ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ
ΤΜΗΜΑ ΕΠΙΣΤΗΜΗΣ ΚΑΙ ΤΕΧΝΟΛΟΓΙΑΣ ΥΛΙΚΩΝ

ΠΑΡΟΥΣΙΑΣΗ ΜΕΤΑΠΤΥΧΙΑΚΗΣ ΔΙΠΛΩΜΑΤΙΚΗΣ ΕΡΓΑΣΙΑΣ

Τίτλος

«Μεσοπορώδη Δίκτυα Νανοσωματιδίων MoS_2 και CdS ως Φωτοκαταλύτες για τη Διάσπαση του Νερού προς Παραγωγή Υδρογόνου»

«Mesoporous Networks of MoS_2 and CdS Nanoparticles as Photocatalysts for Water Splitting and Hydrogen Production»

της Πατριαρχέα Χρυσάνθης, μεταπτυχιακής φοιτήτριας του

Τμήματος Επιστήμης και Τεχνολογίας Υλικών του Πανεπιστημίου Κρήτης

Επιβλέπων καθηγητής: Γεράσιμος Αρματάς

Παρασκευή 05/11/2021

13:00

Η παρουσίαση θα πραγματοποιηθεί στην **αίθουσα Φ2 του Τμήματος Φυσικής,** του Πανεπιστημίου Κρήτης.

ABSTRACT

Hydrogen production by water-splitting photocatalysis has attracted significant interest in recent years as a low-cost and environmentally friendly process. Generally, a tremendous number of semiconductors have been developed that fulfil the criteria of effective photocatalysts such as appropriate band gap (1.23–3.26 eV) and suitable reduction and oxidation band position. However, due the fast recombination process of the photoinduced carriers and low efficiency of the photon to hydrogen conversion, it is essential to construct new heterostructures with intimate contact between the components and pronounced visible-light absorption for achieving high photocatalytic performance. This Thesis focuses on synthesis and characterization of new mesoporous heterojunction networks consisted of ultrasmall MoS_2 nanolayers (ca. 10–15 nm in lateral size) and sub 5 nm sized CdS nanocrystals. It is also studied the application of these

nanostructures as photocatalysts for H_2 generation from water splitting. To prepare these nanocomposite materials we used a polymer-templated oxidative aggregating method for CdS nanocrystal assemblies followed by a wet-chemical deposition of exfoliated MoS_2 nanosheets on CdS surface. The chemical composition and the morphological and structural properties of the catalysts were investigated with electron microprobe analysis (EDS), X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), electron microscopy (TEM) and N_2 physisorption. The results indicated that the MoS_2-modified CdS nanocatalysts consist of a porous network of connected cubic CdS nanocrystals and 2H-phase MoS_2 nanosheets and exhibit large internal BET surface area (ca. 159–225 $m^2 g^{-1}$) and uniform pores (ca. 6–9 nm in diameter). Photocatalytic H_2 evolution experiments coupled with UV–vis/NIR absorption, time-resolved photoluminescence (TRPL) and electrochemical impedance spectroscopy (EIS) measurements revealed that the superior photocatalytic activity in these materials arises from the efficient dissociation and transport of photogenerated charge carriers across the nanoscale MoS_2/CdS junctions and the large number of exposed active sites due to the 3D open-pore structure. The optimized MoS_2/CdS catalyst at 20 wt.% MoS_2 content achieves a H_2 evolution rate of ~0.4 mmol h^{-1} (or ~19 mmol $h^{-1} g^{-1}$ mass activity) under visible light irradiation, which is 6.7 times higher than that of unmodified mesoporous CdS. We also obtained an apparent quantum yield (AQY) of 51.2% for hydrogen generation reaction using monochromatic light of 420 nm. The results of this study present an understanding of the charge transfer dynamics at the MoS_2/CdS nanoscale junctions and support the potential viability of the MoS_2-modified CdS nano-heterostructures as photocatalysts for clean energy conversion.