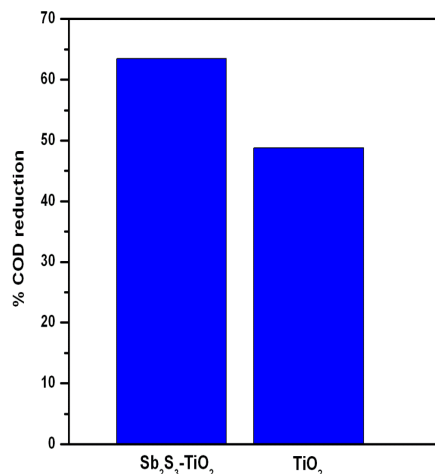


Summary of Findings of Research Projects under ISRO-UoP Programme

PROJECT NO	104
TITLE	Application of remotely sensed data for the evaluation of impervious surface growth and its effect on surface runoff in two rapidly urbanizing watersheds of Western Maharashtra, India
INVESTIGATORS	Dr (Ms) Anargha Wakhare, Department of Geography, Nowrosjee Wadia College, Pune
DURATION	3 years (Started on: April 2010)
BUDGET (₹)	9,66,000
SUMMARY OF FINDINGS	<p>The study aimed at developing and validating a model for estimation of surface runoff integrating the variations in the land use land cover and imperviousness within two rapidly urbanizing basins of Maharashtra. The study areas chosen are Mula-Mutha basin and Bhima-Indrayani basin. Impervious surface extraction and surface runoff estimation are carried out for 20 years span period, for both the basins. Impervious surface was calculated at pixel level with the help of regression model and considering parameters such as band values, NDVI, tasseled cap, population density etc. Estimation of surface runoff was carried out by SCS-CN method. This method computes direct runoff through an empirical equation that requires rainfall, soil, land cover and the curve number (CN). In the last 20 years, the built up area has increased from 14% to 26% for Mula-Mutha basin, and from 5% to 15% for Bhima-Indrayani basin. Impervious surface prevents the infiltration of water into the soil which is considered as important measure of overall health of the watershed. 40% of the area of Mula-Mutha basin is in the degraded category and 57% under impacted category, imperviousness ranging from 40 to 60%. These values indicate fully urbanized status of the watershed. Bhima-Indrayani basin is in developing phase with 24% area under impacted zone (imperviousness ranging from 10 to 25%). Pune city expanded radially and most of the developmental activities are concentrated in the vicinity of city. The surrounding areas of Pune such as, Katraj, Hadapsar, Warje, Singhgad Road show higher values of runoff (25 to 30 mm). The surface runoff calculated with the SCS-CN method is validated statistically with the measured data. The measured and simulated runoff values have good correlation. The present work highlights the fact that there is a strong positive relationship between the percent imperviousness of the watershed and the amount of runoff generated.</p>

PROPOSAL NO	105
TITLE	Modelling spatial patterns of fresh water reservoirs with special reference to plankton, mollusks and fishes using physico-chemical characteristics of water and remote sensing techniques
INVESTIGATORS	Dr Pandit Sangeeta V, Dept of Zoology, UoP
DURATION	3 years (Started on: April 2010)
BUDGET (₹)	13,68,000
SUMMARY FINDINGS	<p>OF A three year study was conducted in two reservoirs, Panshet and Varasgaon to evaluate the changes in water quality parameters, Zooplanktons, Fish diversity and also to use remote sensing and GIS techniques for mapping water quality of the study area. Study showed that concentrations of metals in the reservoirs were within acceptable limits with reference to potability of water. Other parameters such as Spatial Distribution of pH, Electric Conductivity, Total Dissolved Solids, Hardness, Alkalinity, Acidity, Dissolved Oxygen Temperature, Salinity, Phosphate, Nitrate and Sulphate contents in these reservoirs were studied. Fish diversity was dominated by family Cyprinidae of which 11 species were identified. Other abundant groups of fish species belong to families such as Notopteridae, Mastacembelidae, Siluridae, Ambassidae, Hemiramphidae and Belonidae. Fish diversity of the reservoirs, according to Simpson Diversity index, was rich. Zooplankton population of the reservoir was dominated by Copepod followed by Rotifer and Cladocera. Spatial distribution of parameters like pH, Electric conductivity, Hardness, Calcium, Magnesium, Acidity, Nitrate, Phosphate content, TDS etc were found to be within permissible limits. However spatial distribution maps of Chloride and Sulphate were found beyond permissible limits in monsoon season. In this study, LISS III sensor data was used to predict SDT of entire reservoir at pixel level i.e., 24 m X 24 m by developing regression equations based on sampling and radiance data from satellite imagery. Data was useful in measuring transparency of water.</p>

