

SEMINAR ANNOUCEMENT

Development of novel nanoscale materials for hydrogen storage

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Monday April 2, 2007, 4:00 pm

MANN HALL, ROOM 307

Hosted by

Institute for Transportation Research and Education (ITRE)
The Department of Mechanical and Aerospace Engineering (MAE)
The Department of Chemical and Biomolecular Engineering

An efficient on board hydrogen storage system is one of the grand challenges in energy research and researchers are rising to it. Hydrogen may be stored in solids by two principle mechanisms: (I) physisorption and (ii) chemisorption. Physisorption is the preferred mechanism due to its low enthalpy

Carbon nanotubes (CNTs) and other nanostructured materials with large specific area possess a high potential for hydrogen storage by physisorption at lower temperature. Two recent developments in our laboratory show promising routes towards a better hydrogen storage material.

- (i) **CNTs modified with nickel catalyst.** The novelty of this approach is the effective functionalization of CNTs with nickel in $\text{HNO}_3/\text{H}_2\text{O}_2$ medium and the hydrogen adsorption by chemical vapour deposition (CVD) method. Hydrogen was adsorbed at 90°C using CVD technique and the analysis reveals the physical nature of adsorption. From the studies, it is inferred that catalytic phenomena have a very strong influence on the adsorption of hydrogen [*paper submitted to Journal of Nanoscience and Nanotechnology*].
- (ii) **Polyaniline (PANI) /CNT/ nickel composite:** CNTs were functionalised using $\text{HNO}_3/\text{H}_2\text{O}_2$ medium and the PANI/CNT/nickel composite was prepared with the aid of nickel catalyst. The results show that using nickel catalyst consisting of small percentage can drastically improve the reaction kinetics with hydrogen (Paper submitted to nanotech-2007).

The ongoing hydrogen studies include (i) correlation of the specific area of the material with the adsorption, (ii) calculation of heat of enthalpy, (iii) systematic determination of adsorbate adsorption energy and (iv) calculation of molecule dissociation activation barriers.

About the Speaker

Professor José Grácio received his PhD in Mechanics from the University of Coimbra, Portugal in 1992. That same year he joined the University of Aveiro as Head of the Department of Mechanical Engineering. He is currently the scientific coordinator for the Centre for Mechanical Technology and Automation (TEMA), and Director of the Nanotechnology Facilities of the Atlantic Park. He was Research Fellow at the Pacific Northwest National laboratory and invited Professor at the University of Louis Pasteur in France where he directs activities in nanotechnology and forming processes. Professor Grácio has conducted research in various areas of nanotechnology, including hydroxyapatite/ CNT composite, hydrogen storage and CNT's technology for electronic applications. He has authored or co-authored approximately 150 peer-reviewed publications in scientific journals, and has delivered more than 50 presentations at conferences worldwide. Professor Grácio is an inventor of 4 patents.