

Local structure study of BiVO₄ incorporated with Fe and Mn investigated by X-ray absorption spectroscopy

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Mn and Fe-incorporated BiVO₄ nanoparticles with different doping contents were synthesized via one-step sonochemical method. XRD results show the essential structure of monoclinic BiVO₄ structure and secondary phases were clearly found in form of metal-based oxide as MnO, Mn₃O₄, Mn₂O₃ and Fe₂O₃ compounds suggesting the incorporation of Mn and Fe ions. In addition, the effect of higher Fe loading content into BiVO₄ nanoparticles distinctly displays the gradually lower intensity of main peak affected by disorder of major phase structure of BiVO₄ due to the amorphous phase of BiFeO₃. UV-Vis DRS results show the absorption edge in visible range of all samples when loading Mn and Fe contents into pure BiVO₄ exhibit obviously the red-shift in visible range suggesting the lower optical band gap of pure BiVO₄. XAS results show that oxidation states of all elements correspond to Bi³⁺, V⁵⁺, Fe³⁺ and Mn²⁺/Mn³⁺ ions. Mn K-edge XANES spectra of all samples indicate that local atomic sites of Mn atoms would not replace in local site of either Bi or V site in BiVO₄ crystal, confirmed by the simulated Mn K-edge XANES spectra using FEFF9 code. Fe K-edge XANES spectra of all samples suggest that local site of Bi and V site in BiVO₄ crystal were not replaced by Fe atoms verified by the simulated Fe K-edge XANES spectra. EXAFS results evidently display that local atomic site of Fe atoms of all samples was formed to BiFeO₃ in form of the amorphous phase verified by simulated and experimental XANES and EXAFS spectra.

Topics

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