PROPOSAL NO	107
TITLE	Synthesis and applications of composites of TiO ₂ with Carbon nanotubes and metal chalcogenides
INVESTIGATORS	Pragati R. Thakur, Dept of Chemistry, UoP
DURATION	3 years (Started on: April 2010)
BUDGET (₹)	14,52,000
SUMMARY OF FINDINGS	<p>Aim of the study was to synthesize, characterize, and investigate photocatalytic activity of TiO₂ and their composites with Carbon Nanotubes (CNTs) and metal chalcogenides for degradation of model pollutants such as methyl orange dye (MO), p-Chlorophenol (PCP) and p-Nitrophenol (PNP). Synthesized nanocomposite was characterized using various analytical tools. Photocatalytic efficiency of synthesized TiO₂-MWCNTs nanocomposite was studied using multilamp photoreactor and mineralization of pollutants was checked by Chemical Oxygen Demand (COD) values. Rate of degradation of MO dye using 10% MWCNTs-TiO₂ nanocomposites calcined at 300°C, as photocatalyst, was found to be 10 times higher as compared to TiO₂. COD values show substantial mineralization of model pollutants when nanocomposite was used, compared to bare TiO₂, showing better efficiency of the composite. Enhanced photocatalytic efficiency of TiO₂-MWCNTs could be due to MWCNTs acting as adsorbent, dispersing agent and electron reservoir and thus facilitating separation of the photo-generated electron-hole pairs at the TiO₂-MWCNT interface. This also leads to faster rate of photocatalytic oxidation. Synthesis of nanoparticles of Sb₂S₃ by wet chemical method under refluxing conditions and TiO₂-Sb₂S₃ nanocomposite by hydrothermal and mechanical mixing method was also carried out. These materials were characterized using analytical tools. Sb₂S₃ particles under visible light irradiation photodegraded 95 % of MO dye solution within 30 minutes. This was much faster under visible light than under UV light irradiation. Nanocomposite showed higher photocatalytic degradation and mineralization of model pollutant compared to bare TiO₂ nanoparticles. Enhanced photocatalytic efficiency of composite may be attributed to semiconductor-semiconductor heterojunction between TiO₂ and Sb₂S₃, which improved charge separation and thereby enhancing the lifetime of hole. Nanocomposites synthesized under present investigation have potential application in environmental remediation as well as in solar cell application.</p>



COD Reduction using 10%Sb₂S₃-TiO₂ nanocomposite and TiO₂ nanoparticles for photocatalytic degradation of MO dye

PROPOSAL NO 109

TITLE Use of a Geographical Information System to study tuberculosis epidemiology and the factors affecting case detection in a rural population in Pune district, Maharashtra

INVESTIGATORS Dr Anita Kar, Director Interdisciplinary School of Health Sciences, UoP

DURATION 2 years (Started on: April 2010)

BUDGET (₹) 9,66,000

SUMMARY OF FINDINGS Aim of the study was to examine the strains of tuberculosis circulating in a peri-urban industrial area and study transmission dynamics of tuberculosis in that population. All health care facilities in the area were mapped using a Garmin 76CSx hand held device and the data was imported using ArcGIS 10.0. Tuberculosis surveillance was established by involving all practitioners to provide address and sputum samples from suspected tuberculosis cases. Sputum was cultured and species confirmation was done from positive cultures using MPB64 verification. Genotyping of 51 culture positive samples was done using PCR amplification of the 15 MIRU-VNTR loci and strains were identified using the MIRU-VNTR_{plus} database. All

