

Nanocomposites in Photovoltaics

Prof. Dr. M. Lux-Steiner, Dr. Th. Dittrich,
Helmholtz-Centre Berlin for Materials and Energy

Nanotechnologies are aimed to a further cost reduction in solar energy conversion which is possible because nanocomposites can be deposited at low temperatures on large areas. The interpenetration on the nanoscale of materials with distinct optical, photoelectrical, electrical or mechanical properties bears the potential for creation of materials suitable even for applications in solar cells with high energy conversion efficiency. For example, local charge separation is a unique decisive feature in nanocomposite solar cells such as dye sensitized solar cells, organic solar cells or solar cells with extremely thin absorber. The status of research on various types of nanocomposite solar cells will be shown and challenges will be discussed in the presentation.

Nanomaterials for hydrogen production

Kevin Sivula and Michael Grätzel

Laboratory for Photonics and Interfaces, Swiss Federal Institute of Technology, CH-1015 Lausanne, Switzerland

The advancement of tools to control materials on the nanometer length scale has catalyzed the development of a new class of solar energy conversion devices. In addition to photovoltaic applications, nanostructured systems also show great promise for the generation of hydrogen from sunlight via photo-electrochemical water splitting. Here, we explore how nanotechnology has advanced this field by looking at a particular material—iron oxide. Our research efforts with iron oxide have shown that silicon doped alpha-Fe₂O₃ films are capable of an overall solar to hydrogen conversion efficiency of 4.2 percent in a tandem device using a dye sensitized solar cell as a bottom electrode. Given the efficiency, abundance, environmental compatibility, and low cost of the Fe₂O₃ material, this new technology is a viable contender for large-scale future solar energy conversion systems.

Nanostructured materials for electrochemical energy storage

M. R. Palacín

Institut de Ciència de Materials de Barcelona (CSIC), Campus UAB E-08193 Bellaterra, Catalonia, SPAIN

The performance of electrochemical energy storage devices is ultimately dependent on electronic and ionic transport. As a consequence of this, nanostructured materials offer new opportunities and challenges for the development of more efficient and performing devices. This had been realised well before the advent of nanoscience as a scientific discipline, as exemplified by the developments in nickel battery materials. However, the field has only boosted more recently, benefiting from a larger degree of scientific knowledge and rationalisation of structure-property relationships. The presentation will cover diverse examples on how mastering particle size, materials processing or electrode architecture at the nanoscale can address bottlenecks in the performance of lithium based batteries. These will include electrode and electrolyte materials that are at the laboratory stage development as well as other already present in commercial batteries, with a specific description on the intrinsic advantages of nano vs. bulk material electrodes.

To conclude, the organisation and achievements of the ALISTORE network of excellence (*Advanced lithium energy storage system based on the use of nano-powders and nano-composite electrodes/electrolytes*) will be described, as an example of a living success story initiated through EC funding that is effectively contributing to integration of European battery research.

Nanostructured Materials for Solid State Hydrogen Storage

Dr. Klaus Taube, GKSS-Forschungszentrum Geesthacht GmbH, Max-Planck-Strasse 1, D-21502
Geesthacht, klaus.taube@gkss.de

In this talk an overview is given over the current status of development of materials for solid state hydrogen storage. The talk will focus on complex metal hydrides like alanate, amide and borohydride based materials, as only these have the potential for developing a storage technology corresponding to industrial requirements. Their properties, advantages and deficiencies will be discussed and comparisons drawn with the current state of the art in storage alternatives like nanoporous materials and other methods of hydrogen storage like compressed gas and liquid storage.

From this conclusions will be drawn for further needs for development and latest approaches to overcome the shortcomings in solid state hydrogen storage will be described.