



XV Krajowa Szkoła Nadprzewodnictwa
”Stulecie Nadprzewodnictwa”
Kazimierz Dolny, 9-13 października 2011 r.

A new insight into the oxypnictides: NpFeAsO

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We report on the synthesis of NpFeAsO, the first actinide based oxypnictide. This new compound is isostructural to the RFeAsO system (R =Rare Earth), possessing lattice parameters, Fe-As interatomic distances, and Fe-As-Fe bond angles falling within the empirical ‘optimum’ for the observation of the highest superconducting transition temperatures. A series of bulk measurements performed on the parent compound, including susceptibility, heat capacity and resistivity, show no evidence for the expected spin density wave (SDW) formation, nor antiferromagnetic (AFM) ordering of the iron sublattice. Instead, a distinct antiferromagnetic ordering occurs at $T_N = 57$ K, which is four times higher in temperature than the highest T_N observed in the RFeAsO ($R = \text{Pr}$) family.

We attempted doping the iron and the oxygen sites by cobalt and fluorine, respectively. The changes of the lattice parameters and the unit cell volume, are consistent with those published for RFe_{1-x}Co_xAsO and RFeAsO_{1-x}F_x, and indicate that the doping was successful. The subtle changes of the interatomic distances, due to chemical doping, will be discussed.

There is no hint of superconductivity transition observable in the susceptibility and specific heat data for the F-doped or Co-doped NpFeAsO samples down to 2 K. This observation, together with the lack of both SDW and AFM ordering of the iron ions in the parent material, are in agreement with the scenario that the same magnetic interactions are responsible for both antiferromagnetism and superconductivity in 1111 systems.