culture positive patients were mapped at their place of residence. Cluster analysis was done to test for distribution of tuberculosis cases and strain types in the population. The field mapping of health care facilities provided the metrics of healthcare in a peri-urban setting. The data showed that the majority of health care services in this area are being provided by young, male graduates from the traditional medicine sectors who were mostly non-residents in this area. There was a 32% increase in these practitioners over 11 years even as the number of practitioners from modern medicine had remained constant. There was no difference in the services provided by practitioners from traditional and modern medicine services. The 51 culture positive samples from the tuberculosis surveillance yielded ten strains (Delhi/CAS, EAI, Beijing, LAM, West African 1, TUR, Haarlem, Uganda II, Uganda I and NEW-1 using 15 MIRU-VNTR loci. One strain could not be typed. GIS analysis revealed there was a significant clustering of tuberculosis cases in the community, however, the distribution of strains in the population was random, so that whether infection was obtained from within or from outside the community could not be ascertained. This study is a first report from India that shows that there were at least 10 different genotypes of *M. tuberculosis* circulating in the community. This observation has to be kept in mind during treatment, as there have been previous reports that different genotypes may vary in drug susceptibility. Apart from the diversity of circulating genotypes within a community, several unique strains were also identified, which could possibly be attributed to the high levels of migration, a significant characteristic of industrialized, peri-urban communities. Community transmission was not identified in this study, due to the random distribution of strains in the population.

PROPOSAL NO	111
TITLE	Study of biodiversity of some invertebrates of Sawanga Vithoba lake region Dist Amravati Maharashtra
INVESTIGATORS	Varsha Wankhade, Dept of Zoology, UoP
DURATION	3 years (Started on: April 2010)
BUDGET (₹)	13,18,000
SUMMARY OF FINDINGS	<p>The role of invertebrates in the food chain is important either directly as food for reptiles, birds, mammals or indirectly as agents in the recycling of soil nutrients. Invertebrates are also the indicator of ecosystem health. In the present study, status of ecosystem of Sawanga Vithoba Lake was assessed with reference to diversity of few arthropods such as order Odonata, Lepidoptera, Coleoptera and Araneae. Bacterial diversity in soil and water samples of the lake was also estimated. Sawanga-Vithoba lake is a freshwater lake created in 1972. Lake sediment plays significant role in maintenance of the quality of local, regional and global environment. Physicochemical parameters such as pH, nitrogen, phosphorus, organic carbon and potassium present in the lake water influence growth of flora and fauna. These parameters were assessed and found to be in normal range.</p> <p>Twenty eight species of butterfly belonging to five families were observed and studied. Butterfly exhibits seasonal variation in distribution of species. Some species such as <i>Papilio machaon</i>, <i>Parnara guttata</i>, <i>Cepora nerissa</i>, <i>Pieris brassicae</i>, <i>Junonia almanac</i>, <i>Junonia lemonias</i>, <i>Phalanta phalanta</i> and <i>Acraea terpsicore</i> are not observed in summer. Species richness in some cases like <i>Catochrysops strabo</i> and <i>Eurema hecabe</i> is found to be higher in all the seasons. Family Nymphalidae is the most represented family at Sawanga Vithoba lake. Thirty three species of odonata were observed and studied. Family Libellulidae is found to be the most represented family. Species such as <i>Diplacodes lefebvrii</i>, <i>Orthetrum glaucum</i>, <i>Tholymis tillarga</i>, <i>Aethriamanta brevipennis</i>, <i>Aciagrion pallidum</i> and <i>Lestes elatus</i> were not observed in summer. Twenty seven species of beetles belonging to 7 families are observed in the present study and family Scarabidae is found to be the most represented family. Sawanga-Vithoba Lake holds forty two species of spiders belonging to 14 families. Family Araneidae is the most represented family. Species belonging to five types of guild structure were observed with most represented guild as a “web builder”.</p>

PROPOSAL NO 113

TITLE Study of the direct radiative forcing of atmospheric aerosols over different environments

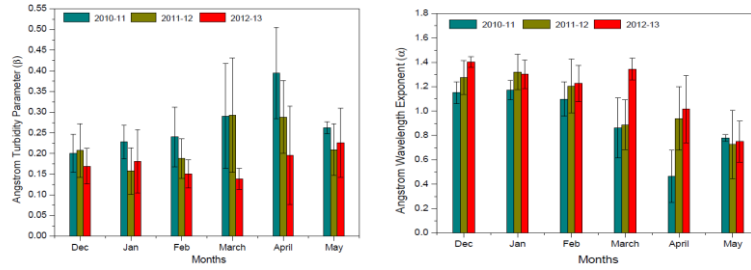
INVESTIGATORS Dr. G. R. Aher, Physics Department, Nowrosjee Wadia College (NWC), Pune 411 001.

