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Editorial

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Editorial

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This year marks the 160th anniversary of Sir Jagadish Chandra Bose.[1] 120 years ago, Bose presented his research on performance of semiconductors at frequencies as high as 60 GHz.[2,3] 130 years ago, Hertz demonstrated the generation of electromagnetic waves and showed that they exhibited properties similar to that of light.[4] Since these discoveries, science has continued to evolve at a rapid pace.

The recent report of green laser sintering of copper oxide nanoparticles to form conductive lines is an excellent example of the interaction of photons with solids.[5] Sunlight-assisted water splitting, as a possible source of generating clean and storable energy, continues to excite researchers. A novel mothed of 'all-in-one sunlight-driven water splitting by combination of nanoparticulates and molecular co-catalysts on CdS nanorods' has been demonstrated recently.[6]

The first of the papers in this issue of *Emerging Materials Research* focuses on 'Optical loss induced by metal electrodes in a polymer optical waveguide for optical sensor'.[7] This paper is by Jia-Wei Zhang (School of Electrical Engineering, Northeast Electric Power University, Jilin, China; State Key Laboratory of Reliability and Intelligence Electrical Equipment, University of Technology, Tianjin, China; Department of Electrical Engineering, Xi'an University of Technology, Xi'an, Shanxi, China), Guo-An Xue (School of Electrical Engineering, Northeast Electric Power University, Jilin, China), Yan-Chen Cui (Zhejiang Electric Transmission and Transformation Co. Ltd, State Grid, Zhejiang, China; School of Electrical Engineering, Northeast Electric Power University, Jilin, China) and Rui-Tong Liu (Power Research Institute, Liaoning Province Power Company Limited, State Grid, Shenyang, China). Optical electric field sensors have received significant attention in recent years for their potential in a broad range of applications. There are many studies in the literature about the electro-optic field sensors, but only a few reports focus on the optical losses. In this paper, an analysis model is developed for the design of the electrode of a polymer electro-optic modulator in an optical electric field sensor. The optical losses due to the electrode are presented for different core waveguide thickness and cladding refractive indices. It has also been found that the optical loss due to electrode absorption will depend not only on the cladding layer but also on the core waveguide thickness. At the same time, the thickness of the cladding layer and core waveguide can be chosen freely by adjusting the refractive index of the polymer materials and keeping the optical losses to be less than 0·1 dB/cm. The results of this study will be helpful for the design of a polymer electro-optic modulator in an electro-optic field sensor.

The second paper by Yanhua Cai and Lisha Zhao of the Chongqing Key Laboratory of Environmental Materials and Remediation Technologies, Chongqing University of Arts and Sciences, Chongqing, People's Republic of China, is on 'Thermal behavior and light transmittance of PLLA nucleated using strontium phenylmalonate'.[8] Adding functional additives in the poly(L-lactic acid) (PLLA) matrix to develop high-performance modified biodegradable polymers is of great interest. Therefore, in this work, strontium phenylmalonate (SrPA), as an organic–inorganic hybrid material, was prepared through a neutralization reaction to evaluate its influence on the crystallization behavior, melting behavior, thermal stability and light transmittance of PLLA. The non-isothermal crystallization behavior for all PLLA/SrPA samples showed that the SrPA loading and variations in cooling rate significantly influenced the non-isothermal crystallization of PLLA; 5 wt% SrPA exhibited the best crystallization-accelerating capability for PLLA. However, the effects of the set final melt temperature used on the non-isothermal crystallization were negligible, resulting from the minimal difference in solubility of SrPA in the PLLA matrix in the temperature range of 170–210°C. The results from X-ray diffraction measurements and melting behavior further demonstrated the crystallization-accelerating role of SrPA for PLLA. Thermal stability measurements indicated that the incorporation of SrPA did not change the thermal decomposition behavior of PLLA, but the onset decomposition temperature decreased with increasing SrPA concentration. The addition of SrPA led to a significant decrease in light transmittance.

