World Academy of Science, Engineering and Technology
International Journal of Chemical and Materials Engineering
Vol:14, No:02, 2020

Visible-Light-Driven OVs-BiOCl Nanoplates with Enhanced Photocatalytic Activity toward NO Oxidation

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Abstract : A series of BiOCl nanoplates with different oxygen vacancies (OVs) concentrations were successfully synthesized via a facile solvothermal method. The concentration of OVs of BiOCl can be tuned by the ratios of water/ethylene glycol. Such nanoplates containing oxygen vacancies served as an efficient visible-light-driven photocatalyst for NO oxidation. Compared with pure BiOCl, the enhanced photocatalytic performance was mainly attributed to the introduction of OVs, which greatly enhanced light absorption, promoted electron transfer, activated oxygen molecules. The present work could provide insights into the understanding of the role of OVs in photocatalysts for reference. Combined with characterization analysis, such as XRD (X-ray diffraction), XPS(X-ray photoelectron spectroscopy), TEM(Transmission Electron Microscopy), PL(Fluorescence Spectroscopy), and DFT (Density Functional Theory) calculations, the effect of vacancies on photoelectrochemical properties of BiOCl photocatalysts are shown. Furthermore, the possible reaction mechanisms of photocatalytic NO oxidation were also revealed. According to the results of in situ DRIFTS (Diffused Reflectance Infrared Fourier Transform Spectroscopy), various intermediates were produced during different time intervals of NO photodegradation. The possible pathways are summarized below. First, visible light irradiation induces electron-hole pairs on the surface of OV-BOC (BiOCl with oxygen vacancies). Second, photogenerated electrons form superoxide radical with the contacted oxygen. Then, the NO molecules adsorbed on the surface of OV-BOC are attacked by superoxide radical and form nitrate instead of NO_2 (by-products). Oxygen vacancies greatly improve the photocatalytic oxidation activity of NO and effectively inhibit the production of harmful by-products during the oxidation of NO.

Keywords : OVs-BiOCl nanoplate, oxygen vacancies, NO oxidation, photocatalysis
Conference Title : ICECE 2020 : International Conference on Environmental and Chemical Engineering
Conference Location : Dubai, United Arab Emirates
Conference Dates : February 13-14, 2020