Editorial

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I am pleased to introduce the first editorial of *Nanomaterials and Energy* (NME). It is an endeavor to provide scientists and engineers around the world with an interdisciplinary platform for reporting strategic and fundamental approaches aimed at overcoming current energy challenges.

This new journal aims to provide an outlet specifically for research focused on novel nanomaterials and their energy applications. The future of energy nanomaterials is full of innovative advancements that will revolutionize the commercial as well as the academic sector, impacting highly on the environment and humanity. Thus, NME will provide an opportunity to scientists and engineers from diverse backgrounds to arrive at a common platform (http://www.icevirtuallibrary.com/upload/NME_scope.pdf).

Since several decades, fossil fuels such as petroleum, have been the top choice in fulfilling our energy demands. Even though the demand for energy is steadily increasing, it is estimated that the supply of fossil fuels will reach its maxima around 2025. Beyond this, the supply will start declining and the world will face an acute shortage of one of its most critical energy resources. This decreasing supply and increasing demand will lead to a significant rise in the prices of petroleum necessitating its replacement with other sources of energy (Fanichi, 2005). In order to achieve fossil fuel independence, it is now critical to develop alternate and clean energy technologies. Towards this end, the following tasks need to be accomplished: (a) development of advanced materials and their architectures that possess high-energy densities and delivery capabilities, (b) fundamental understanding of energy materials, (c) integration of materials into energy critical platforms and devices, (d) development of high-efficiency and green energy devices, (e) low-cost energy generation, storage and conversion, (f) calability of developed devices and energy materials, (g) rapid transfer of technology from laboratories to commercial scale and (h) developing the capability to generate abundant amounts of critical energy materials. Achieving these goals will have a huge positive impact on our future generations. It is clear from the above list that development and understanding of novel materials is the ab-initio step towards a successful alternative energy sector. The credit goes to Nobel laureates Professor Alan Heeger (conductive polymers), late Professor Richard Smalley (fullerenes) and Professor Walter Kohn (density functional theory) for advancing alternative energy research and development with their pioneering work in this field thereby laying solid foundations for future research (see <http://nobelprize.org>).

A recent study reported 25 top institutions that are contributing heavily to the alternative energy sector. These institutions are located in various countries including China, Japan, Canada, Germany, Great Britain, Korea and the Netherlands, with United States leading the way. The statistics showed that the total number of research articles published by the United States in the areas of photovoltaics, fuel cells and environment-related energy research were 893, 1006 and 1997, respectively, in the period between 2003 and 2007 (Boyack, 2009).

The rapid utilization of energy releasing huge amounts of carbon dioxide into the atmosphere also warrants attention towards both the fundamental and applied aspects of research in alternative energy sources (Fanichi, 2005). The astronomical increase in carbon dioxide emissions into our atmosphere poses a serious problem and is motivating scientists and engineers around the world to work towards exploring alternative and clean energy sources and materials.

Studying and understanding materials utilized for alternative energy production is critical. Whether it is nuclear fuel or solar cell, without the right material selection and design, it would be impossible to successfully accomplish the goals of any energy research program. Materials used for alternative energy can be broadly divided into two subcategories: (a) bulk materials (eg, nuclear power, wind power, hydro power, biomass and synfuel) and (b) low-dimensional materials (eg, photovoltaics, electrocatalytic fuel generation, fuel cells, supercapacitors and biocatalytic systems) (Fanichi, 2005). The latter incorporates nanotechnology and nanoscience and is attracting the interest of researchers due to the huge potential of nanomaterials, which impact our energy production, usage, transport and storage (Lok, 2010). Due to the nanoscale dimensions, these nanomaterials have unique size-dependent properties, multifunctionality and chemical reactivity (Chopra, 2010; Chopra *et al.*, 2007; Kongkanand, 2008). All of these characteristics and many more lead to sustainable designs that will be ideal for efficient energy conversion, storage and transport. In addition, depending on the material selection, green energy sources based on nanotechnology are also possible (Rolison, 2005).

When it comes to nanotechnology, the top six alternative energy devices of utmost interest to the scientific community are solar cells, fuel cells, batteries, energy storage and photocatalysis, thermoelectrics and bio-based energy devices. Some current developments (see Figure 1) include new low-dimensional materials systems, complex energy efficient heterostructures, lighter, flexible and multifunctional substrates, unique electron transport mechanisms, high-efficiency

Figure 1. (a) Low-dimensional nanostructures such as vertically aligned carbon nanotubes (Chopra, unpublished), (b) photocatalytic cupric oxide nanowire- Co_3O_4 nanoparticle heterostructures (Chopra, unpublished), (c) schematic showing flexible nanowire-based solar cell substrate, (d) actual zinc oxide nanowires embedded in flexible polydimethylsiloxane matrix (Chu *et al.*, 2011, open access article), (e) schematic showing radially heterostructured nanowire, p-type Si/n-type Si core/shell nanowires for photovoltaics and their performance under illumination (reprinted with permission from Garnett and Yang 2008, Copyright 2008 American Chemical Society) and (f) efficient charge transfer mechanism (inverse Auger effect) observed for quantum dot-based solar cell (reprinted from *Physica E*, 14, AJ Nozik, Quantum dot solar cells, 115–120, Copyright 2002, with permission from Elsevier)

photocatalysts, high-surface area nanostructures for storing hydrogen, nanoporous double-layer supercapacitors, oxide nanostructure-based pseudocapacitors, nanofabricated fuel cells and improved charge carrier movement and nanostructured platforms for bio-fuel cells (Chan *et al.*, 2008; Grimes *et al.*, 2008; Huynh *et al.*, 2002; Snyder and Toberer, 2008; Steele and Heinzl, 2001; Willner, 2002).

Due to the multidisciplinary nature of NME, scientists and engineers from backgrounds such as metallurgy, materials science; chemical, mechanical, electrical, aerospace and environmental engineering; chemistry; physics; biology; mathematics and computer science are welcome to contribute their work to this journal. A full list of topics covered by the journal is available on the NME website: www.icevirtuallibrary.com/nme.

The inaugural issue of the NME will be composed of comprehensive reviews, research articles and letters/short communications to present original research of authors working in related areas. We will also publish news and views, providing authors a venue to describe and analyze a particular area of energy nanomaterials and related devices from their perspective. All submissions will be peer-reviewed in a highly efficient manner which will lead to rapid publication and wide dissemination, resulting in a high impact publication. This journal is published by the ICE Publishing, an institutional publisher with a history of connecting research and practice since 1836. Our dedicated and efficient publishing staff, within all departments, continue to work diligently in launching the journal and contributing greatly towards its success. In addition, special recognition goes to the editorial board members and the associate editors for their valuable time and effort to launch this journal.

I am extremely enthusiastic about the future of energy nanomaterials. In this regard, I am very excited about the important and unique role NME will play in communicating novel and original research and developments in the field. The area of alternative energy is relatively new and of great importance. With the emergence of nanotechnology, it is expected that research in this area will be boosted significantly and will directly contribute towards narrowing the gap between energy nanomaterials innovations and the commercialization of devices and systems. On behalf of my team at ICE Publishing, the associate editors and the editorial board, I'm excited to introduce this new journal and we eagerly look forward to your submissions.

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