量子ビーム科学セミナー

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（茨城大フロンティアセンター）

Inelastic neutron scattering investigations of an anisotropic hybridization gap in the Kondo insulators: CeT_2Al_{10} (T = Fe, Ru and Os)

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The recent discovery of topological Kondo insulating behaviour in strongly correlated electron systems has generated considerable interest in Kondo insulators both experimentally and theoretically. The Kondo semiconductors CeT_2Al_{10} (T = Fe, Ru and Os) possessing a c-f hybridization gap have received considerable attention recently because of the unexpected high magnetic ordering temperature of $CeRu_2Al_{10}$ (T_N=27 K) and $CeOs_2Al_{10}$ (T_N=28.5 K) and the Kondo insulating behaviour observed in the valence fluctuating compound $CeFe_2Al_{10}$ with a paramagnetic ground state down to 50 mK [1-3]. We are investigating this family of compounds, both in polycrystalline and single crystal form, using inelastic neutron scattering to understand the role of anisotropic *c-f* hybridization on the spin gap formation as well as on their magnetic properties. We have observed a clear sign of a spin gap in all three compounds from our polycrystalline study as well as the existence of a spin gap above the magnetic ordering temperature in T = Ru and Os. Our inelastic neutron scattering studies on single crystals of $CeRu_2Al_{10}$ and $CeOs_2Al_{10}$ revealed dispersive gapped spin wave excitations below T_N. Analysis of the spin wave spectrum reveals the presence of strong anisotropic exchange, along the c-axis (or z-axis) stronger than in the ab-plane. These anisotropic exchange interactions force the magnetic moment to align along the c-axis, competing with the single ion crystal field anisotropy, which prefers moments along the a-axis. In the paramagnetic state (below 50 K) of the Kondo insulator $CeFe_2Al_{10}$, we have also observed dispersive gapped magnetic excitations which transform into quasi-elastic scattering on heating to 100 K [4-5]. We will discuss the origin of the anisotropic hybridization gap in $CeFe_2Al_{10}$ based on theoretical models of heavy-fermion semiconductors [6-8]. Further the effect of electron- and hole-doping as well as chemical pressure effect on the magnetic and transport properties of CeT_2Al_{l0} compounds will be discussed. We will compare the observation of spin and charge gap formation in CeT_2Al_{10} with that observed in Ce-based Skutterudite compounds as well as that of topological Kondo insulators.

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