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Specific heat, resistivity, magnetoresistance, Hall effect, magnetization and susceptibility etc. experiments were performed to systematically study the fundamental physical properties of ytterbium monopnictides YbX and gadolinium monopnictides GdX (X = N, P, As, Sb and Bi). The main results obtained from this study are as follows.

1. Yb-monopnictides: (1). Anomalous broad peak of specific heat around 4 K has been reported for YbP by Ott et al. It is predicted that the similar anomalies would also exist in other Yb-monopnictides, and believed that this broad peak is originated from the Kondo effect. We have measured the specific heats of all YbN, YbP, YbAs and YbSb samples. A specific heat anomaly was found for all YbX samples near 4 K. The single impurity Kondo model can not explain the behavior of these broad peaks under magnetic fields. We analysed this specific heat anomaly with both the competition (between Kondo effect and magnetic exchange interactions) model and the magnetic polaron model. (2) Susceptibility and magnetization measurements can be explained by considering the CEF effect, magnetic exchange interactions and Kondo effect. Combining the magnetic properties and specific heat measurements with other reported experimental results, many physical properties were found changing regularly from YbAs to YbP and to YbN. This suggests that the strengths of the Kondo coupling, the magnetic exchange interaction or the magnetic polaron effect increase or decrease with the same sequence. (3). YbSb is a very exceptional case in YbX series. Our measurements show that the magnetic and thermal properties of YbSb do not follow the regular change observed in YbX series when going from YbN to YbAs. The specific heat anomaly near 4 K in YbSb is also different from those in YbN, YbP and YbAs and resembles a phase transition peak. (4). Neutron scattering measurements indicate that stoichiometric YbN and YbAs exhibit the antiferromagnetic fcc type-III order below T_N. Nonstoichiometric $YbP_{0.84}$, however, shows an antiferromagnetic fcc type-II order below T_N. This difference was initially believed to be due to the nonstoichiometry of $YbP_{0.84}$ sample. However we have prepared a YbP sample with almost ideal stoichiometry, and measured its spin structure by neutron scattering. The results confirmed the existence of antiferromagnetic type-II order below T_N = 0.66 K even in stoichiometric YbP.

2. Gd-monopnictides: (1). Fundamental physical properties of high quality single crystal GdP, GdAs, GdSb and GdBi as well as polycrystal GdN have been studied in detail for the first time. The Néel temperatures, paramagnetic Curie temperatures, critical fields as well as the magnetic phase diagrams are determined for Gd-monopnictides. (2). Susceptibility, magnetization and specific heat measurements show ferromagnetic behavior for our GdN sample with a ferromagnetic transition at $T_C = 58$ K and the saturation moment value reached at about 2 T. (3). According to magnetization and susceptibility measurements, GdP, GdAs, GdSb and GdBi are ferromagnets. The magnetic properties of the stoichiometric GdP, GdAs, GdSb and GdBi reveal the Heisenberg antiferromagnetic behaviors. The molecular field theory can be used to explain these behaviors. While the change of nearest neighbor exchange J_1 and next nearest neighbor exchange J_2 as a function of lattice constant in Gd-monopnictides is similar to that in Eu-chalogendes. This can be understood with the superexchange mechanism similar to the situation of Eu-chalogendes. While the existence of RKKY interaction was also observed from resistivity measurements. Anisotropy fields of GdX are very weak, two magnetic phase transitions, spin-flop transitions at low fields and the ferromagnetic phase transitions at high fields, are discovered. (4). The stoichiometric GdX samples have a large magnetoresistance, and show the behavior of semimetals with a good compensation between electrons and holes. Carrier concentrations of the stoichiometric GdAs and GdSb samples determined from dHvA effect and Hall effect measurements are 0.010/ion and 0.025/ion, respectively. For stoichiometric samples, the low temperature transport properties are almost entirely dictated by the temperature dependence of the mobilities of electrons and holes, the change of carrier concentration is small and has a rather weak effect. (5). A sharp peak of specific heat was found at T_N for all GdX samples. Applying a magnetic field to them, both the positions and intensities of these peaks decrease, which can be explained qualitatively by MFA theory. Another anomalous broad specific heat peak was also discovered at the temperature well below T_N for all GdX samples. The mechanism of this broad peak is not clear at this stage of the study. (6). A regular change of various physical properties is also found in Gd-monopnictides from our fundamental physical properties measurements. The results suggest that the strength of magnetic exchange interaction increase when going from GdP to GdBi. (7). Comparing with stoichiometric GdX samples, anomalous physical properties such as a smaller entropy at T_N; a larger negative magnetoresistance at low fields and a spontaneous magnetic moment existed at zero field are found for the first time in nonstoichiometric GdX. These anomalous properties can be explained by using the trapped magnetic polaron model. Trapped magnetic polaron effects have been found in semiconductor Eu-chalogendes, according to our experimental results, the possibility of the formation of trapped magnetic polaron states in nonstoichiometric semimetal Gd-monopnictides is very high. (8). Evidence of self-trapped magnetic polaron effect is not found in the stoichiometric GdX samples.