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Editorial

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Materials of interest for energy conversion and optimal energy utilization will continue to be one of the primary areas of research across the globe. Efforts to reduce the gap between manufacturing and fundamental research and development in areas such as fuel cells, hydrogen storage, ocean wave generators, photovoltaics, storage batteries, thermoelectrics, ultracapacitors and windmills are anticipated to grow significantly. These efforts will be accompanied by demands on minimizing pollution, maximizing recycling and reuse of materials, reduction in manufacturing costs and return on investments. Hybrid approaches to energy conversion – for example, wind/photovoltaics[1] or photovoltaics/photothermal[2] – will be the landscape of the future. From a materials perspective, approaches such as Roll to Roll (R2R) Processing Technology[3] will be implemented for a variety of energy-related applications.

Carbon continues to highlight the landscape of materials research. Q-carbon, reported recently by Narayan and Bhaumik,[4,5] with its unusual properties of ferromagnetism, mechanical strength and low work function, has potential applications in switching, power electronics and electronic displays. Efforts to develop cleaner fuel sources and reduce CO_2 to CO by way of electrocatalysis have been making significant progress.[6]

The International Conference on Sustainable Energy Technologies (ICSET) 2014 (see http://www.icset.ex.ac.uk/) was held in Coimbatore, Tamil Nadu, India, on 11–13 December 2014. The conference was organized by the PSG College of Technology (PSGCT), Tamil Nadu, India; the University of Exeter, UK; the University of Oslo, Norway; the Institute for Energy Technology, Norway and the Bergen University College, Norway. Six plenary lectures and 16 invited talks focusing on materials and energy were given at the conference. The oral sessions focused on power electronics, wind energy, dye-sensitized solar cells, thin-film photovoltaics, nanomaterials, hydrogen storage, electrolytes, photocatalysis, biomaterials and thermal energy.

This joint issue of *Nanomaterials and Energy* and *Emerging Materials Research* is dedicated to selected papers that were presented at ICSET 2014.

The first of the papers in this joint issue presents 'A study of plasmonic effect in silicon (Si) solar cells with silver nanoparticles'.[7] This paper is a collaborative study between K. Yakubov of the Urganch branch of Tashkent Medical Academy, Urganch, Uzbekistan, J. Zhanabergenov of the Department of Physics, Nukus State Pedagogical Institute, Karakalpakstan, Uzbekistan, and S. Turemuratov and U. Ernazarov of the Complex Institute of Natural Sciences, Karakalpak Branch of Uzbekistan Academy of Sciences, Karakalpakstan, Uzbekistan. In this paper, a study of the plasmonic effect of small-size silver nanoparticles in silicon-based solar cells is presented. The particles were deposited on the surface of Si by thermal evaporation method. The size of the particles and their distribution were studied using scanning electron microscopy. It is shown that the largest particle size was ≈32 nm. The samples were capped by SiO_x or SiN_x, and the reflectance spectra were measured. It was found that the reflectance decreases with increasing silver nanoparticle diameter. Annealing at 375°C did not cause any qualitative change in the reflectance spectra. The particles were deposited on Si solar cells and current–voltage characteristics were measured.

The second paper[8] focuses on 'Studies on cadmium telluride–cadmium selenide bilayer'. This paper is by L. S. Balakrishnan, S. P. Subramanian and T. R. Perchamy of the School of Electrical and Electronics Engineering, SASTRA University, Thanjavur, India, and M. Sridharan of the Functional Nanomaterials and Devices Lab, Centre for Nanotechnology and Advanced Biomaterials (CeNTAB), School of Electrical and Electronics Engineering, SASTRA University, Thanjavur, India. Group II–VI elements of the periodic table are suitable for electronic and optoelectronic applications. Cadmium selenide (CdSe) and cadmium telluride (CdTe) bilayer films were deposited onto well-cleaned glass substrates using vacuum evaporation technique. These films were analyzed using X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM), energy dispersive X-ray analysis (EDAX) and ultraviolet–visible (UV–Vis) spectrophotometry to study their microstructural, morphological and optical properties. Crystallinity of the CdSe film increased with increase in film thickness, which in turn favored the crystallinity of the CdTe layer deposited over CdSe. The CdTe/CdSe bilayer showed that globular surface morphology and the grain size of the films measured by FESEM micrographs ranged from 16 to 31 nm. EDAX analysis confirmed the presence of cadmium, selenium and tellurium. Two electronic transitions were observed in the optical band gap of the CdTe/CdSe bilayer whose energy levels lie in between the energy band gap of the bulk CdTe and CdSe semiconductors. These electronic transitions are mainly due to the spin orbit splitting of energy levels in the valence bands.

