project Name	Opening Balance as on 1.4.2015	Receipts during the year 2015-16	Payments during the year 2015-16			Closing Balance as on 31.3.2016
				Fixed Assets	Other Expenses	Total	
	1	2	3	4	5	6 = (4+5)	7 = (2+3-6)
56	SP48 BRNS(RR)	634,217	1,007,947	-	1,514,430	1,514,430	127,734
57	SP49 DST(SNP)	303,629	910,550	42,612	579,790	622,402	591,777
58	SP50 DEITY(AS)	1,700,842	3,499,416	2,432,807	1,317,350	3,750,157	1,450,101
59	SP51 DEITY(AS)	2,388,385	2,766,115	1,177,890	2,726,233	3,904,123	1,250,377
60	SP52 BRNS(RT)	1,374,993	374,223	327,246	370,256	697,502	1,051,714
61	SP53 BRNS(RR)	12,544,468	3,652,476	11,434,299	1,879,302	13,313,601	2,883,343
62	SP54A DIETY(NCP)	40,729,858	49,154,475	13,053,018	3,114,129	16,167,147	73,717,186
63	SP54B DST(NCP)	63,140,664	611,178	1,572,250	1,537,867	3,110,117	60,641,725
64	SP55 BRNS(NR)	597,905	112,445	-	784,494	784,494	(74,144)
65	SP56 BRNS(NCP)	-	15,421,270	-	2,074,191	2,074,191	13,347,079
66	SP57 SERB(NR)	-	1,258,060	36,750	83,488	120,238	1,137,822
67	GIA-III JRF- Ms. VANI K	168,244	-	-	168,244	168,244	-
68	GIA-IV JRF- Ms. DIVYA A S	1,374	464,667	-	436,700	436,700	29,341
69	GIA-V JRF- Ms. VIJYA K	30,404	736,624	-	609,305	609,305	157,723
70	GIA-VI JRF- Ms. LAXMI PRIYA	813	680,319	-	638,711	638,711	42,421
71	GIA-VIII JRF- MR. MANOJ N	27	247,463	-	246,251	246,251	1,239
72	KSCSTE FELLOWSHIP- MR. ANIL A	2,671	254,929	-	246,337	246,337	11,263
	TOTAL (c)	**124,788,275**	**82,855,503**	**30,231,032**	**20,570,972**	**50,802,004**	**156,841,774**
	GRAND TOTAL (a+b+c)	**231,833,143**	**211,852,583**	**54,802,230**	**96,606,276**	**151,408,506**	**292,277,220**

Centre for Materials for Electronics Technology, Pune

RECEIPTS AND PAYMENTS FOR THE YEAR ENDED 31st March, 2016

(Amount ₹)

RECEIPTS	Current Year 2015-16	Previous Year 2014-15	PAYMENTS	Current Year 2015-16	Previous Year 2014-15
I. Opening Balances			**I. Payments**		
a) Cash in Hand	10,627	3,873	Establishment		
b) Bank Balances :			Expenses	95,114,022	89,544,027
i) Saving Account	79,627,645	15,914,431			
ii) In Fixed Deposits	273,456,400	399,266,974	Administrative		
iii) In Project &			Expenses	38,878,263	55,215,371
Others Deposits	204,364,448	92,928,783			
			II.Project Payments		
			Sponsored Projects	74,112,005	65,326,489
II. Grants Received			**III.Fixed Assets**		
a) From DeitY, G.o.I.			Purchase of Fixed		
Capital Grants	3,943,863	94,565,668	Assets	3,943,863	94,392,468
Revenue Grants	102,056,137	59,484,332	Capital Work in		
			Progress	-	16,879,961
III. Interest on Deposits					
On Bank Deposits	27,829,842	34,343,990	**IV.Other Payments**		
			Loans & Advances to		
			staff & others	53,093,652	35,472,072
IV. Other Income					
Analysis Income	1,096,914	354,240	**V.Closing Balances**		
Miscellaneous Receipts	20,649,884	28,237,242	a) Cash in Hand	9,710	10,627
			b) Bank Balances :		
			i) In Savings accounts	98,291,734	79,627,645
			ii) In Fixed Deposits	251,628,773	273,456,400
			iii) In Project &		
			others Deposits	244,639,682	204,364,448
V. Other Receipts					
Sponsored Project					
Receipts	135,839,030	181,259,337			
Loans & Advances					
from staff & others	10,836,914	79,30,638			
TOTAL	**859,711,704**	**914,289,508**	**TOTAL**	**859,711,704**	**914,289,508**

Statement showing comments of the Statutory Auditors on the accounts of C-MET for the year 2015-2016 and C-MET's replies thereto

<table>
<tr><th>Sr.</th><th>Brief Subject</th><th>Auditor's Comments</th><th>C-MET Reply</th></tr>
<tr><td>1.</td><td>Fixed Assets pertaining to projects</td><td>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 & the fixed assets which are not likely to be returned to the sponsorers, feasibility to dispose off such assets may be assessed.</td><td>Actual amount of Fixed Assets procured out of the projects is separately accounted for & indicated in the schedule. Also individual headwise expenditure is separately maintained and sent to Sponsoring Agency. In addition, project Fixed Assets register is also maintained.
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.</td></tr>
<tr><td>2.</td><td>Valuation of Inventory</td><td>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.</td><td>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.</td></tr>
<tr><td>3.</td><td>Prior period income and expenditure</td><td>Expenses for ₹ 67,788.73/- of previous year have been accounted for in the current year.</td><td>For information only.</td></tr>
<tr><td>4.</td><td>Contingent Liability</td><td>Contingent liability not provided in the books of account :-
In ₹
<table><tr><th>Particular</th><th>Current Year</th><th>Previous Year</th></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></td><td>For information only.</td></tr>
</table>