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Editorial

Nanomaterials for Energy-Efficient Applications

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The ways we used to generate and utilize energy have been threatening our living environment. For example, the crude oil spills in Gulf of Mexico in 2010 left devastating effects to the Gulf ecosystem, Fukushima nuclear plant leaks in Japan in 2012 threatened the lives of thousands of people, and the Haze in the cities of China at present affects the health of millions of people. All of them remind us of the global energy and environment crisis that we have to face in the near future. Alternative solutions in energy generation and utilization have to be explored towards a sustainable earth.

Many breakthroughs in the area of nanomaterials and nanosciences have been reported recently [1–12], which open up tremendous opportunities to tackle the challenges in energy and environment. With shrinking the size of the materials into nanoscale, fewer materials are required, which translates to higher utility efficiency of the resources. Moreover, with the dimensions of the materials decreasing to a scale comparable to the characteristic length of the physical properties, behaviors of photon emission [1], electron transport [2], surface train [3], and phonon scattering [4] change drastically compared to their bulk counterpart. The resulting properties have very important implications to their applications in high brightness light-emitting diodes [5–7], low power nanoelectronics [2], high efficiency solar cells [8], thermoelectric power generator [4], and so forth. In addition, the large surface-to-volume ratio in nanomaterials facilitates more efficient chemical reactions, which is highly desirable in many applications such as high performance batteries and catalysts [9, 10]. Therefore, the research activities of nanomaterials on energy-related applications have surged over the past decade, which is manifested by the exponential growth of the corresponding research publications and citations as shown in Figure 1. It is very clear that the research on energy-related nanoscience and nanotechnology has been becoming extremely active since 2010.

However, the success of nanomaterials in energy-efficient applications relies on our ability to synthesize nanomaterials at will and to understand and tailor the properties of the nanomaterials [11, 12] and to integrate the nanomaterials into devices [1, 2, 7, 9]. This special issue solicits some of these topics to foster the applications of nanomaterials in the emerging energy research. Moreover, the research trend of nanomaterials towards high performance energy-efficient applications could be summarized from the articles published in this special issue, for example, chemical doping, interface engineering, and hybridizing.

We hope that the readers will find in this special issue not only the interesting results but also important questions to be resolved and finally incorporate the findings into their own research. We hope this special issue can inspire more

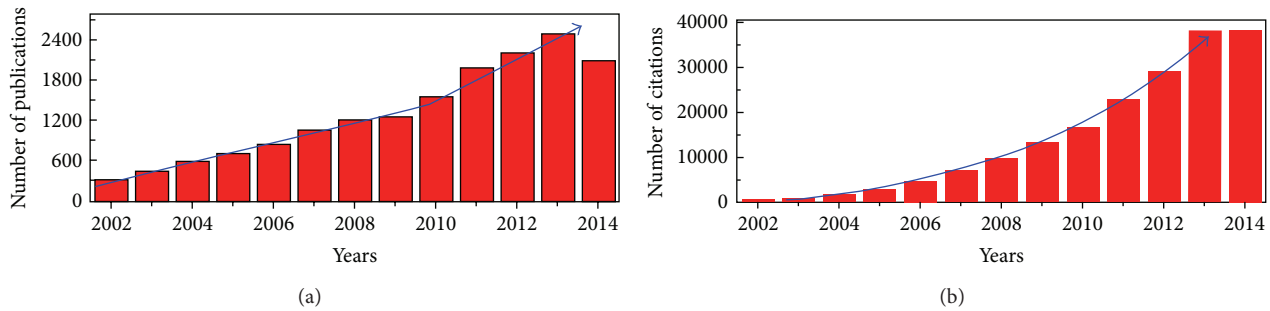

Figure 1: The numbers of (a) publications and (b) citations retrieved from Web of Science by listing both "nano" and "energy" as the key words in the search engine. The search was conducted on November 21, 2014; thus any update after that was not reflected in this figure.

research efforts on nanomaterials towards energy-efficient and environmentally friendly applications.

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