'Studies on ZnCdSe thin films prepared by thermal evaporation' by S. Selva Priya, B. Lakshmi Shree, P. Therasa Ranjani and M. Sridharan of the Functional Nanomaterials & Devices Lab, CeNTAB, SASTRA University, Thanjavur, India School of Electrical and Electronics Engineering, SASTRA University, Thanjavur, India is the third paper[9] in this issue. This paper reports a study on the zinc cadmium selenide (ZnCdSe) thin films that were prepared on thoroughly cleaned glass substrates by co-evaporating highly pure zinc and CdSe powders and the films were subsequently annealed at 100°C for 1 h in a vacuum. The influence of zinc concentration on the structural, morphological, compositional and optical properties of the ZnCdSe films was studied using XRD, FESEM, EDAX and UV–Vis spectroscopy, respectively. The XRD patterns confirmed the polycrystalline nature of the ZnCdSe films. The optical band gap of the films increased from 2·07 to 2·69 eV with increasing zinc concentration, owing to the replacement of cadmium with zinc atoms. The increase in optical band gap with increasing zinc concentration signifies the wide coverage over the electromagnetic spectrum, which facilitates the application of the ZnCdSe thin films in optoelectronics.

Next is the paper 'Preparation and characterization of $ZnIn_2S_4$ thin film'[10] by H. Sampath, T. I. Jayaraj, R. Oommen and U. R. Parthasarathy of the Department of Physics, Avinashilingam Institute for Home Science and Higher Education for Women, Tamil Nadu, India. In this study, a $ZnIn_2S_4$ (ZIS) crystalline thin film was prepared by spray pyrolysis technique. The as-deposited ZIS film was characterized by XRD, UV–Vis–near infrared spectroscopy, FESEM and EDAX. XRD revealed the crystalline nature of the material. Absorption edge was found to be 471 nm. Direct band gap of the film was calculated and found to be 2·68 eV. The absorption coefficient of the ZIS film exhibits the maximum value of $5{\cdot}3 \times 10^6$ cm^{-1}. The as-deposited ZIS composition was nearly stoichiometric.

The next paper is on 'Synthesis and characterization of Cu_2ZnSnS_4 nanoparticles'[11] by A. G. Kannan and T. E. Manjulavalli of the Department of Physics, NGM College, Pollachi, India. The study focuses on copper zinc tin sulfide (Cu_2ZnSnS_4 or CZTS), which is a *p*-type semiconducting material with a high absorption coefficient (10^4 cm^{-1}) and a band gap of ~1·5 eV. Most of its constituents are abundantly available in nature and are environmentally benign. Therefore, in this work, the authors have investigated the structural and optical properties of CZTS nanoparticles synthesized by solvothermal method (water, ethylene glycol (EG)). XRD and Raman studies revealed that the CZTS nanoparticles exhibited kesterite structure with preferential orientation along the (1 1 2) direction. The crystallite sizes of the nanoparticles were found to vary from 14 (water) to 7 nm (EG). Morphological analysis using FESEM shows that the growth of the particles is controlled using EG as a solvent. It was observed from EDAX spectra that the composition of the nanoparticles prepared in EG was found to be nearly stoichiometric. The calculated optical band gaps of CZTS nanoparticles were 1·39 and 1·53 eV for water and EG, respectively. The electrical conductivity of the samples was measured and found to be higher for the sample prepared in EG.

