**Hydrogen Energy and Fuel Cell Technology.**

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Typical Energy Conversion and Storage (ECS) devices include fuel cells, solar cells, photoelectrochemical water splitting cells, batteries (especially Li-ion batteries), light-emitting diodes, sensors, thermoelectric and supercapacitors. The performance of these energy devices relies strongly on the properties of their nanostructured materials. New development in the field of nanomaterial chemistry is believed to hold the key to further breakthroughs in ECS systems.

Nanostructured metal chalcogenides (NMCs) and carbon nanostructures (CNs) are attracting significant attention in a variety of energy devices, such as solar and fuel cells. Some features of NMCs are the high stability in an acidic environment, especially if in combination with other transition metals had significant oxygen reduction activity in acid conditions and their remarkable superconducting properties. By the other side, the broad range of CNs exhibits novel physico-chemical properties, and thus it is triggering intense research in the area of carbon nanoscience with numerous applications.

In this context, new synthesis routes that are operated under moderate conditions are definitely needed in order to simplify the process, reduce costs and allow the production of NMCs at lower temperatures and CNs whose size and shape can be controlled. Some related studies about Pt-based on sulfides and selenides, and carbon nanostructures (nanotubes and graphene)-supported Fe or Co nanoparticles, show promise for fuel cells and these NMCS, CNS or even NMCS-CNS could also be applied for solar cells. However, in terms of catalytic activity, durability and chemical/electrochemical stability, much more research is needed to produce commercially valid non-noble catalyst, electrocatalyst or support.