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Electronic Structure of $NdMn_2Ge_2$ and $GdMn_2Ge_2$

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The intermetallic compounds RMn_2Ge_2 (R=Nd, Gd) with $ThCr_2Si_2$-type structure show a wide variety of magnetic structure depending on temperature. In case of $NdMn_2Ge_2$, the magnetic moment on Mn-sublattice exhibits the ferromagnetic ordering along *c*-axis still at room temperature. The Mn-sublattice moment is canted toward *ab*-plane (Mn layers) and orders antiferromagnetically in the *ab*-plane. Below ~215 K, the conical ferromagnetic structure takes place on the Mn layers due to spin reorientation. Furthermore, below ~100 K, the moment also appears on the Nd-sublattice with a ferromagnetic arrangement along *a*-axis and is ferromagnetically coupled with the Mn layers. On the other hand, in case of $GdMn_2Ge_2$, the Mn-sublattice moment exhibits a collinear antiferromagnetic structure at room temperature. Below 95K, the Gd-sublattice moment is aligned antiparallel to the ferromagnetic Mn-sublattice moment along the *c*-axis and exhibits ferrimagnet behavior. It is considered that these magnetic properties are sensitive to the interlayer Mn-Mn spacing [1]. In this study, we have investigated electronic structure of RMn_2Ge_2 (R=Nd, Gd) by means of the photoemission spectroscopy.

Photoemission experiments in the R 4d-4f excitation region for polycrystalline RMn_2Ge_2 compounds were carried out at the beamline BL-11D. Spectra were measured at 295 K for $NdMn_2Ge_2$ and 20 K for $GdMn_2Ge_2$.

Figure 1 shows the photoemission spectra measured at on- and off-resonance and the derived R 4f partial DOS's of RMn_2Ge_2 (R=Nd (a) and R=Gd (b)). Binding energy is referred to the Fermi level E_F. The Nd 4f partial DOS in $NdMn_2Ge_2$ has a weight at 5.5 eV and also has finite DOS toward the low binding energy side due to the hybridization with the conduction bands. In particular, one notices that the Nd 4f states contribute to E_F. On the other hand, the Gd 4f partial DOS shows a core-like peak at 8.5 eV and we find no contribution to E_F. The experimental results indicate that the hybridization between the R 4f and conduction bands is higher for $NdMn_2Ge_2$ than for $GdMn_2Ge_2$. The off-resonance spectra is extremely different between both compounds. Taking into account the photo-ionization cross-section, the off-resonance spectra almost reflect the Mn 3d states. The experimental results indicate that the Mn 3d DOS is affected by R elements.

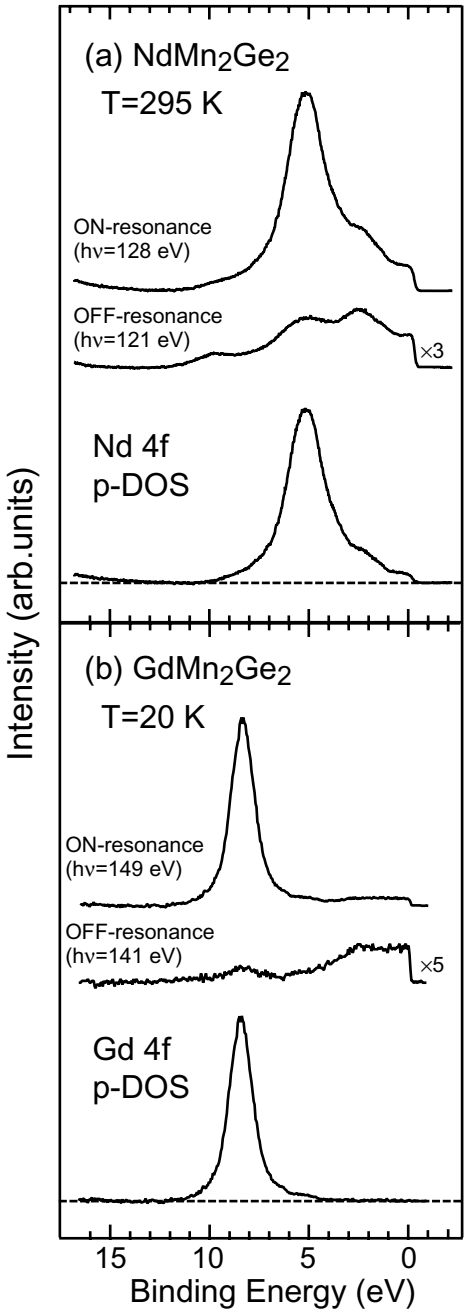

Fig. 1. Photoemission spectra of (a) $NdMn_2Ge_2$ and (b) $GdMn_2Ge_2$.

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