The third paper focuses on 'Influence of heat treatment on Cr and Fe-rich precipitates in thermally aged duplex steels'.[9] This paper has been reported by Shamanth Vasanth and Hemanth Krishna of the School of Mechanical and Automotive Engineering, Reva University, Bangalore, India, Karekere Rangaraju Gopi of the Department of Mechanical Engineering, Rajeev Institute of Technology, Hassan, India and Gajanan Anne of the Department of Mechanical Engineering, Shri Madhwa Vadiraja Institute of Technology and Management, Udupi, India. In this investigation, three different heat treatment conditions were evaluated to correlate the microstructural changes of duplex steels with their mechanical properties. In the first heat treatment condition, the samples were aged at 475°C for up to 1000 h. This resulted in the formation of alpha and alpha-prime precipitates in ferrite matrix due to spinodal decomposition, which in turn embrittled the samples. In the second heat treatment condition, the embrittled samples were reversion heat-treated at 550°C for up to 120 min, which resulted in dissolution of the alpha and alpha-prime precipitates. This resulted in an increased ductility of samples. In the third heat treatment condition, the reversion heat-treated samples were re-aged at 475°C for 100 h in order to check the applicability of reversion heat treatment. The results showed that spinodal decomposition again remained as the primary mechanism of embrittlement, and it was also found that there was not much difference in the re-embrittlement rate.

The fourth paper 'Equal channel angular extrusion of semicircular AA 5083 covered with copper casing'[10] has been reported by Ananda Babu Varadala (Department of Mechanical Engineering, Vignan's Institute of Engineering for Women, Visakhapatnam, India), Swami Naidu Gurugubelli (Department of Metallurgical Engineering, Jawaharlal Nehru Technological University Kakinada – University College of Engineering Vizianagaram, Vizianagaram, India) and Sateesh Bandaru (Department of Mechanical Engineering, Vignan's Institute of Information Technology, Visakhapatnam, India). The microstructural evolution and mechanical behavior of semicircular AA 5083 billets subjected to equal channel angular extrusion (ECAE), with and without copper casing (CC), are investigated in this work. The semicircular billets, circumferentially covered with and without CC, are extruded up to three passes in route A at room temperature. Even when the coarse grain structure of the initial material is significantly refined, the microcracks and the structural defects were observed in the billets extruded without CC due to non-uniform strain distribution. The use of CC on the circumference of the semicircular billets reduces the dead zone effect on the structural homogeneity and minimizes the formation of microcracks on the outer periphery of the extruded material. The uniform distribution of the effective strain imposed on the billets ECAE'd with CC enhances the development of equiaxed ultrafine grains at low pressing loads. The newly formed ultrafine grains with a size of few hundreds of nanometers significantly increase the mechanical properties of the ECAE'd AA 5083 with the CC. The obtained results were in good agreement with the earlier reports in which ECAE was carried out with back pressure arrangement.

'Effect of nano-SiO_2 from rice hull ash on the conductivity of cement paste'[11] is the fifth paper in this issue of *Emerging Materials Research*. Joshua T. Dimasaka (Department of Civil Engineering), Engelbert K. Peralta (Institute of Agricultural Engineering), Milagros M. Peralta (Institute of Chemistry), Alvin Karlo G. Tapia (Institute of Mathematical Sciences and Physics) and Marish S. Madlangbayan (Department of Civil Engineering), all from University of the Philippines Los Baños, Los Baños, Philippines, are the coauthors of this paper. The electrical conductivity of simulated cement paste matrixes with water/cement ratios of 0·50 and 2·0% amorphous nanosilica, synthesized from rice hull ash, has been related to the effect of hydration stages on the ions dissociated in the capillary pore solution of the cement paste mesostructure. The increase in ions as the hydration proceeded has also been implied by the increasing trend of the conductivity spectra obtained from the complex impedance spectroscopy in the frequency region from 100 kHz to 20 MHz. In the 10^5–10^7 Hz spectra, the conductivity was also found to exhibit a power-law behavior. To consider the effect of capillary pores, a comparable set of cement pastes with a similar macrostructure has been established using a modified method of simple grinding and pelletizing with similar techniques. From the results of the Kramers–Kronig validation test, the impedance data have been found to exhibit a causal, linear and stable behavior in the high-frequency region from 6 to 20 MHz.

