Magnetic properties and electronic structure of $Y_xGd_{1-x}Ni_5$ compounds

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Measurements of the magnetic susceptibility, crystal and electronic structure for $Y_xGd_{1-x}Ni_5$ (x=0.0, 0.2, 0.5, 0.8, 1.0) compounds with the $CaCu_5$ type of crystal structure are reported. The substitution of Y for Gd atoms results in a decrease of the volume unit cell and the Curie temperature (Fig. 1). In the paramagnetic range (300 - 650 K) the dc-susceptibility follows Curie-Weiss law for all investigated compounds. The effective moment deduced from the Curie constant decreases rapidly with Y concentration. The saturation magnetic moment for $GdNi_5$ shows negative polarization of Ni *3d* band induced by interactions with Gd *5d* states [1]. Both valence band and core level X-ray photoelectron spectra are analyzed. The presence of the satellite structure in Ni *2p* core level suggests the magnetic polarisation of nickel *3d* states which dominate the valence band in all investigated compositions (Fig. 2). The experimental investigations were completed with the band structure calculations. In all cases the calculations were carried out with the use of the SPR-KKR band structure programme of H. Ebert [2] (based on KKR and KKR–CPA methods). Satisfactory agreement between the measured spectra and those obtained from the calculated electronic structure has been achieved.

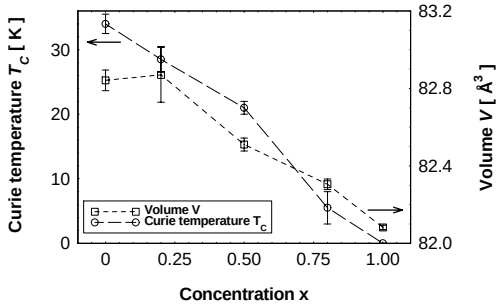

Fig. 1. Volume unit cell V and Curie temperature for $Y_xGd_{1-x}Ni_5$ system.

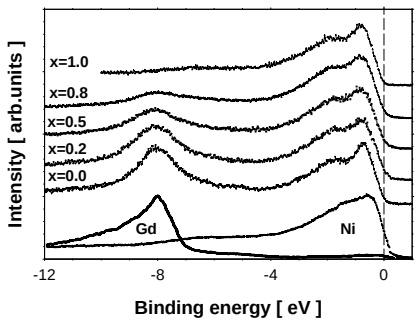

Fig. 2. The XPS valence band spectra for $Y_xGd_{1-x}Ni_5$ compounds.

[1] D. Gignoux, D. Givord, A. del Moral, Solid State Commun. **19** (1976) 891.
[2] H. Erbert, Lecture Notes in Physics **535** (2000) 191.

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