

Local structure of codoped $\text{Ag}_x\text{-Zn}_{0.92}\text{Co}_{0.08}\text{O}$ nanostructure studied by XAFSWensheng YAN¹, Tao YAO¹, Zhiyun PAN¹, Bo HE¹, Yong JIANG¹, He WEI¹,
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Organization (KEK), Tsukuba, Ibaraki 305-0801, Japan**Introduction**

Transition metals doped ZnO-based diluted magnetic semiconductors (DMS) have recently attracted considerable research interests for their promise applications in "spintronic" devices[1]. A number of experimental results on the magnetic behaviors and structures have been studied. More recently, Qiu *et al.* have reported that DMS nanostructures, especially for Ag^+ hybrid nanostructure of surface modification, can provide unique functions in enhancing and stabilizing magnetism[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 $\text{Ag}_x\text{-Zn}_{0.92}\text{Co}_{0.08}\text{O}$ samples were determined by means of XAFS to clarify the structural detail of the doping atoms.

Experimental

The $\text{Ag}_x\text{-Zn}_{0.92}\text{Co}_{0.08}\text{O}$ nanostructures are prepared via solution chemistry method[2]. The Co K-edge EXAFS spectra of $\text{Ag}_x\text{-Zn}_{0.92}\text{Co}_{0.08}\text{O}$ samples 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.

Results and discussion

Fig. 1(a) and (b) display the Co K-edge EXAFS oscillation functions $k^3\chi(k)$ and the Fourier transforms (FT) of the $k^3\chi(k)$ functions with those of the reference compounds ZnO, CoO, and Co_3O_4 . One can see that the existence of CoO and Co_3O_4 in $\text{Zn}_{0.92}\text{Co}_{0.08}\text{O}$ and $\text{Ag}_x\text{-Zn}_{0.92}\text{Co}_{0.08}\text{O}$ powder samples can be safely excluded, since their FT features are significantly different from those of $\text{Zn}_{0.92}\text{Co}_{0.08}\text{O}$ and $\text{Ag}_x\text{-Zn}_{0.92}\text{Co}_{0.08}\text{O}$ samples. Fig. 1(a) manifests the quite similar oscillation shapes of the $\text{Zn}_{0.92}\text{Co}_{0.08}\text{O}$ 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 $\text{Zn}_{0.92}\text{Co}_{0.08}\text{O}$ nanorods. Remarkably, it is evident that the FTs of $\text{Ag}_x\text{-Zn}_{0.92}\text{Co}_{0.08}\text{O}$ 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.

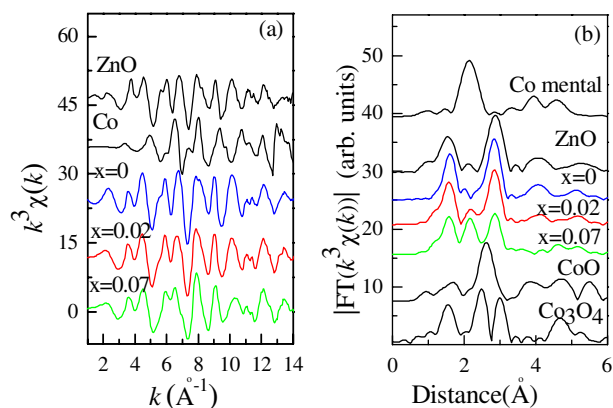


Fig.1 (a)EXAFS oscillation functions $k^3\chi(k)$; (b)Fourier transform amplitudes curves of Co K-edge for EXAFS functions of $\text{Ag}_x\text{-Zn}_{0.92}\text{Co}_{0.08}\text{O}$ hybrid-nanorods with different Ag concentrations, CoO, Co_3O_4 and Co metal.

To verify our supposition, Fig.2 shows Fourier transform of Ag K-edge EXAFS for $\text{Ag}_x\text{-Zn}_{0.92}\text{Co}_{0.08}\text{O}$, the reference Ag foil and Ag_2O powder. It is found that the FTs for the samples show a primary peak at 2.68Å corresponding to Ag-Ag of Ag foil, indicates that Ag atoms mostly exist as metallic Ag. However, a shoulder peak at 2.15Å observed in $\text{Ag}_x\text{-Zn}_{0.92}\text{Co}_{0.08}\text{O}$ can't be simply attributed to the non-linearity of the phase shift function of back-scattering atom Ag, because the gap between shoulder and main peak in $\text{Ag}_x\text{-Zn}_{0.92}\text{Co}_{0.08}\text{O}$ is obviously larger than that in Ag foil. Moreover, its site is quite similar with the peak at 2.16 Å in Co K-edge FTs for $\text{Ag}_x\text{-Zn}_{0.92}\text{Co}_{0.08}\text{O}$, suggesting that Ag atoms partially exist in interstitial site. Hence, we consider that besides main metallic Ag, numerous interstitial Ag atoms exist in $\text{Ag}_x\text{-Zn}_{0.92}\text{Co}_{0.08}\text{O}$.

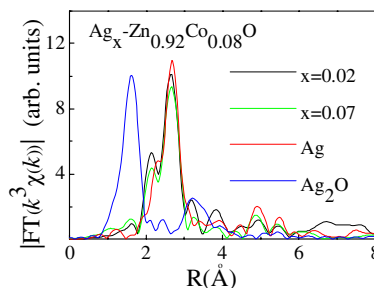


Fig. 2 The RSFs of the Ag K-edge EXAFS for the $\text{Ag}_x\text{-Zn}_{0.92}\text{Co}_{0.08}\text{O}$ and the reference Ag foil.

References

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