Magneto-transport properties of BaNiS₂ and BaCoS₂ under high pressure up to 10 GPa

Hancheng Yang⁹, Yannick Klein⁹, and Andrea Gauzzi⁹

⁹ Institut de Mineralogie, de Physique des Matériaux et de Cosmochimie (IMPMC), Sorbonne Université, CNRS, IRD, MNHN, 4 place Jussieu 75005 Paris, France

* Hancheng.yang@upmc.fr

During the 1990s, the quasi-2D BaCo₁₋ₓNiₓS₂ system (x = 0 to 1) has been topic of numerous studies due to its similarity with high-T_C superconducting materials. Its structure consists of electronically active Co(Ni)S sheets sandwiched between BaS layers. The relation between magnetism and transport properties in BaCo₁₋ₓNiₓS₂ is quite complex and not yet understood. As an illustration, the mother compound (x = 0) exhibits a paramagnetic to antiferromagnetic transition at T_N ~ 300 K, but without any transition in the transport properties [1]. On the other hand, when doped with Ni, the system undergoes a metal–insulator transition (MIT) at x ~ 0.22 [1]. A systematic study on the two end members of the series (BaNiS₂ and BaCoS₂) should help to unveil the mechanism of the MIT.

The control of the bandwidth and band-filling are two traditional ways to understand and manipulate the MIT. Experimentally, the bandwidth control can be achieved by applying a high pressure that may provide a tool to adjust the magnetic properties simultaneously.

In that respect, we have carried out magneto-transport measurements under high pressure up to 10 GPa on high quality single-crystals of BaNiS₂ and BaCoS₂. The resistance is measured down to a temperature of 2 K and under magnetic fields of up to 9 T. Only BaCoS₂ shows an MIT. BaNiS₂ keeps a metallic behavior, except at the lowest temperature where a weak localization is found. The results presented are interpreted with a Debye model.