DURATION 3 years (Started on: April 2010)

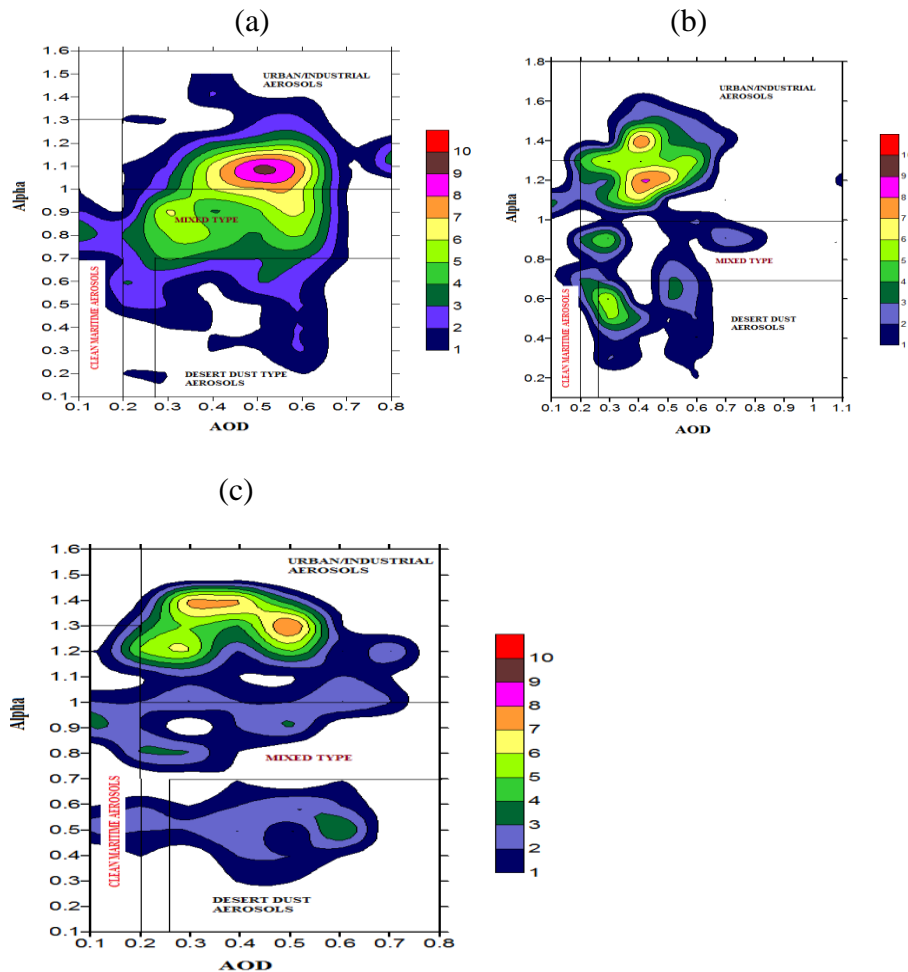
BUDGET (₹) 15,01,050/-

SUMMARY OF FINDINGS The project envisages independent ground-based radiometer measurements under clear-sky conditions simultaneously with comprehensive measurements of aerosol microphysical and optical properties. The short-wave global solar flux shows systematic seasonal diurnal variation pattern which is symmetric around local noon. The variation is represented by Gaussian distribution law at all the observing sites and is found to be dependent on the optical state of the atmosphere. The diurnal cycle in AOD at NWC and the observing sites is found to be related to the prevalent meteorological conditions, surface-based nocturnal temperature inversion in atmospheric boundary layer and influx of aerosols from different source regions as revealed by the wind trajectory analysis. Magnitudes of Ångström parameters, α and β suggest transformation of aerosols over NWC, during winter from high accumulation-mode dominance ($\alpha > 1$) to increased coarse-mode dominance ($\alpha < 1$) during pre-monsoon. This indicates that in winter, submicron aerosols are produced mainly from bio-fuel burning and fossil fuel combustion sources whereas during pre-monsoon, aerosol scenario is controlled by the combination of pollution and dust generation from strong surface heating and high winds. Aerosol direct radiative forcing (ADRF) shows significant day-to-day variation and co-varies with AOD. Cause of day-to-day variation is an anti-correlation between ADRF/AOD and daily RH and temperature range. Winter days generally show low surface forcing as compared to the pre-monsoon days at NWC. ADRF is minimum in winter and maximum during pre-monsoon. The minima and maxima in ADRF are found to correlate well with seasonal variation of AOD. The SBDART model derived top of the atmospheric forcing (TOA) is found to be considerably lower taking values in the range -15 W/m^2 to -30 W/m^2 . As a result of this, averaged atmospheric forcing is seen to be maximum in March and minimum in the month of May. For other months, averaged atmospheric forcing values are assumed in this range. For observing year 2011-12, the average atmospheric forcing is relatively less as compared to that during 2010-11. The large difference in the TOA and BOA during 2010-11 and 2011-12 demonstrate that the solar radiation is absorbed within the atmosphere causing warming of the atmosphere and at the same time there is a cooling effect at the earth's surface. This can substantially alter atmospheric stability and influence

