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Construction of Heterojunction of Electronic Structure-Modified Graphitic Carbon Nitride-Decorated Ceria Quantum Dots for Interfacial Applications

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We engineered novel heterojunction ceria (CeO2) QDs decorated on the surfaces of graphitic carbon nitride (g-C3N4) nano-sheets by a facile in situ hydrothermal synthetic route. Using core-level/valence-band X-ray photoelectron spectroscopy (XPS), diffuse reflectance spectroscopy (DRS), and work function measurements of the materials, we constructed the energy band alignment at the heterojunction. The band alignment has a Type-II alignment between organic (g-C3N4) and inorganic (CeO2 QDs) semiconductors junction with valence/conduction band offsets (VBO/CBO) of -0.07/-0.31 eV. The calculated band alignment parameters of the heterojunction were compared with the experimental values of g-C3N4/CeO2 QD composite and a new energy band diagram was proposed for the electronic structure-modified g-C3N4/CeO2 QDs heterojunction. The newly constructed heterojunction is formed by carbon-vacancy-promoted g-C3N4 coupled with lower defect-mediated (oxygen vacancies) CeO2, as determined by high-resolution XPS analysis. Moreover, the CeO2 QD distribution on g-C3N4 sheets using HR-TEM and the lattice parameter variations of g-C3N4/CeO2 QDs as compared to those of pristine CeO2 QDs from Rietveld refinement were investigated. To demonstrate the ability of the proposed heterojunction as a catalyst, we tested the catalytic activity of the composite junction for the degradation of Rhodamine B (RhB) in the presence of NaBH4 as an example. The band alignment mechanism is useful for promoting the catalytic activity of the graphitic carbon nitride-based organic semiconductor and will attract researchers' attention for developing new composite heterojunction catalysts for multi-functional applications.

Recent Publications

1. Gosami S, Nandy S, Banerjee AN, Kiazadeh A, Dillip GR, Pinto JV, Joo SW, Matins R, Fortunato E (2017) Electrotyping on Carbon Nanoparticles Filled Polymeric Film Using conducting atomic Force Microscopy. Advanced Materials 29: 1703079.
2. Sreekanth TVM, Jyothi PCN, Dillip GR, Lee YR (2017) Determination of Band Allignment in The Synergistic Catalysis of Electronic Structure Modified Graphitic Carbonnitride Integrated Ceria Quantum Dot Heterojunctions for Rapid Degradation of Organic. The Journal of Physical Chemistry C 21:25229.
3. Dillip GR, Banerjee AN, Anitha VC, Deva Prasad Raju B, Joo SW, Min BK (2016) Oxygen Vacancy-Induced Structural, Optical, and Enhanced Supercapacitive Performance of Zinc Oxide Anchored Graphitic Carbon Nanofiber Hybrid Electrodes. ACS Applied Materials & Interfaces 8:5025.
4. Anitha VC, Banerjee AN, Dillip GR, Joo SW, Min BK (2016) Nonstoichiometry - Induced Enhancement of Electrochemical Capacitance in Anodic TiO2 Nanotubes with Controlled Pore Diameter. The Journal of Physical Chemistry C 120:9569.
5. Dillip GR, Banerjee AN, Anitha VC, Joo SW, Min BK, Sawant SY, Cho MH (2015) Anchoring Mechanism of ZnO Nanoparticles on Graphitic Carbon Nanofiber Surfaces through a Modified Co-Precipitation Method to Improve

Biography

G.R. Dillip is an Assistant Professor in the School of Mechanical Engineering, Yeungnam University, South Korea. He finished his Ph.D. Degree in Physics from Sri Venkateswara University, India in 2013 and after that he joined at Yeungnam University, South Korea. He has authored 40 scientific articles in various reputed International Journals, a Book Chapter and also presented his work in both National and International Conferences and participated in several Workshops. He registered a Korean Patent. His research interests include various carbon based metal oxide nanocomposites/hybrids for energy-related applications, waste water treatment and also rare-earth doped optical materials for white LEDs.

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