Metastability of crystal and magnetic structures in compounds containing heavy rare earths

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A comprehensive review is given of our recent advances in the study of metastable phases in intermetalics RCu_5 and $RGe_6Fe_{6-x}Mn_x$ (x=0, 3, 6) containing heavy rare earths (R=Tb, Dy, Ho, Yb) synthesized by rapid quenching of the liquid phase. The relations between the structures of the metastable and equilibrium phases and the transformations from the former to the latter are discussed by using X-ray and neutron diffraction, differential scanning calorimetry and magnetic measurements.

The magnetic and structural properties of RCu_5 with the cubic $AuBe_5$-type structure have been investigated with the neutron diffraction and magnetic measurements [1]. In magnetisation measurements it has been found that $TbCu_5$ and $DyCu_5$ [2] behave antiferromagnetically below a temperature of 15 K and 7 K, respectively. For $YbCu_5$ sample the minimum at around 20 K in the temperature dependence of the Knight shift of ^{63}Cu at 4c site was shown [3], which may be associated with a formation of Kondo-lattice state.

The compound $DyGe_6Mn_6$ is known as a complicated helimagnet with hexagonal $HfGe_6Fe_6$-type structure and it shows also an incommensurate magnetic order. Similar systems attracted much attention due to complicated magnetic ordering phenomena. Substitution of Fe instead Mn (ferromagnetic element instead antiferromagnetic element) in $DyGe_6Mn_6$ has been shown to influence the crystal and magnetic structures [4].

The point-contact-spectroscopy (PCS) enables us to gain energy spectra of quasiparticles like phonons, magnons or crystal-field excitations. Here, it was employed to study the impact of magnetic interactions on the electron-quasiparticle interactions in $DyGe_6Mn_{6-x}Fe_x$ for x = 0, 3 and 6. In the sample of pure $DyGe_6Mn_6$ we observe electron-phonon scattering and also scattering on magnetic quasiparticles. For all samples we observed a maximum in *dV/dI(V)* around zero and an increase for voltages higher than 5 mV (for $DyGe_6Fe_6$) and 30 mV (for $DyGe_6Mn_6$). The point-contact characteristic of the compound with x = 3 shows a similar behaviour [5]. We suggest a magnetic origin of the maximum around zero voltage.

For comparison, the results of magnetic investigation obtained for $DyFe_6Al_6$ compound in the fully amorphous state will be discussed.

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[1] B. Idzikowski, A. Kreyssig, M. Loewenhaupt, A. Hoser, K.-H. Müller, accepted for presentation at ICM 2006, Kyoto, Japan.
[2] B. Idzikowski, A. Jezierski, K. Nenkov, J. Appl. Phys . **85** (1999) 4744.
[3] T. Mito, M. Shimoide, T. Koyama, M. Nakamura, S. Wada, M. Reiffers, B. Idzikowski, J.L. Sarrao, T.C. Kobarashi, J. Magn. Magn. Mater. **290-291** (2005) 405.
[4] P. Kerschl, U.K. Rößler, B. Idzikowski, D. Eckert, K-H. Müller, L. Schultz, Physica B **326** (2003) 489.
[5] G. Pristáš, P. Kerschl, Z. Śniadecki, M. Reiffers, U.K. Rößler, B. Idzikowski, K.-H. Müller, accepted for presentation at JEMS 2006, San Sebastian, Spain.

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