Nanomaterials and Composites for Energy Conversion and Storage

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The emergence of nanostructured and composite materials has resulted in significant advancements in energy conversion and storage. The design and development of low-dimensional nanomaterials and composites include photocatalysts for photoelectrochemical devices for solar fuel production; semiconductor nanomaterials for new-generation solar cells, high specific surface area electrodes for efficient energy storage systems including batteries and supercapacitors, and nanocatalysts for increased triple phase boundaries in fuel cells, among others.

The published papers on this topic are divided into two parts. Nanomaterials and Composites for Energy Conversion and Storage: Part I, published in the August 2021 issue of *JOM*, presents a collection of papers with general emphasis on energy storage, while Nanomaterials and Composites for Energy Conversion and Storage: Part II, published in this issue of *JOM*, presents a collection of papers with general emphasis on energy generation.

In Nanomaterials and Composites for Energy Conversion and Storage: Part I, three papers discuss processing and characterization of nanomaterials and composites. The paper, “Radial Distribution Function Analysis and Molecular Simulation of Graphene Nanoplatelets Obtained by Mechanical Ball Milling”, led by Marcelo Pagnola, discusses the structural features of nanoplatelets of graphene obtained by ball-milling of synthetic graphite. The review paper, “Recent Development

of Natural Fiber Reinforced Polymer Nanocomposites”, led by Mahmood Anwar, discusses the increasing use of natural fibers as a sustainable alternative for synthetic fibers in polymer matrix composites for various applications. The paper, “Anode Electrolysis of Manganese Dioxide in Photoelectrochemical Cells”, led by Ziwei Ma, provides mechanistic insights into the photoelectrochemical deposition of electrolytic MnO_2 .

Four papers discuss the use of lower-dimensional materials in batteries. The paper, “Controlling Morphologies and Tuning the Properties of Co_3O_4 with Enhanced Lithium Storage Properties”, led by Jiaming Liu, reports that pyrolysis of Co_3O_4 with sodium citrate used as a structural modifier leads to multi-shelled hollow Co_3O_4 microspheres, which, when used as lithium ion battery anode materials, lead to high specific capacity and good cycling stability of the batteries. The paper, “Yeast-Derived Carbon Nanotube-Coated Separator for High-Performance Lithium–Sulfur Batteries”, led by Xiaodong Li, reports that coating the separator in Li-S batteries with yeast-derived carbon nanotubes suppressed the negative shuttle effects of polysulfides. The paper, “Electrochemical Properties of Mn-Doped Nanosphere LiFePO_4 ”, led by Xiaowu Nie, reports that Mn-doped LiFePO_4 nanospheres improve the discharge performance over undoped LiFePO_4 , when used as a cathode material for Li-ion batteries. The paper, “Facile Synthesis of Boron-Doped Reduced Electrochemical Graphene Oxide for Sodium Ion Battery Anode”, led by Yu Lin Zhong, demonstrates that boron-doped, highly reduced electrochemical graphene oxide, synthesized by electrochemical oxidation coupled with high-temperature thermal reduction, can be an effective active material in sodium ion battery anodes.

Yulin Zhong, Soumendra Basu, and Ziqi Sun are Guest Editors for the Energy Committee and the Energy Conversion and Storage Committee of TMS. They coordinated the topic Nanomaterials and Composites for Energy Conversion & Storage in this issue. The first part of this topic was published in August 2021.

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Finally, the paper, “Fabrication of a Novel Highly Thermal Conductive Shape-Stabilized Phase-Change Material using Cheap and Easily Available Cabbage Mustard Biochar as the Matrix”, led by Yan Chen, reports that cabbage mustard biochar used as the supporter of tetradecanoic acid for the fabrication of shape-stabilized phase-change materials can significantly increase the thermal conductivity while decreasing cost.

To download any of the papers in Nanomaterials and Composites for Energy Conversion and Storage: Part I, follow the URL: <https://link.springer.com/journal/11837/73/8/page/1> to the table of contents page of the August 2021 issue (vol. 73, no. 8).

In Nanomaterials and Composites for Energy Conversion and Storage: Part II, three papers discuss the use of nanomaterials in solid oxide fuel cells. The paper, “Investigations on Positive (Sm^{3+}) and Negative (Ho^{3+}) Association Energy Ions Co-Doped Cerium Oxide Solid Electrolytes for IT-SOFC applications”, led by T.R. Rajasekara, reports that Sm- and Ho-doped ceria exhibited good high-temperature stability and increased oxygen vacancy concentration, leading to increased oxygen ion diffusivity. The paper, “Alternating Current Electrophoretic Deposition of Spinel Coatings on Porous Metallic Substrates for Solid Oxide Fuel Cell Applications”, led by Soumendra Basu, explores the use of AC signals for electrophoretic deposition of protective spinel coatings on all the surfaces of porous stainless-steel substrates used in metal-supported solid oxide fuel cells. The paper, “Exploring the Role of Humidity, Temperature, and Mixed Ionic and Electronic Conductivity on SOFC Anode Electrocatalysis”, led by Srikanth Gopalan, explores the effects of providing electronically conducting pathways to activate additional triple phase boundaries in Ni/YSZ cermet anodes infiltrated with Ni nanoparticles.

Four papers discuss the use of lower-dimensional materials in solar cells and photo-electrochemical devices. The paper, “ $\text{SiN}_x\text{:H}$ Films for an Efficient Bulk Passivation of Non-Conventional Wafers for

Silicon Heterojunction Solar Cells”, led by Rocio Barrio, suggests that $\text{SiN}_x\text{:H}$ films deposited by plasma-enhanced chemical vapor deposition can be used to passivate defects in bulk of *p*-type textured polycrystalline Si wafers used as the absorber layer in silicon-heterojunction solar cells. The paper, “Structural and Nanomechanical Properties of $\text{Cu}(\text{In}_x\text{Ga}_{1-x})\text{Se}_2$ Thin Films Fabricated by One-Step Sputtering”, led by A.A. Elmustafaa, discuss the effects of the substrate temperature and composition on the microstructure and nanomechanical properties of $\text{Cu}(\text{In}_x\text{Ga}_{1-x})\text{Se}_2$ thin films deposited on (100) Si substrates by radio frequency magnetron sputtering. The paper, “Limiting Effect of Interface States Density on the Photoelectric Properties of Sol-Gel *n*-ZnO/*p*-Si Heterojunction”, led by Mohamed Manoua, reports that ZnO thin films deposited by sol-gel spin-coating exhibited good rectifying behavior when used in *n*-ZnO/*p*-Si heterojunctions. The paper, “Nanoporous CoFe_2O_4 Loaded with Pt-Ag for Photocatalytic Hydrogen Evolution”, led by Zhanbo Sun, demonstrates that, when Pt and Ag catalysts are loaded into nanoporous CoFe_2O_4 , the photocatalytic generation of hydrogen improves by a factor of 24.

Finally, the paper, “Boost Thermoelectric-Mechanical Properties of BiSb-Based Material by SiC Nanocomposite”, led by Mohamed Saad El Asfoury, shows that the addition of SiC nanoparticles in a BiSb-based thermoelectric material increased the Seebeck coefficient, suppressed the thermal conductivity, and improved the mechanical properties of the composite material.

To download any of the papers in Nanomaterials and Composites for Energy Conversion and Storage: Part II, follow the URL: <https://link.springer.com/journal/11837/73/9/page/1> to the table of contents page of the September 2021 issue (vol. 73, no. 9).

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