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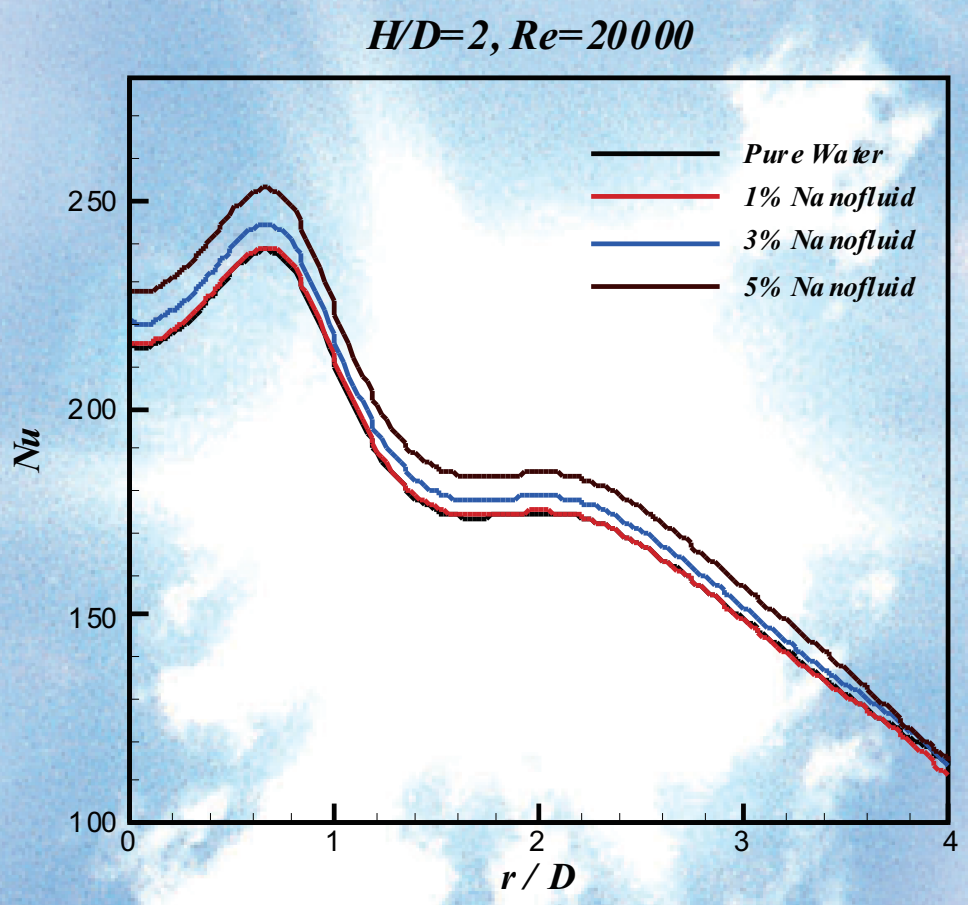

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Invited Speech:

Title: Nanomaterials: Towards Energy Storage Applications

Speaker: Prof. Bingqing Wei, University of Delaware, USA

Abstract

Electricity storage is a growing challenge among a broad range of renewable energy sources. The development of high-energy storage devices has been one of the research areas of top most importance in recent years and rechargeable batteries and/or electrochemical capacitors (supercapacitors) are anticipated to be the primary sources of power for modern-day requirements in portable electronic devices, satellites, and electric vehicles, etc. Most recently, flexible/stretchable electronics have attracted considerable attention and have opened the door to many important applications that current, rigid electronics cannot achieve. In order to accommodate these needs, power source devices must be flexible and stretchable in addition to their high energy and power density, light weight, miniaturization in size, and safety requirements.

Research in the development of new materials and new structures for energy storage applications is an ongoing pursuit. Nanomaterials and nanostructures such as carbon nanotubes (CNTs) have been full of surprises since their emergence and this trend continues. Utilizing CNTs for various energy storage applications such as electrodes in lithium ion batteries and supercapacitors are under close scrutiny because of the promising electrochemical performance of such nanomaterials. In this presentation, I will discuss our research efforts in assembling 2-D CNT macrofilms using chemical vapor deposition method and their applications for different supercapacitors, such as stretchable supercapacitors. I will also discuss a CNT supercapacitor based on-chip power management for achieving high efficiency, long lifetime and system miniaturization. Such a system can benefit many low-power microsystems and lead to new design architectures and concepts.

