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Editorial

Emerging Materials Research

Editorial: Renewable energy materials and manufacturing of metal materials

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It's my pleasure to write this editorial for introducing the September 2023 issue of *Emerging Materials Research*. This issue covers quantum dots (QDs), nanoparticles, alloys, metal oxides and polymers for the applications of solar cells, optoelectronics, anti-corrosion materials, building materials and so on. These topics focus on the development of renewable sources of energy for sustainable energy, environmental protection and novel bionic materials, which are current research hot-spots and areas of concern.

With the rapid development of modern society and increasing consumption of fossil energy, the discovery of renewable and sustainable energy is a main concern for researchers. Recovering bioenergy from wastewater for conversion of organic matter to methane gas by anaerobic biological techniques has attracted intensive attention. Wang *et al.*[1] developed various iron materials, including zerovalent iron (ZVI), magnetite (iron (II,III) oxide (Fe_3O_4)) and iron (III) oxide (Fe_2O_3) for methane production in anaerobic sludge. The results displayed that ZVI gave the best performance for methane production arising from the enhanced direct interspecific electron transfer. Even though the solar cell is one of the renewable and clean sources of energy, the harvesting of solar energy is quite costly and slow. It is vital to realize cost-effective rates for solar cells with high efficiency. In recent years, QD solar cells, in which the QDs serve as the primary absorbing material, have attracted increasing attention owing to their versatile electrical and optical properties. In the work of Umar *et al.*,[2] the authors employed the Solar Cell Capacitance Simulator in One Dimension (SCAPS-1D) software to study the effect of defect density on the performance of a QD solar cell, which was designed by using QDs as an absorber, lead sulfide as a type of *n*-sulfide, titanium dioxide (TiO_2) as the electron transport layer and poly[bis(4-phenyl) (2,4,6-trimethylphenyl)amine] as the hole transport layer. The results showed that the increase of electron mobility could lead to an increase in the values of efficiency and power conversion efficiency of solar cell. By optimizing the temperature, mobility of electrons, interface defect density and so on, they believe that the QD solar cell has the potential to revolutionize the solar energy industry. Peters *et al.*[3] found that their as-synthesized hybrid ternary $Cd_{1-x}Fe_xS$ nanoparticles by the cost-effective chemical method with the tunable energy band gap structures had potential applications in optoelectronics and energy harvesting. In order to increase the efficiency of the solar cell device, Kaundal *et al.*[4] used the hydrothermal method to synthesize the graphene oxide (GO)–cadmium sulfide (CdS) nanocomposites, which exhibited the good luminescence properties in optoelectronic applications.

Regarding the corrosion phenomenon, the next paper[5] has proposed a strategy to hinder corrosion. The bubble cap in the moisture absorption towers could lose its efficiency quickly since it continuously contacts the stream, which would severely increase the corrosion damage in facilities in the oil, gas and petrochemical industry. In the paper by Mohammadzadeh *et al.*,[5] with the aim to prevent corrosion and prolong the service life of facilities, they explored the corrosion mechanism and the results depicted that the corrosion products after service were iron (II,III) oxide, iron (III) oxide, iron (III) hydroxide ($Fe(OH)_3$) and iron (II) carbonate ($FeCO_3$). The casting defects and ineffective microstructural phases formed from the deficient alloying elements were responsible for the poor performance of the material against corrosion. Based on these results, the authors provide some suggestions and solutions for hindering the corrosion.

For the purpose of reducing the mineral waste and harmful gas emissions generated in urban construction, Elbashiry *et al.*[6] designed a novel straw-filled bionic concrete hollow block (BCHB) with a model of the beetle elytron plate, which could not only improve the thermal insulation performance of the concrete block, but also reduce construction costs, protect the environment and realize rational use of resources. The authors believe that this BCHB could be used as a new non-bearing wall material to replace the traditional material in building construction.

Although polyetheretherketone (PEEK) is a high-performance thermoplastic polymer with a semicrystalline structure, the poor surface bioactivity and poor mechanical properties relative to those of human cortical bone limit its usage in load-bearing orthopedic implants, such as total knee and hip replacements. Kumar *et al.*[7] introduced multiwalled carbon nanotubes (MWCNTs) and nano-hydroxyapatite (nHA) into PEEK for the fabrication of hybrid nanocomposites using the Taguchi method by optimizing the ball-mixing and compression molding process parameters. The results demonstrated that the elastic modulus and hardness of PEEK-based hybrid nanocomposite with 30 wt% of

nHA and 3 wt% of MWCNTs could be significantly improved up to 83 and 65% compared with pure PEEK, respectively.

The last three papers are related to metals and alloys. Zhao *et al.*[8] studied the effect of different extrusion conditions, such as extrusion ratios and temperatures, on the microstructure, dynamic recrystallization behavior and texture evolution of Mg-6Zn-1Mn-0.2Gd (ZMG610) alloy. The results indicated that the low temperature of 350°C and high extrusion ratio of 45 could produce alloys with optimal mechanical properties, which was highly dependent on the synergistic effect of dynamically recrystallized grains, I-phase particles and texture. Amarnath *et al.*[9] analyzed the effect of the gas tungsten arc welding (GTAW) process, including constant-current (CC) and pulsed-current (PC) modes, on the weldability of electrolytic tough pitch copper, which is widely applied in the manufacturing of electrical machines and automobiles. The results expressed that GTAW-PC mode with optimal heat input and pulsating action could produce refined grains in the weld zone and heat-affected zone and increase the joint efficiency compared to the GTAW-CC mode. For the examination of the correlation between wire arc additive manufacturing (WAAM) technology and the microstructure and properties of Inconel 625 alloy, Junwen *et al.*[10] introduced cold metal transfer technology into WAAM for the Inconel 625 alloy, which formed good welds and a homogeneous distribution of mechanical properties.

I hope that you enjoy the contents of this issue, and the scientific and technical information in it can provide you more ideas to take your research forward.

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