Defect-Induced Band Gap Narrowed CeO_2 Nanoparticles for Visible Light Activities

Mohammad Mansoob Khan, Sajid A. Ansari, 조무환*
Yeunganam University
(mhcho@ynu.ac.kr*)

This work reports an electron beam irradiation (30 kGy and 90 kGy) methodology to narrow the band gap of the pristine CeO2 nanoparticles (p-CeO2) to enhance their visible light activity through defect engineering. This was confirmed by diffuse reflectance spectroscopy, photoluminescence, Raman spectroscopy, X-ray diffraction, X-ray photoelectron spectroscopy (XPS), Brunauer–Emmett–Teller, electrochemical impedance spectroscopy and linear scan voltammetry. XPS revealed changes in the surface states, composition, Ce4+ to Ce3+ ratio and other defects in the modified CeO2 nanoparticles (m-CeO2). The m-CeO2 nanoparticles exhibits excellent photocatalytic activities by degrading 4-nitrophenol and methylene blue in the presence of visible light ($\lambda > 400$ nm) compared to the p-CeO2 nanoparticles. The optical, photocatalytic, photoelectrochemical studies and proposed mechanism further supports the enhanced visible light photocatalytic activities of the m-CeO2 nanoparticles. This study confirmed that defect induced band gap engineered m-CeO2 nanoparticles could be used effectively as photocatalyst and photoelectrodes due to their enhanced visible light photocatalytic activities.