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Research Article

# Synthesis of $CeO_2$–$BiVO_4$ nano photocatalyst material and used for the degradation of gaseous formaldehyde

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## Highlights

- In addition, BiVO4 is added to reduce the band gap of CeO2 to produce a visible light-driven catalyst.
- The light source used in this experiment is a green light. In the experiment of formaldehyde degradation by irradiating CeO2/BiVO4 with a green light.
- The experimental results show that CeO2 –BiVO4 (4:1) catalyst has the highest formaldehyde degradation rate and is higher than that of commercially available P25 TiO2 (64%).
- The total reaction time is 240min, and its degradation rate is 78%.

## Abstract

Formaldehyde is one of the common volatile organic compound (VOC) found in indoor environment. Reducing indoor formaldehyde exposure levels is an important issue because toxicological studies have demonstrated its carcinogenicity. In this study, hydrothermal method was used to prepare ceria-bismuth vanadate ($CeO_2$–$BiVO_4$) composite photocatalyst. $CeO_2$–$BiVO_4$ has the advantages of high-efficiency photocatalytic activity, and high stability making it a promising photocatalytic material in the fields of energy conversion and environmental protection. As-prepared samples were characterized by X-ray diffraction (XRD), reflection ultraviolet–visible spectroscopy (UV–Vis), transmission electron microscopy (TEM), scanning electron microscopy (SEM) and photoluminescence spectroscopy (PL). XRD, TEM, and SEM verified that the material was successfully prepared. The energy level was measured by UV–Vis, and it was verified by PL that the $CeO_2$–$BiVO_4$ can reduce the recombination rate of electron holes. Here, $BiVO_4$ is added to reduce the band gap of $CeO_2$ to produce a visible light-driven catalyst. The photodegradation reaction of formaldehyde is carried out by mixing in different proportions of $BiVO_4$ in to $CeO_2$. The light source used in this experiment is a green light. In the experiment of formaldehyde degradation by irradiating $CeO_2$/$BiVO_4$ with a green light, the concentration of product carbon dioxide ($CO_2$) and water ($H_2O$) increases with the irradiation time. The experimental results show that $CeO_2$–$BiVO_4$ (4:1) catalyst has the highest formaldehyde degradation rate of 78%, and the total reaction time is 240min. The importance of $CeO_2$–$BiVO_4$ as a photocatalytic material in formaldehyde degradation is to provide an environmentally friendly and efficient method to purify indoor air. It can help reduce the potential harm of formaldehyde to human health, improve indoor air quality, and contribute to creating a healthier and more comfortable indoor environment.