Energy nanomaterials: bridging the gap between fundamental science and applied aspects

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Understanding the fundamental mechanisms of harvesting energy using nanoscale materials is a primary challenge in the development of alternative energy technology. For example, understanding the relationship between processing and structure of thermoelectric materials could allow higher figure of merits and lead to better materials and devices with improved performance. Similarly, for electrocatalytic splitting of water, it is important to study novel nanoscale electrodes for their basic electrochemical and catalytic properties while, for battery applications, it is critical to develop lithium (Li) extraction processes from natural resources and synthetic media for absorbing Li. These are only a few examples of challenges and demands in the emerging field of energy nanomaterials.

In this issue of *Nanomaterials and Energy*, we present research in the area of thermoelectric materials, electrochemical nanocatalysts and Li-absorbing ceramic media. The review article by Jariwala and Ravindra¹ focuses on the processing, properties, and performance evaluation to enhance the figure of merit of chalcogenide-based thermoelectric materials. This article also focuses on the various factors influencing thermoelectric figure of merit. Material systems including bismuth telluride, antimony telluride and lead telluride are discussed and meticulously evaluated for their performance. A research article by Fuqiang *et al.*² demonstrates the fabrication and output performance of a bismuth telluride-based thermoelectric module. The fabrication approach for this module is based on zone melting method. Figure of merits of 1.1 and 1.09 are achieved at different device-operating temperatures. An output power of ~8.2 W is achieved in the fabricated device. The power output is reported as a function of temperature difference in the device. Focusing on the importance of structure–function relationships with these two articles, this issue additionally presents articles on electrochemical nanocatalysts for oxygen evolution reaction by Li *et al.*³ This article demonstrates the growth of CuO nanowires decorated with Co₃O₄ nanoparticles, material characterisation, as well as examination of

their electrochemical behaviour. The heterostructures demonstrate improved catalytic response for oxygen evolution reaction. Finally, the article by Hajipour *et al.*⁴ shows the material development for storage and extraction of Li from brine. In this regard, the synthesis of nanostructured zirconium oxide is reported, and Li ion absorption studies as well as various structural and analytical characterisation studies are performed. The uptake of lithium ions into the developed media is observed to be 17 mg/g.

Overall, this issue of *Nanomaterials and Energy* presents a set of unique studies, which will critically advance our knowledge in the specific areas of thermoelectrics, electrocatalysis, and Li ion extraction and storage. With this issue, I also encourage readers and interested scientific community to submit their novel research work in the areas of energy nanomaterials to this journal. One of the aims of *Nanomaterials and Energy* is to provide an exciting platform for publishing high-quality energy research that bridges the gap between fundamental science and applied aspects.

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