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Physical Properties of $Co_{1-x}Ga_x$ alloys

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Recently, transition-metal (TM) gallides attract wide interest as a candidate of high-temperature structural materials. Even though TM gallides are intensively studied, a systematic study on the correlations between physical properties and electronic structures are rather insufficient. In this study, the physical properties and electronic structures of Co-gallide in a wide composition range were investigated. $Co_{1-x}Ga_x$ alloys ($0.35 \leq x \leq 0.55$) were prepared by using an arc-melting method and were annealed at 1000℃ for 48 hours to increase homogeneity. In this composition range, it was known that Co-Ga alloy have CsCl *(B2)* crystallographic structure, but exhibit diverse mechanical properties according to the compositions. The structural characterization has been performed by using x-ray diffraction and the magnetic properties were investigated by using a vibrating sample magnetometer. The chemical states and the electronic structure were studied by using x-ray photoemission spectroscopy (XPS), scanning photoelectron microscopy (SPEM), and x-ray absorption near-edge structure (XANES). Ga- and Co-*K* edges, and Co-$L_{2,3}$ edge XANES spectra were obtained at the U7 undulator and 3C1 EXAFS beamline of the Pohang Light Source. It was revealed that all the $Co_{1-x}Ga_x$ alloys exhibit CsCl structure, but the lattice constant of the alloys gradually changes according to the composition. It was also found that the $Co_{1-x}Ga_x$ alloys contain Ga_2O_3 phase by XPS analysis. Evolution of the electronic structures of the TM gallides are discussed in terms of Ga composition.