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## Distribution of Co Ions in Ferromagnetic Zn (1-x) Co (x)O Films

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We examined the distribution of Co ions of ferromagnetic n-type Zn(1-x)Co(x)O semiconducting films with the Co concentrations of 0.03~0.07 using x-ray absorption fine structure (XAFS) measurements at the Co and Zn K edges. Extended XAFS (EXAFS) revealed that Co ions mainly occupied the zinc sites of the films. X-ray absorption near edge structure (XANES) spectra demonstrated that the pre-edge peak of the Co K edge was substantially affected by the second neighboring Co ions at the zinc sites due to hybridizing of the Co 4p conduction electrons with the Co 3d bounded electrons. From XANES and EXAFS analysis using ab initio calculations, we found that Co ions uniformly occupied the zinc sites of the Zn (0.93) Co (0.07)O film, whereas the Co ions of the Zn (0.97) Co (0.03)O and Zn (0.95) Co (0.05)O films were substituted at localized zinc sites. The ferromagnetic properties of the Zn (0.93) Co(0.07)O film could be induced by direct interaction between the magnetic dipoles of the Co ions with a mean distance of 4.3 Å or by Co 4p electron mediation.

**Keywords:** ZnCoO, DMS, EXAFS, XANES, ferromagnetism, structure