Following this is the paper on 'Influence of bias voltage on sputter deposited V_2O_5 films'[12] by D. R. Pattabiraman and S. Madanagurusamy of the Functional Nanomaterials and Devices Lab, CeNTAB and School of Electrical and Electronics Engineering, SASTRA University, Thanjavur, India and S. Gupta of the Solid State Physics Laboratory, New Delhi, India. Vanadium pentoxide (V_2O_5) thin films were deposited over thoroughly cleaned silicon dioxide (SiO_2)-coated silicon (Si (100)) substrates by reactive direct current magnetron sputtering technique at various substrate bias voltages keeping the other deposition parameters constant. The thickness of the films, measured using stylus probe technique, was in the range of 200–230 nm. The films were characterized for their structural, morphological, optical and electrical properties using XRD, FESEM, UV–Vis spectroscopy and four-point probe method, respectively. The crystallinity of the films improved at higher substrate bias voltages, which in turn had an influence on the optical band gap and electrical resistivity. The optical band gap of the deposited films was decreased to 2·68 eV from 2·71 eV as a result of removal of defects. The temperature coefficient of resistivity of V_2O_5 films, deposited at −100 V, was found to be −1·9%/K. The results obtained are correlated to the substrate bias voltage.

P. T. Ranjani, P. Deepak Raj, B. Lakshmi Shree, S. Selva Priya and M. Sridharan of the Functional Nanomaterials and Devices Lab, CeNTAB and School of Electrical and Electronics Engineering, SASTRA University, Thanjavur, Tamil Nadu, India report their 'Studies on magnetron-sputtered V_2O_5/ZnO thin films'.[13] In this study, V_2O_5 thin films were grown over zinc oxide (ZnO) buffer layer-coated glass substrates at room temperature by magnetron sputtering technique. Initially, ZnO thin films were formed by oxidizing sputtered zinc films at different annealing temperatures (300–500°C) in ambient air for 1 h. The influence of the ZnO buffer layer on the structural, morphological, optical and electrical properties of V_2O_5 films was studied using XRD, FESEM, EDAX, UV–Vis spectrophotometry and four-point probe method. The thickness values of the deposited films were measured using the stylus probe profilometer. XRD patterns of the V_2O_5 films deposited over ZnO (VZO) showed reflection planes corresponding to V_2O_5 and the ZnO buffer layer. The optical studies showed an enhancement in the optical properties of V_2O_5 films deposited over a ZnO buffer layer. The electrical studies of the VZO films showed that the resistivity of VZO films varied from 400 to 60 Ω cm. The enhancement in the optical and electrical properties may be due to the improvement in the crystallinity of the film because of the ZnO buffer layer.

A. Serra-Torrent (the Escola Tècnica Superior d'Enginyeria Industrial de Barcelona, Universitat Politècnica de Catalunya, Barcelona, Spain, the Functional Nanomaterials & Devices Lab, CeNTAB, and the School of Electrical and Electronics Engineering, SASTRA University, Thanjavur, India), P. Deepak Raj (the Functional Nanomaterials & Devices Lab, CeNTAB and the School of Electrical and Electronics Engineering, SASTRA University, Thanjavur, India), L. Abad (the

Institut de Microelectrònica de Barcelona - Centro Nacional de Microelectrònica–CSIC, Cerdanyola del Vallès, Barcelona, Spain), A. Lopeandia-Fernandez and J. Rodriguez-Viejo (the Departament de Física, Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Barcelona, Spain) and M. Sridharan (the Functional Nanomaterials and Devices Lab, CeNTAB and School of Electrical and Electronics Engineering, SASTRA University, Thanjavur, India and Departament de Física, Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Barcelona, Spain) report their studies on 'Vanadium-doped zinc oxide films for piezoelectric application'.[14] In this study, nanocrystalline zinc oxide:vanadium (ZnO:V) films were deposited over thoroughly cleaned glass substrates using reactive direct current magnetron sputtering technique. The deposited ZnO:V films were analyzed for their structural, morphological, optical and electrical properties using XRD, FESEM, UV–Vis spectrophotometry and two-probe method, respectively. Microstructural parameters of the films varied with respect to substrate temperature, substrate bias and sputtering powers. FESEM micrographs of the films showed that the prepared films were porous when compared with pure ZnO films. ZnO:V films were highly transparent and the optical band gap of the films varied between 3·10 and 3·37 eV. Piezoelectric generation of the ZnO:V films was tested using different testing methodologies. The lab-scale device fabricated in the present work generated 100 μV on applying vibrations. Scaling up this device would yield piezoelectricity of higher voltages.