Ramesh Kumar Chouhan, Manish Mudgal, Abhishek Bisarya and Avanish Kumar Srivastava (Council of Scientific and Industrial Research–Advanced Materials and Processes Research Institute, Bhopal, India) report their studies on 'Rice-husk-based superplasticizer to increase performance of fly ash geopolymer concrete'.[12] Workability is a major drawback of fly-ash-based geopolymers due to its high viscosity. In this sixth paper, a new type of superplasticizer is developed to overcome this workability issue. Due to the high viscosity of geopolymeric binder structures, none of the conventional superplasticizers was found to be effective in maintaining the viscosity of the mixture. The novel hybrid superplasticizer was developed by utilizing agrowaste – that is, rice husk – and an alkaline activator. Characterization studies (by X-ray diffraction, Fourier transform infrared spectroscopy and field emission scanning electron microscopy) of the material indicated that the amorphous silica from rice husk reacts with the alkaline activator – that is, sodium hydroxide – and results in the in situ synthesis of sodium silicate and lignin. The developed superplasticizer was used in different percentages in fly-ash-based geopolymeric systems to study its engineering properties. The workability of the fresh geopolymer concrete was measured using the slump cone test method as per IS 1199-1959,[13] while the compressive strength was evaluated as per IS 516-1959,[14] and it is reported that the workability of the geopolymer concrete was improved significantly compared to that of conventional geopolymeric systems. In the present work, an attempt has also been made to establish a working mechanism for the developed superplasticizer with geopolymeric systems, which indicated its compatibility with $[–Si–O–Al–O–]_n$ networks.

'Detection of thermal response of geomaterials: a critical appraisal'[15] is the seventh paper in this issue. Somenath Mondal, Devendra Narain Singh and Maryam Shojaei Baghini (Indian Institute of Technology Bombay, Mumbai, India) are the authors of this paper. Heat sensors and thermal probes have been employed to determine the thermal properties (i.e. thermal flux, thermal conductivity, thermal resistivity and volumetric heat capacity/specific heat) of geomaterials (i.e. soils and rocks) in both laboratory and in situ conditions. However, the applicability of these methods for different types of geomaterials and the influence of the inherent properties of the sensors on the obtained results are still a matter of concern. Hence, it becomes essential to review conventional and state-of-the-art methods that can be used to determine these properties of geomaterials along with their advantages and limitations. In addition to this study, a review of different sensors and probes and the influence of various specific characteristics of geomaterials (i.e. morphology, mineralogy, pore structure, microbial aspect, organic content and material heterogeneity) on their thermal response is discussed. It is highlighted that the mineralogy and pore structure of geomaterials have a significant influence on their thermal response.

'Process parameter optimization for FSW of AA6061/SiC/fly ash AMCs using Taguchi technique'[16] by Sachinkumar, Sannayellapa Narendranath and Dupadu Chakradhar of the Department of Mechanical Engineering, National Institute of Technology Karnataka, Mangalore, India, is the eighth paper in this issue of *Emerging Materials Research*. In this research work, aluminum matrix composite (AMC) plates were welded using friction stir welding (FSW). AMCs contain AA6061 as a base metal with silicon carbide (SiC) and fly ash particles as reinforcements. The FSW process parameters considered in this work were tool rotational speed (revolutions/min), tool traverse speed (mm/min) and tool tilt angle (degrees). The Taguchi L9 orthogonal array was considered for optimizing the process parameters. Tensile strength and hardness were the two output responses obtained by analyzing joint efficiency and signal/noise ratio. An analysis of variance (Anova) study was conducted to identify the percentage contribution of each process parameter to the output responses. The Anova study concluded that among the three process parameters, tool rotational speed was the most dominant parameter in deciding the tensile strength and hardness of the FSW joints, followed by traverse speed and tool tilt angle. At the end, the results were validated by performing additional experiments.

The ninth and last paper 'Study on applying inorganic polymers to restore rammed earth brick monuments'[17] is by Yen-Men Lu (Eastern District Engineering Office, MRT Engineering Bureau, Taipei City Government, Taiwan), Yung-Piao Chiu (Department of Digital Media Design, Hwa Hsia Institute of Technology, New Taipei City, Taiwan) and Yan-Chyuan Shiau (Department of Construction Management, Chung Hua University, Hsinchu, Taiwan). Rammed earth has been used as a building material in China for thousands of years. However, due to weather and environmental impact, monuments built from rammed earth suffer from varying degrees of damage. In order to restore these structures effectively, the authors heated kaolinite featuring the same characteristics of rammed earth and added glass powder and sodium hydroxide to make inorganic polymers. Subsequently, using various mix ratios, calcination temperatures and calcination times, the compressive strength of the clay produced was investigated. It was determined that by controlling the inorganic polymers and clay ratio at 1:1 and calcinating the mixture at 300°C for 1 h, the compressive strength could be increased to 430·9 kg-force/cm^2. This result met the Chinese National Standard for red bricks, and the proposed material consumed only 1% of the energy used during the red brick burning process. The proposed method substantially reduced carbon dioxide (CO_2) emissions while conserving energy. These results verify that inorganic polymers can be applied to rammed earth used to restore monuments.

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