Field-dependence of the resistivity minimum in intermediate valence nanometric $YbAl_3$

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The magnetoelectronic properties of nanometric Rare Earth alloys are relatively unknown [1-3], even nowadays when nanoscience is a principal subject of scientific activity. The understanding of their size-dependent properties is a must as they are connected to fundamental condensed matter physics, in particular related to Fermi surface shape. Yb-based alloys follow the Doniach diagram in which the competition between RKKY and Kondo interactions plays a major role. Among them, $YbAl_3$ is a simple cubic compound (*Pm-3m* structure), displaying *strong electronic correlation* effects [4].

Recently, we have shown that it is possible to prepare nanometric *4f*-alloys with a narrow size distribution and in *massive* quantities. The latter is a significant advantage as it clearly simplifies the interpretation of macroscopic measurements and thereby enables technological advances [1]. In such samples a shell of antiferromagnetic Yb-oxide is present and Rietveld refinements show that amounts around 10%. In nanometric $YbAl_3$, we had demonstrated that the variation of valence is due to a modification of the fraction of surface atoms compared to the total number of particles. This clearly affects both the specific heat and the susceptibility [2, 3]. Here, we study the magnetic field-dependence of the electrical resistivity between 2 K and 300 K (Fig. 1) of pressed pellets of $YbAl_3$ with particle sizes below 10 nm deduced from XRD and TEM (HRTEM) analysis (Fig. 2). The results, with an *unexpected resistivity minimum* around 15 K, are broadly *relevant,* with a drastic change compared to bulk counterparts [5]. The explanation for its existence involves the appraisal of a Kondo interaction in intermediate valence nanoparticles.

References

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Figures

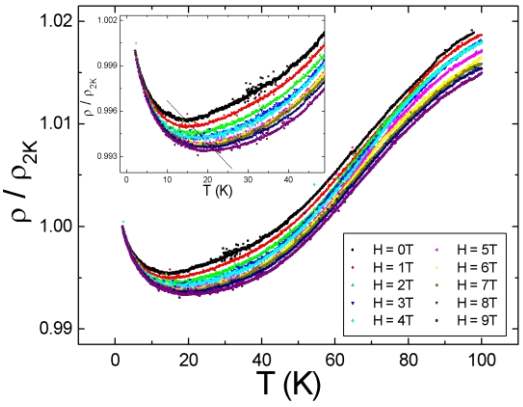

Figure 1. Field-dependence of electrical resistivity for 70h milled $YbAl_3$.

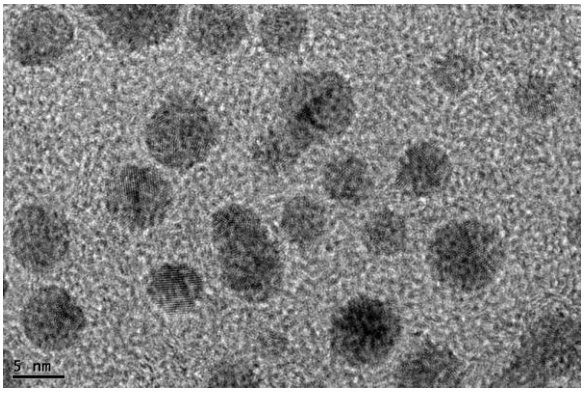

Figure 2: TEM image of milled (70h) $YbAl_3$ nanoparticles.