The paper 'Synthesis of nano-composite $Ca_xZn_y(OH)_{2(x+y)}$ as thermochemical storage material'[15] is presented by J. Hu and M. S Zheng of the School of Chemical Engineering, Northwest University, Xi'an, China and the Energy Transmission Technology and Applied Institute, Northwest University, Xi'an, China and S. M. Sun and L. J. Yu of the School of Chemical Engineering, Northwest University, Xi'an, China. They report that thermal energy storage has good application prospects. Thermochemical storage is one of the interesting methods for long-term storage as it can store energy at room temperature without energy loss. Their experiment investigates a method to synthesize the material of expanded graphite-based $Ca_xZn_y(OH)_{2(x+y)}$ in ammonia/ammonium chloride solution for solar energy storage. Scanning electron microscopy, thermogravimetric analysis and XRD are used to characterize the properties of this material. The results show that calcium hydroxide and zinc hydroxide in the expanded graphite composite are disposed at the nanolevel. Specifically, the crystal size of the composite material ranges from 29·9 to 47·3 nm. The structure of expanded graphite adsorbed the porous nanocomposite material $Ca_xZn_y(OH)_{2(x+y)}$. Furthermore, the decomposition temperature of expanded graphite-based $Ca_xZn_y(OH)_{2(x+y)}$ was nearly 171·6°C, which will significantly and effectively improve the reaction rate of thermal decomposition.

'Crystal structures of aluminum-based hydrides' is a study[16] by P. Vajeeston and H. Fjellvåg of the Centre for Materials Science and Nanotechnology, Department of Chemistry, University of Oslo, Oslo, Norway. The interest in hydrogen as the future energy is that it is a clean energy carrier, the most abundant element in the universe, the lightest fuel, richest in energy per unit mass and, unlike electricity, it can be easily stored. Hydrogen is the most promising fuel for various applications and is already being used as the fuel of choice for space programs around the world. Metal hydrides are a fascinating class of compounds because the small mass and size of hydrogen and its medium electronegativity result in large flexibility in terms of metal–ligand interactions. These manifest in a vast variety of possible compositions, chemical bonding, crystal structures and physical properties. In this review, the authors present the structural details of all up-to-date known aluminum-based hydrides.

The last paper in this joint issue is on 'Comparative investigation on performance of various aspiration methods applied in a single-cylinder diesel engine'.[17] This study is reported by P. Duraiswamy, R. Guru and V. Madakkan of the Department of Mechanical Engineering, JCT College of Engineering and Technology, Coimbatore, India. Better fuel economy and higher power with lower maintenance cost have increased the popularity of diesel engine vehicles. This paper investigates the effects of various aspiration methods such as natural aspiration, charge preheating, exhaust gas recirculation and supercharging on the performance of a diesel engine using neat diesel fuel in terms of brake thermal efficiency, indicated thermal efficiency, mechanical efficiency, specific fuel consumption and total fuel consumption. For this study, a naturally aspirated four-stroke single-cylinder diesel engine was modified and tested with diesel fuel under various load conditions. The evaluation of the experimental data showed that the engine gives good performance.

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Selected papers from the Global Conference on Polymer and Composite Materials (see http://www.cpcmconf.org/2015/), the International Conference on Materials Science (see http://www.icmsconf.org/), the 9th National Conference on Solid State Chemistry and Allied Areas (Delhi, India) and the International Conference on Multifunctional Materials for Future Applications (Varanasi, India) will be published in the future issues of *Emerging Materials Research*.

My heartiest congratulations to Dr. Sungho Jin, Professor Emeritus of the University of California, San Diego, the recipient of the 2016 Acta Materialia Gold Medal (see http://www.journals.elsevier.com/acta-biomaterialia/news/2016-acta-materialia-gold-medal-award-recipient-announced/).

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