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Editorial

Special Issue: "Thin Films for Energy Harvesting, Conversion, and Storage"

Zhong Chen [1,*], Xin Zhao [1,*] and Yuxin Tang [2,*]

1 School of Materials Science and Engineering, Nanyang Technological University, 50 Nanyang Avenue, Singapore 639798, Singapore
2 Institute of Applied Physics and Materials Engineering, University of Macau, Macau, China
* Correspondence: ASZChen@ntu.edu.sg (Z.C.); xinzhao@ntu.edu.sg (X.Z.); yxtang@um.edu.mo (Y.T.)

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Abstract: Efficient clean energy harvesting, conversion, and storage technologies are of immense importance for the sustainable development of human society. To this end, scientists have made significant advances in recent years regarding new materials and devices for improving the energy conversion efficiency for photovoltaics, thermoelectric generation, photoelectrochemical/electrolytic hydrogen generation, and rechargeable metal ion batteries. The aim of this Special Issue is to provide a platform for research scientists and engineers in these areas to demonstrate and exchange their latest research findings. This thematic topic undoubtedly represents an extremely important technological direction, covering materials processing, characterization, simulation, and performance evaluation of thin films used in energy harvesting, conversion, and storage.

Keywords: thin films; synthesis; characterization; energy harvesting; energy conversion; energy storage

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Thin film-based energy harvesting, conversion, and storage devices have attracted great attention due to their attractive potential for improved efficiency, manufacturability, and production costs. Nowadays, thin film electrodes have been used in a wide range of fields, such as photovoltaics, fuel cells, supercapacitors, flow batteries, and rechargeable metal ion batteries [1,2]. In order to enhance the efficiency of energy conversion, rational thin film design strategies, novel thin film materials, and the fundamental understanding of structure–property correlation have been systematically studied [3,4]. For examples, thin film materials can be fabricated by various methods, including thermal evaporation method, electrochemical deposition, atomic layer deposition, chemical vapor deposition, pulsed laser deposition, and molecular beam epitaxy. By controlling these thin film fabrication techniques, thin film electrodes with desirable properties are obtained and can be used towards improving the device performance via fundamental understanding of the structure–property–performance correlations.

This Special Issue contains 9 research articles and 2 review articles. In their research article, Hu et al. [5] present a DFT-based model on the adsorption behavior of H_2O, H^+, Cl^-, and OH^- on clean and Cr-doped Fe (110) planes, and the surface energy study suggests that the Cr-doped Fe(110) surface is more stable than Fe(110) and Cr(110) facets upon adsorption of these four typical adsorbates. This study could provide guidance for the design of corrosion-resistant devices. Bonomo et al. [6] investigate the effect of sensitization on the electrochemical properties of nanostructured NiO, and the photoelectrochemical cells displaying the highest efficiencies of solar conversion were those that employed sensitized NiO electrodes with the lowest values of charge transfer resistance through the dye/NiO junction in the absence of illumination. This finding indicates that the electronic communication between the NiO substrate and the dye sensitizer is the most important factor in the electrochemical and photoelectrochemical processes occurring at this type of modified semiconductor.

Mohammed et al. [7] fabricated a few-layer graphene nano-flake thin film by an affordable vacuum kinetic spray method at room temperature and modest low vacuum conditions. Meantime, the proposed affordable supercapacitors show a high areal capacitance and a small equivalent series resistance. Gao et al. [8] synthesized $Cu_2ZnSn(S,Se)_4$ (CZTSSe) and $Cu_2Zn(Sn,Ge)(S,Se)_4$ (CZTGSSe) thin films using a non-vacuum solution method. Based on the CZTSSe and CZTGSSe films, solar cells were prepared. The as-fabricated CZTGSSe solar cells exhibited a lower diode ideality factor and lower reverse saturation current density. She et al. [9] report the fabrication of the mixed nickel–cobalt–molybdenum metal oxide nanosheet arrays for hybrid supercapacitor applications. In their paper, Yu et al. [10] construct a $LaFeO_3$ perovskite nanoparticle-modified TiO_2 nanotube array, and the fabricated sample displays excellent photocatalytic performance. Zhu et al. [11] have demonstrated facile formation of ultrathin Al_2O_3-coated $LiNi_{0.8}Co_{0.1}Mn_{0.1}O_2$ cathode material by an atomic layer deposition (ALD) method. Enhanced electrochemical performance was obtained by optimizing the thickness of the Al_2O_3 layer. In their brief report, Li et al. [12] propose a metal–dielectric metal structure based on a Fabry–Pérot cavity, and the as-prepared narrow-band absorber can be easily fabricated by the mature thin film technology independent of any nanostructure, which makes it an appropriate candidate for photodetectors, sensing, and spectroscopy. Chen et al. [13] performed an in situ investigation of the early-stage $CH_3NH_3PbI_3$ ($MAPbI_3$) and $CH(NH_2)_2PbI_3$ ($FAPbI_3$) degradation under high water vapor pressure. Their experimental results highlight the importance of the compositional and morphological changes in early stage degradation in perovskite materials. In one of the two review articles, Shin and Choi [14] summarize the recent studies of semitransparent solar cells and discuss the major problems to be overcome towards commercialization of these solar cells. Hu et al. [15] present a review of the latest processes for designing anode materials to improve the efficiency of photoelectrochemical water splitting. This review is helpful for researchers who are working in or are considering entering the field to better appreciate the state of the art, and to make a better choice when they embark on new research in photocatalytic water splitting materials.

Conflicts of Interest: The author declares no conflict of interest.

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