dynamic system of the atmosphere. The overall TOA forcing at NWC, Pune are comparable, but the BOA forcing are stronger (more strongly negative) during 2010-11.



Seasonal variation of Angstrom wavelength exponent and Angstrom turbidity parameters at NWC, Pune



Contour density map of the Angstrom Exponent versus AOD at 500 nm during observing years (a) 2010-11, (b) 2011-12 and (c) 2012-13.

PROJECT NO 115

TITLE Studies on structural, optical and electrical properties of transparent conducting thin film(TCO)

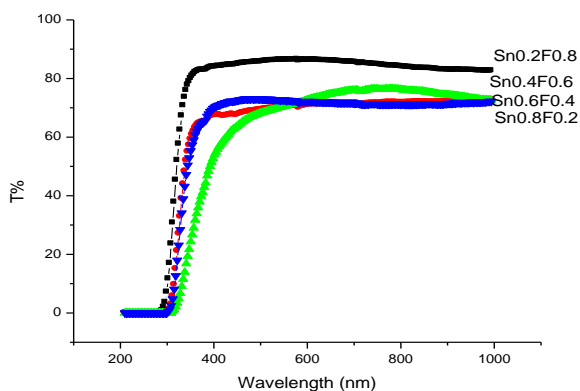
INVESTIGATORS Dr Arle Ramdas Nivrutti, Jijamata College of Science and Arts, Bhende

DURATION 2 years (Started on: July 2011)

BUDGET (₹) 3,30,000

SUMMARY OF FINDINGS Thin films of ZnO have been deposited by chemical spray technique using mixed aqueous solutions of Zinc acetate. The effect of deposition parameters on thin film formation has been investigated and deposition parameters such as volume of solution, substrate temperature, substrate to nozzle distance, nozzle diameter, spray rate etc. have been optimized. The X-ray diffraction pattern of the deposited films shows hexagonal wurtzite crystal with mean crystallite size in the range of 30nm to 52nm. The film exhibits increasing c-axis orientation along (002) with change in molar concentration of spray solution. The films have been characterized using optical and electrical measurements. The effect of various Al doping concentrations on the thin film formation has been investigated. The variations in the Al doping concentrations affect the optical and electrical properties. The optical and electrical properties were verified using spectrophotometer and two-probe method. The related optical data are recorded in the wavelength of range 200-999 nm. Study shows that the films deposited at substrate temperature higher than 550⁰C were of highly conducting nature and strongly adherent to substrate. Al doping in ZnO thin films affects the electrical and optical properties of the films. F doping in SnO₂ thin films also affects the electrical and optical properties of the films. The formed thin films are found to be useful in solar cell as window layer and conductive layer.

