Local structure of codoped Ag\textsubscript{x}-Zn\textsubscript{0.92}Co\textsubscript{0.08}O nanostructure studied by XAFS

Wensheng YAN\textsuperscript{1}, Tao YAO\textsuperscript{1}, Zhiyun PAN\textsuperscript{1}, Bo HE\textsuperscript{1}, Yong JIANG\textsuperscript{1}, He WEI\textsuperscript{1}, Masaharu NOMURA\textsuperscript{2} and Shiqiang WEI\textsuperscript{*}

\textsuperscript{1} National Synchrotron Radiation Laboratory, University of Science & Technology of China, 42# HeZuoHua Road, Hefei, Anhui 230029, People’s Republic of China
\textsuperscript{2} Photon Factory, Institute of Materials Structure Science, High Energy Accelerator Research Organization (KEK), Tsukuba, Ibaraki 305-0801, Japan

\textbf{Introduction}

Transition metals doped ZnO-based diluted magnetic semiconductors (DMS) have recently attracted considerable research interests for their promise applications in “spintronic” devices\textsuperscript{[1]}. A number of experimental results on the magnetic behaviors and structures have been studied. More recently, Qiu \textit{et al.} have reported that DMS nanostructures, especially for Ag\textsuperscript{3} hybrid nanostructure of surface modification, can provide unique functions in enhancing and stabilizing magnetism\textsuperscript{[2]}. But it is not clear enough that the relationship between the local structure around Ag ions and magnetism of Ag-ZnCoO nanostructure. In this report, the local structure around Co and Ag in Ag\textsubscript{x}-Zn\textsubscript{0.92}Co\textsubscript{0.08}O samples were determined by means of XAFS to clarify the structural detail of the doping atoms.

\textbf{Experimental}

The Ag\textsubscript{x}-Zn\textsubscript{0.92}Co\textsubscript{0.08}O nanostructures are prepared via solution chemistry method\textsuperscript{[2]}. The Co K-edge EXAFS spectra of Ag\textsubscript{x}-Zn\textsubscript{0.92}Co\textsubscript{0.08}O powders were measured in fluorescence mode at BL-12C beamline of Photon Factory, High Energy Accelerator Research Organization (PF, KEK), using a Si(111) double crystal monochromator.

\textbf{Results and discussion}

Fig. 1(a) and (b) display the Co K-edge EXAFS oscillation functions $\chi(k)$ and the Fourier transforms (FT) of the $\chi(k)$ functions with those of the reference compounds ZnO, CoO, and Co$_2$O$_3$. One can see that the existence of CoO and Co$_2$O$_3$ in Zn$_{0.92}$Co$_{0.08}$O and Ag$_{x}$-Zn$_{0.92}$Co$_{0.08}$O powder samples can be safely excluded, since their FT features are significantly different from those of Zn$_{0.92}$Co$_{0.08}$O and Ag$_{x}$-Zn$_{0.92}$Co$_{0.08}$O samples. Fig. 1(a) manifests the quite similar oscillation shapes of the Zn$_{0.92}$Co$_{0.08}$O nanorods as that of ZnO, but quite different from the curves of Co powders. Moreover, in Fig.1(b), the FTs for the samples also exhibit two peaks at 1.60 and 2.84 Å corresponding to the nearest Co–O and the next nearest Co–Zn coordinations at the same positions as those of ZnO, suggesting that Co ions are substitutionally doped into ZnO host in Zn$_{0.92}$Co$_{0.08}$O nanorods. Remarkably, it is evident that the FTs of Ag$_{x}$-Zn$_{0.92}$Co$_{0.08}$O has an obvious peak at 2.16 Å which is very similar to that of Co-metal characteristic peak. With further increasing the Ag concentration from 0.02 to 0.07, its intensity increases remarkably. However, we do not find any Co metal in our Co core-level XPS spectra. On the other hand, it is well known that the interstitial Ag widely exists in Ag doped ZnO host lattice. Therefore, we suppose that the peak at 2.16 Å in FTs corresponds to the interstitial Ag.

\textbf{References}


* sqwei@ustc.edu.cn