ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ
ΤΜΗΜΑ ΕΠΙΣΤΗΜΗΣ & ΤΕΧΝΟΛΟΓΙΑΣ ΥΛΙΚΩΝ

UNIVERSITY OF CRETE
DEPARTMENT OF MATERIALS SCIENCE & TECHNOLOGY

ΠΡΟΣ

1) Όλα τα μέλη ΔΕΠ του Τμήματος Επιστήμης και Τεχνολογίας Υλικών

2) Την Επταμελή Εξεταστική Επιτροπή

3) Όλα τα μέλη της Πανεπιστημιακής Κοινότητας

Πρόσκληση σε Δημόσια Παρουσίαση της Διδακτορικής Διατριβής της

κ. Ευαγγελίας Σκλήρη

(Σύμφωνα με το άρθρο 41 του Ν. 4485/2017)

Την **Τετάρτη 12 Φεβρουαρίου 2020** και ώρα **11:00** στην **αίθουσα τηλεεκπαίδευσης Ε130** στο κτήριο **Τμήματος Μαθηματικών και Εφαρμοσμένων Μαθηματικών**, Πανεπιστημίου Κρήτης, θα γίνει η δημόσια παρουσίαση και υποστήριξη της Διδακτορικής Διατριβής της υποψήφιας διδάκτορος του Τμήματος Επιστήμης και Τεχνολογίας Υλικών κ. Ευαγγελίας Σκλήρη με θέμα:

«Ordered Porous Structures from Metal Oxide Nanocrystals.

Synthesis, Structural Characterization and Applications in Redox Catalysis»

Abstract:

The rapid development of civilization and industrial activities has led to a large amount of pollutants being disposed into the environment either intentionally or accidentally, including toxic metals with great health concerns. Chromium is a heavy metal with variable oxidation states; in aquatic systems, chromium exists mostly in the hexavalent (Cr(VI)) and trivalent (Cr(III)) forms. Anionic Cr(VI) species are far more mobile and toxic than Cr(III) and difficult to remove from water. The World Health Organization (WHO) recommended a maximum allowable concentration of 50 μg/L for Cr(VI) in drinking water. Moreover, as a consequence of its toxicity, Cr(VI) has also been categorized as a Group I human carcinogen by the International Agency for Research on Cancer (IARC). Therefore, finding an effective way for remediation of Cr(VI)-contaminated solutions is undoubted of high priority in the field of environmental and health protection.

This dissertation focuses on synthesis, structural characterization and environmental applications of high-surface-area mesoscopic architectures composed of tightly connected ultra-small metal oxide nanoparticles. In particular, we found that mesoporous spinel ferrite nanoparticle assemblies ($MeFe_2O_4$ or MeFO MNAs, Me = Zn, Mn, Ni, Cd and Co) can efficiently suppress electron-hole recombination, manifesting an exceptional activity and magnetic recyclability in photocatalytic reduction of aqueous Cr(VI). Among spinel ferrite nanocrystal assemblies, ZFO MNAs present the highest activity which is a result of the combined effect of accessible pore surface area (ca. 105–159 m^2/g), appropriate band edge positions and small grain composition (ca. 6–7 nm in size). Moreover, in an effort to further improve the photocatalytic performance of ZFO assemblies, we suggest the synthesis of new binary mesoporous networks consisting of ZFO and MFO (x% MFO-ZFO MNAs, x = 4–12.5 wt%) nanoparticles as promising catalysts for detoxification of Cr(VI) aqueous solutions. The remarkable activity and durability of the 6.5% MFO-ZFO MNAs implies the great possibility of implementing these new composite catalysts into a realistic Cr(VI) detoxification of contaminated water.

Additional subject of the present doctoral thesis is the synthesis of mesoporous Mn3O4 nanoparticle assemblies and investigation of their catalytic activity in oxo-functionalization of various aromatic and cyclic alkenes as well as aryl alkanes with tert-butyl hydroperoxide (TBHP) as mild oxidant. The successful synthesis of this material highlights the general applicability of the proposed polymer-assisted aggregating self-assembly method to produce high-surface-area mesoporous networks of cross-linked metal oxide nanoparticles. Through comparative studies, we evidenced that the high catalytic activity and stability of these Mn3O4 assemblies arise from the unique 3D open-pore structure, large internal surface area (ca. 90 m^2/g) and uniform pores (ca. 6.6 in size). These results open up the possibility of using mesoporous assembled structures of small-sized Mn_3O_4 nanocrystals for selective alkene and aryl alkane oxidations.