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Structural Phase Transitions in FeVO4 – CrVO4 Solid Solutions and effect on Multiferroicity in FeVO4

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Abstract

Thorough structural studies using XRD, Raman, Mossbauer and FT-IR Spectroscopic methods were performed to establish the structural phase diagram of $FeVO_4$-$CrVO_4$ solid solutions. Solid solutions $Fe1–xCrxVO_4$ ($0 \leq x \leq 1.0$) were synthesized through the standard solid state route. $FeVO_4$ and $CrVO_4$ were found to be in triclinic (P-1 space group) and orthorhombic structures (Cmcm space group), respectively. Cr incorporation into the $FeVO_4$ lattice leads to the emergence of a new monoclinic phase dissimilar to the both end members of the solid solutions. In $Fe1–xCrxVO_4$ up to x = 0.10, no discernible changes in the triclinic structure were found. A new structural monoclinic phase (C2/m space group) emerges within the triclinic phase at x = 0.125, and with the increase in Cr content, it gets stabilized with clear single phase signatures in the range of x = 0.175–0.25 as evidenced by the Rietveld analysis of the structures. Beyond x = 0.33, orthorhombic phase similar to $CrVO_4$ (Cmcm space group) emerges and coexists with a monoclinic structure up to x = 0.85, which finally tends to stabilize in the range of x¼ 0.90–1.00. The Raman spectroscopic studies also confirm the structural transition. $FeVO_4$ Raman spectra show the modes related to three nonequivalent V ions in the triclinic structure, where up to 42 Raman modes are observed in the present study. With the stabilization of structures having higher symmetry, the number of Raman modes decreases and the modes related to symmetry inequivalent sites collate into singular modes from the doublet structure. 57Fe

Mossbauer spectroscopic studies show a finger print evidence for disappearance of non-equivalent sites of Fe as the structure changes from Triclinic–Monoclinic–Orthorhombic phases with the increasing Cr content in $Fe1–xCrxVO_4$. FT – IR studies also corroborate the results with similar band formations.

Biography

G.R.Turpu has completed his PhD at the age of 27 years from Osmania University, India. He worked as a postdoctoral fellow at Indiana University, Bloomington, USA, IIP –UFRN, Natal, Brazil and was Research Professor at Sejong University, Seoul, South Korea before joining the Assistant Professorship at Guru Ghasidas Central University, India. He has published more than 32 articles and those include Phy Rev /JPCC / JAP/JPCM etc. He is also reviewer of various journals spanning through ACS, Springer, etc., His research includes the studies on structural and magnetic phase transitions in transition metal oxide systems. His studies on the phase transitions in CMR materials through Mossbauer spectroscopy were published in reputed journals like JPD: Applied Physic (IOP) , Chem Phy Lett and Phy Lett A (Elsevier). His recent publication on structural phase transitions appeared as the cover page of JAP (122/11) 2017 also appeared as Featured Article by JAP.

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