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Editorial
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Editorial

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Materials science and engineering is evolving rapidly. The convergence between biomaterials, ceramics and composite materials, electronic materials, including semiconductors, metals, polymers and superconductors has been catalyzed by the aerospace, automotive, bio/health/pharma-related, construction and infrastructure, electronics, energy, environment and pollution-prevention, optics/optoelectronics and the transportation industry. Materials are being utilized in various forms – bulk, coatings, multilayers, nanolayers, thick films, thin films and so forth. The gap between research and development and manufacturing has started to narrow.

Human health and the continued demand to improve the quality of life have been the primary driver for research in biomaterials. Heart disease has been the leading cause of death in several parts of the world, including the USA.[1] Coronary angioplasty, also known as percutaneous coronary intervention, is a procedure that is used to open clogged heart arteries.[2] The procedure involves temporarily inserting and blowing up a tiny balloon, which leads to the widening of the artery to facilitate improved blood circulation. Angioplasty is often combined with the permanent placement of a small wire mesh tube called a stent to help prop the artery open and decrease the chance of it narrowing again.[2] Some stents, referred to as drug-eluting stents, are coated with medication to assist with keeping the artery open while others are not (bare-metal stents). The first article in this issue of Emerging Materials Research focuses on new approaches in evaluating metallic candidates for bioabsorbable stents.[3] This article, by Patrick K. Bowen, Jaroslaw Drelich, Robert E. Buxbaum, Rupak M. Rajachar and Jeremy Goldman of Michigan Technological University (MTU), focuses on the series of unconventional approaches that have been developed (at MTU), which are able to screen candidate materials for use in bioabsorbable (or bioresorbable) stents by reducing the scale of necessary animal studies and the complexity of biocorrosion analyzes. Using a novel in vivo approach, materials formed into simplified wire geometry were implanted into the wall of the abdominal aorta of rodents for several weeks or months to measure the extent of in vivo degradation, quantify mechanical strength over time, characterize the resulting products and assess biocompatibility. An in vitro method was developed to identify bioabsorbable candidate materials, reproduce the corrosion products formed in vivo and predict the degradation rate of stent materials.

Fuel cells are considered as a promising alternative energy conversion device for mobile and stationary applications.[4] They are considered "green" because of their ability to generate water, heat and electricity without emitting pollutants. This generation occurs by an electrochemical reaction with hydrogen as a fuel and oxygen in the air as an oxidant. Among the various types of fuel cells, proton-exchange membrane fuel cells (PEMFCs), also called polymer electrolyte fuel cells (PEFCs) or solid-PEFCs, are a type of fuel cell in which PEMs are used as an electrolyte. The main advantage of PEMFCs is that they permit the use of thin polymer electrolytes. The second article in this issue of Emerging Materials Research focuses on enhanced electrochemical activity of hybrid composite membranes and their proton conductivity.[5] The author, Uma Thanganathan of Okayama University, presents a study of a new type of proton-conducting membrane with good structural and electrochemical properties when used as an electrolyte for low-temperature PEMFCs. In this study, the cross-linking agent, glutaraldehyde and polyvinyl alcohol, were reacted with tetraethyl orthosilicate and 3-glycidyloxypropyltrimethoxysilane. The obtained membranes demonstrated large proton conductivity, in the order of 10^2 S/cm at −20 to 140°C and a relative humidity of 50%. The fuel cell performance evaluation was performed at 70°C, and a maximum current density of 401 mA/cm^2 was obtained at a cell voltage of 0·6 V.

Glass fibers have been utilized as the reinforcement component in a variety of applications ranging from aircraft and automobiles to printed wire circuit board substrates and sporting goods.[6] An ultimate stress of 3·5 GPa has been measured, in the literature, in small-diameter glass fibers.[6] However, flaws resulting from contact abrasion and hydrolytic degradation significantly reduce the realizable strength of commercial fibers used for manufacturing.[6] Moisture interaction with the metal oxides in E-glass leads to corrosion-induced defects and decreases fiber mechanical strength.[6] The third article in this issue of Emerging Materials Research focuses on the thermal shock behavior of hydrothermally conditioned E-Glass fiber/epoxy composites.[7] This article, by Ananta P. Chakraverty, Upendra K. Mohanty and Bibhuti B. Biswal of National Institute of Technology, Rourkela, India, describes a study of the moisture absorption properties of glass-fiber-reinforced polymer composites. The work evaluates the glass fiber/

epoxy composite under hydrothermal exposure coupled with up- and down-thermal shocks for various lengths of time. Interlaminar shear strength (ILSS) values of shocked and nonshocked composite specimens were determined using INSTRON-1195 testing system. Low-temperature differential scanning calorimetry was used to monitor the glass transition temperature (T_g). A longer hydrothermal exposure showed an increase in the ILSS value after an initial low value.

As the demand for high-torque, low-emission and improved fuel economy continues to grow, engine designers are constantly forced to seek stronger materials for engine block construction.[8] This is particularly the case in the diesel sector in which resolution of the conflicting performance objectives requires increased cylinder bore pressures. The fourth article in this issue of Emerging Materials Research focuses on novel material used in the automotive industry: compacted graphite iron (CGI).[9] This article, by Ajit Behera and Subas C. Mishra also of National Institute of Technology, Rourkela, India, focuses on increasing the performance of automotive parts by utilizing new materials. The main objective of their study is to achieve increase in quantity and quality of automotive parts produced and for an optimum performance along their life cycle. The article gives a comparative view of CGI with gray cast iron and ductile iron.

Today, geosynthetics[10] have become an integral part of road construction. Geogrids have become established as a part to reinforce or stabilize layers in structures. The fifth article in this issue of Emerging Materials Research focuses on the experimental evaluation of utilizing geogrids under subbase layers to decrease rutting and increasing bearing capacity.[11] This article, by Alireza Mardookhpour of Islamic Azad University, Lahijan, Iran, focuses on utilizing polymer materials in order to improve the performance of road structure based on two factors, decreasing deformation and increasing bearing capacity. The purpose of this research work was to find a relation between the loading of the geogrid, the thickness of the aggregate layer and its bearing capacity.

Body armor is a bullet-resistant metal or alternate material worn by a person to provide protection from weapons or bodily injury.[12] The sixth article in this issue focuses on the development and performance testing of the world's first automated individual body armor inspection system.[13] This article, by Lawrence J. DAries, US Army ARDEC Picatinny Arsenal, describes the feasibility of designing an automated inspection system to examine the integrity of all the small arms ceramic armor plates currently in service. This amounted to ~1 million units, so the need for a high-throughput, fully automated system was apparent, and this included automated defect recognition software and automated material handling. Since the writing of this Editorial, the US Army announced the following: "Army Designs Body Armor for Women and Batteries."[14]

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