

2016 中拨社境外生研究獎學金 CTCI Science and Technology Research Scholarship





Synthesis Of Nanocomposites for the Removal of Toxic Pollutants and Heavy Metals and for the Development of Next Generation Power Sources

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Photocatalytic titanium dioxide nanospheres (TiO₂ NSs) doped with gold nanoparticles (Au NPs) has been used towards degradation of organic and inorganic pollutants. The effect of deposited ions like Hg²⁺ and Ag⁺ on TiO₂-Au NSs have also been studied, revealing their extraordinary influence in increasing its photocatalytic degradation efficiency, allowing it to be used for methylene blue (MB) and chromium(VI) (Cr⁶⁺) degradation. Based on this a novel sensing strategy has been developed for the highly sensitive, selective and colorimetric detection of mercury using the TiO₂-Au NSs. The strategy is based on the difference in rate of degradation of MB in the presence and absence of Hg²⁺ doped onto TiO₂-Au NSs. The sensor has been used to detect mercury ions in water, soil and most importantly, fish. Furthermore, we have developed a strategy to enable on field detection in water and soil using an APP. We are also developing prepared hybrid silicon nanosheets (NSs)/graphene quantum dot nanocomposites (Si-GQD NCs) from a mixture of GQDs and Si NSs in ethanol at room temperature for application as high performance catalyst for oxygen reduction reactions (ORR) in direct methanol fuel cells (DMFCs).

TiO₂-Au Nanospheres Based Removal of Pollutants and On-Field Detection of Trace Mercury in Water and Fish Using a Smart-APP Rini Ravindranath, P. Roy, A.P. Periasamy and H.-T. Chang, RSC Adv., 2014, 4,57290-57296. Au NP or Au/M NP 5.0 7.5 10.0 12.5 15.0 1,5-DPZ: 1,5-diphenylcarbazide 1.Efficient degradation of MB and 2. (A)TEM image (B) EDX(inset: SEM 3.Degradation rates of Methylene reduction of Cr6+ using TiO2-Au or image), (C) XRD pattern (D) XPS blue TiO₂-Au/M NSs. spectrum of TiO₂-Au NSs CIE Lab: 0:0:0 HEX: #000000 HUE 0 Chroma: 0 4. Degradation rates of Chromium(VI) 5. (A) UV-Vis absorption spectra 6. Smartphone APP using TiO₂of MB (a) before, and after the Au NS/MB approach for addition of (b) TiO₂-Au NSs, and

(c) TiO₂-Au-Hg NSs.

Green Synthesis of Si-GQD Nanocomposites as Cost-effective Catalysts for Oxygen Reduction Reaction Rini Ravindranath, P. Roy, A.P. Periasamy and H.-T. Chang ,RSC Adv.,2016, 6, 108941-108947. 1. Representation of Si-GQD nanocomposites for 2. (A) TEM image (Inset: High magnification), oxygen reduction reaction (B) XPS, (C) XRD and (D) EDX spectra of Si-GQD_{1.0} NCs. -0.8 -0.5 -0.4 -0.3 -0.2 -0.1 0.0 E/V vs. Ag/AgCI -0.6 -0.5 -0.4 -0.3 -0.2 -0.1 0.0 EV vs. Ag/Ag/Cl 3. Comparison of electrochemical performance 4. (A) LSVs of the Si-GQD_{1.0} NC electrode in N₂ and of Si NSs, GQDs, and Si-GQD_{1.0} NCs-modified O₂-saturated. (B) LSVs recorded from a Si-GQD_{1.0} electrodes. (A) CV, (B) Current density and (D) NC electrode in 0.1 M KOH at different rotation CV curve for Si-GQD_{1.0} NCs-modified electrodes rates. (C) Koutecky-Levich plots (D) Electron transfer number (n) at different potentials. under O₂ and N₂ saturated solutions.

Acknowledgement: I would like to thank my advisor for the invaluable mentorship and constant guidance. Thanks are due to National Taiwan University and Academia Sinica for their support. A big thanks to the CTCI Foundation for the 2016 Scholarship.

detection of Hg²⁺/CH₃Hg⁺.