Invited Speech

Title: Reliability Modeling and Assessment in a Smart Grid Environment: Status, Challenges, and Probable Solutions

Speaker: Dr. Lingfeng Wang, University of Toledo, USA

Abstract

The power grid we are utilizing is one-century old and aging for the modern industry. The dramatic economic loss brought by the obsolete power system triggers the research of the smart grid. The next-generation electric grid being developed should have the capability or potential of accommodating high renewable energy penetration, preventing cyber intrusions to the critical infrastructure, and facilitating real-time computing and communications. For this purpose, the current power grid is undergoing significant changes and upgrades. For instance, more significant amounts of renewable energy resources are being integrated into the power grid. Meanwhile, various innovative smart grid technologies are being developed and deployed in the current power grids, including intelligent sensors, advanced metering infrastructure, novel power electronic equipment, and demand response based operating strategies. These emerging technologies are instrumental to enabling various desired functionalities of smart grid, but meanwhile they aresignificantly increasing the complexity and uncertainty of the overall system. For instance, some renewable energy resources such as wind and solar are intermittent which may decrease the power system reliability; power supply reliability may also be compromised due to the cyber vulnerability from the imposed information and communication infrastructure. A comprehensive set of new failure modes induced by the smart grid technologies should be modeled and included in power system reliability evaluation. As a result, conventional

methods for reliability modeling and assessment have to be improved or novel methods should be developed to handle these newly arising uncertainties. This talk will discuss the reliability modeling and assessment of contemporary power systems by accounting for the new uncertain factors from both the physical and cyber domains of smart grid. The state-of-the-art of the field will be presented by reviewing the most up-to-date work. The major difficulties and challenges in this field will be identified and discussed. This talk will also discuss the probable solutionsto effectively and efficiently modeling and evaluating the power grid reliability considering the cyber-physical interdependency.

Invited Speech

Title: Battery Management Systems - The Key Challenge to the Electric Vehicle

Speaker: Prof. Michael Pecht, University of Maryland, USA

Abstract

Electric vehicles have significant advantages over gas powered vehicles, but also have significant draw-backs related to customer anxiety associated with being stranded on the road or having to wait at a charging station. For unmanned vehicles, a failure of the battery can result in mission abortion. To address these concerns as well as other operational and charging requirements and safety, a battery manage system (BMS) has become a necessary part of the electric vehicle. This presentation discusses some of the advances and remaining concerns with BMS today and looks at opportunities for innovation.

Invited Speech

Title: Next Generation Photovoltaics Based on Nanomaterials

Speaker: Prof. Jingbiao Cui, University of Arkansas at Little Rock, USA

Abstract

Solar cells based on nanocrystals, nanowires and their composites are often referred to as the next generation photovoltaic devices and have been attracted much attention in scientific community as well as industries. The advantages of the solar cells include reduced reflection, light trapping capability, improved band gap tuning, and increased defect tolerance, which are expected to reduce the quantity and quality of material necessary to reach high efficiency and allow for cost reductions.

This talk will address the important achievements as well as challenges in current photovoltaic research based on nanomaterials, with an emphasis on nanowire radial and axial junction solar cells. These special structures have potential for improved performance in solar cells due to increased junction area and improved charge carrier collection. However, the solar cells are still in its initial stage of development by using expensive and complicated microfabrication processes as well as low cost solution routes. The general device structure can be achieved by coating the nanowires with shell layers to form core-shell structures or embedding the nanowires in absorbing thin films. Inorganic nanowires embedded in thin films and inorganic-organic hybrid nanowire structures will be discussed as examples to demonstrate the progress in nanowire solar cell research. While much effort is needed to optimize the device overall performance, it has demonstrated that these nanowire junctions have the potential for high efficiency and low cost solar cell devices. Finally, the challenges of nanowire solar cell research will be discussed.

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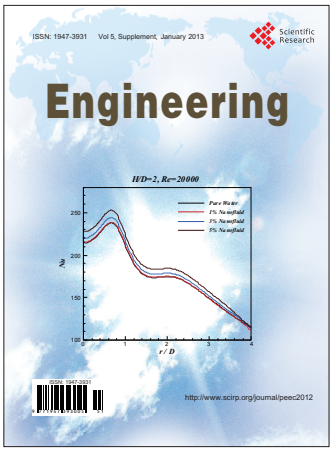

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