Transmittance and absorbance of the SnO₂ : F thin films



PROJECT NO 116

TITLE Novel electrochemical approach to prepare CuInGaSe₂ based solar cells using non-aqueous bath

INVESTIGATORS Dr N B Chaure, Dept of Physics, UoP

DURATION 2 years (Started on: July 2011)

BUDGET (₹) 12,68,000

SUMMARY OF FINDINGS Aim was to deposit CuInSe₂ (CIS) and CuInGaSe₂ (CIGS) thin films by electrodeposition technique from non-aqueous bath for solar cell applications. At the initial stage of the project, window layers such as CdS, ZnS, ZnO and Al –doped ZnO were deposited using different deposition techniques and optical, structural, compositional, morphological and electrical properties were studied. Cyclic voltammetry was used to optimize the deposition parameters to get the stoichiometric and highly polycrystalline CIS and CIGS thin films. CIS and CIGS thin film electrodeposited from non-aqueous bath was found to be highly crystalline with tetragonal structure without post deposition heat treatment as compared to the films deposited from aqueous bath. We observed that the preferential orientation of CIGS thin film deposited in non-aqueous bath can be changed from reflection plane (112) to (204)/(220) by changing the deposition parameters. Systematic shift in Bragg's angle 2θ with increasing concentration of Ga into CIGS thin films has been also observed. All CIS and CIGS layers deposited from non-aqueous bath were void free, compact, uniform, with different morphology and adhering well with the substrates. Besides the growth of highly crystalline film, large size particles are electrodeposited in non-aqueous bath which have better prospects in high efficiency solar cell development plan. Superstrate configuration, Glass/FTO/CIS/Au and Glass/FTO/CIGS/Au was prepared for solar cell development. The Glass/FTO/CIGS/Au structure measured $V_{oc} = 370$ mV, $J_{sc} = 27$ mA cm⁻², $FF = 0.49$ and $\eta = 4.8\%$. Experiments to electrodeposit CIS and CIGS thin films on to flexible substrates have been also carried out.

PROJECT NO 119

TITLE Identification of critical areas of conservation concern using RS-GIS technique from northern Western Ghats of India

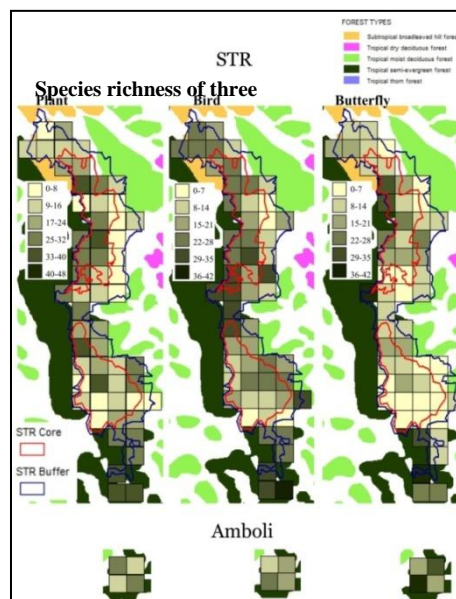
INVESTIGATORS Dr Ankur Patwardhan, Abasaheb Garware College, Pune

DURATION 2 years(Started on: July 2011)

BUDGET (₹) 10,87,000

SUMMARY FINDINGS

OF The study aimed at preparing (a) biological richness maps and (b) thematic maps using GIS and RS tools. Multiple taxa approach was used to prioritize areas of conservation concern in northern Western Ghats of India. Woody plants, birds and butterflies were considered as focal taxa. There have been no such studies on congruence of these taxa and their use in conservation planning. Effective action in terms of conservation management calls for an understanding of ‘spatial distribution’ of the ‘conservation value’ of the forests besides knowing their vegetation types. A composite picture generated through understanding of thematic maps of multiple taxa such as birds, butterflies and plants is needed to identify critical areas for conservation of rare, endangered and threatened (RET) species. 2.5' X 2.5' grids were laid on the study areas. Belt transects (500m length and varied width) were laid in each grid for each taxa and in different habitats for sampling. Other taxa were recorded opportunistically. The focus on planning management strategies for biodiversity conservation increased in the recent times due to the development in GIS and RS techniques. Therefore thematic maps of species richness, abundance, endemic species richness, threat status, and conservation value were prepared. New spatial distributions of some species have been recorded during the study. We have also provided inputs from the study to State Forest Department for further use and action while designing of ecological corridor of Sahyadri Tiger Reserve.



