ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ
ΤΜΗΜΑ ΕΠΙΣΤΗΜΗΣ ΚΑΙ ΤΕΧΝΟΛΟΓΙΑΣ ΥΛΙΚΩΝ

ΠΑΡΟΥΣΙΑΣΗ ΜΕΤΑΠΤΥΧΙΑΚΟΥ ΔΙΠΛΩΜΑΤΟΣ ΕΙΔΙΚΕΥΣΗΣ

Τίτλος

«Development of Mesoporous $Zn_{1-x}Cu_xS$ Frameworks for Photocatalytic Water Splitting Toward Hydrogen Production»

Ιωάννης Δασκαλάκης

Μεταπτυχιακός Φοιτητής

Τμήματος Επιστήμης και Τεχνολογίας Υλικών, Πανεπιστημίου Κρήτης

Επιβλέπων καθηγητής κ. Γεράσιμος Αρματάς

Πέμπτη 10/10/2019

11:00

Αίθουσα Φ2
Κτίριο Τμήματος Φυσικής,

Πανεπιστήμιο Κρήτης

ABSTRACT

As a potential answer to the global energy crisis and environmental pollution, the solar light hydrogen generation has recently attracted great attention. Currently, hydrogen is mainly being produced from fossil fuels or high-energy consumption processes, which are not environmentally friendly and economical methods. Since the first report by Fujishima and Honda on the photoelectrochemical water-splitting over a TiO_2 electrode, photocatalytic hydrogen production has become a promising approach for clean, economical, and environmentally viable production of solar fuels. This master thesis focuses on synthesis, structural characterization and energy applications of new 3D mesoporous frameworks consisting of connected Cu-doped ZnS nanocrystals ($Zn_{1-x}Cu_xS$; x = 0.02, 0.05, 0.10). In particular, we report the synthesis of high-

surface-area mesoporous $Zn_{1-x}Cu_xS$ frameworks using a two-step chemical procedure that involves polymer-templated aggregating assembly of ZnS nanocrystals (~5 nm in size) and chemical transformation of ZnS constituents into $Zn_{1-x}Cu_xS$ heterostructures. The crystal structure, morphology and chemical composition of the prepared materials were characterized by powder X-ray diffraction (XRD), transmission electron microscopy (TEM), energy-dispersive X-ray spectroscopy (EDS), X-ray photoelectron spectroscopy (XPS) and N_2 porosimetry. Also, the electronic band structure of the $Zn_{1-x}Cu_xS$ heterostructures was investigated by UV-vis/NIR optical absorption and electrochemical impedance spectroscopy (EIS). Moreover, we highlight the impact of Cu doping on the photochemical behavior and visible-light photocatalytic H_2 production activity of the $Zn_{1-x}Cu_xS$ nanocrystal assemblies. An important aspect of this study is also the further improvement of the photocatalytic performance of $Zn_{1-x}Cu_xS$ catalysts by sulfur treatment.