PROJECT NO	120
TITLE	Development of High Performance Polycarbonate/Graphite Nanocomposites with Low Percolation for EMI Shielding Application
INVESTIGATORS	Dr Rajendra Kumar Goyal, College of Engineering, Pune Dr (Mrs) R C Aiyer Ex Professor of Dept of Physics, UoP
DURATION	2 years (Started on: July 2011)
BUDGET (₹)	10,30,000
SUMMARY FINDINGS	<p>OF Main objective was to increase the electrical conductivity of the thermoplastic polycarbonate (PC) matrix by adding expanded graphite (EG) using solution method followed by hot pressing technique. For comparison purpose, nickel (Ni) and cobalt (Co) powders were also added into the PC matrix. The experimental densities of the micro- and nanocomposites were found to be close to the theoretical density indicating samples free from porosity. Results of scanning electron microscope (SEM) confirmed that honeycomb structure of the EG particles was maintained in nanocomposites. It also showed the uniform dispersion of EG in the PC matrix. Three dimensional structure of EG in the PC matrix was observed after 2 % EG addition. Uniform dispersion of Ni and Co particles was also observed in PC matrix. The electrical conductivity increased from 3.97×10^{-16} S/cm for the pure PC matrix to 0.9×10^{-3} S/cm for the 10 % EG filled nanocomposite. This improvement in the electrical conductivity was nearly fourteen orders of magnitude than that of pure PC. The electrical percolation threshold for the PC/EG nanocomposites is found between 1 and 2 % EG, which is much lower than the reported value in literature. Cost of PC/EG is lower than PC/CNT nanocomposites. The dielectric constant of PC/EG nanocomposites containing 5 and 10 % EG is measured to be 56 and 387 respectively at 1 MHz. This is a high value compared to CNTs and metal filled polymer matrix nanocomposites. The dc electrical conductivity of pure PC increases to 1.7×10^{-1} S/cm for 60 wt % (~17 vol.%) Ni composite. This improvement in the electrical conductivity is nearly fifteen orders of magnitude than that of pure PC. For a given volume %, the PC/EG nanocomposites showed higher electrical conductivity than that of PC/Ni composites. In case of PC/Co composite, the rate of increase in electrical conductivity was lower than those of PC/EG and PC/Ni composites. The theoretical EMI shielding effectiveness (EMI-SE) was calculated using Simon formalism. EMI-SE of 2.8 vol % EG filled PC nanocomposites is 19 dB which increases to 30 dB at 1 MHz for 5.7 vol % of EG. Due to their good electrical conductivity, dielectric constant and dissipation factor these composites may be useful for the antistatic/EMI shielding applications.</p>

PROJECT NO 122

TITLE Preparation of Barium magnesium tantalite (BMT) and Barium Zinc Tantalate(BZT) with and without dopants for microwave dielectric applications

INVESTIGATORS Dr Manisha Y Khaladkar / Dr (Mrs) Rohini P Mudhalwadkar, College of Engineering, Pune

DURATION 2 years (Started on: July 2011)

BUDGET (₹) 10,00,000

SUMMARY OF FINDINGS Aim of the project was to prepare ternary and quaternary mixtures with perovskite structure of Barium Magnesium Tantalate (BMT) and Barium Zinc Tantalate (BZT) using co-precipitation as hydroxide or citrate as well as by solid state route and to study kinetics of decomposition of hydroxides/citrate by TG, DTA. Accordingly synthesis of ternary ceramics Barium Magnesium Tantalate (BMT) $Ba(Mg_{1/3}Ta_{2/3})O_3$ and Barium Zinc Tantalate (BZT) $Ba(Zn_{1/3}Ta_{2/3})O_3$ was attempted with and without addition of B_2O_3 . The synthesis was finally carried out by two step solid state route as co-precipitation did not give satisfactory results. By optimizing process parameters, sintering temperature could be successfully reduced by 300 °C (from 1600 to 1300 °C) and sintering time by 2 hours. Densification of the ceramic is achieved by addition of 2.5% B_2O_3 glass additives in BMT. The sample was tested and the results show 97.7% theoretical density, Dielectric constant-24, resonant frequency 8.8 GHz for pellets with 10mm diameter and 4 mm thickness. Kinetics of decomposition and phase formation from room temperature to 1400°C in nitrogen atmosphere, using TG and DTA has been studied. The morphology and crystal was studied by XRD and SEM for different thermal history. Dielectric measurements were carried at SAC Ahmadabad. 15 pellets were delivered to SAC Ahmadabad for final approval on the basis of dielectric measurement.