UNIKASSEL VERSITÄT

Physikalisches Kolloquium

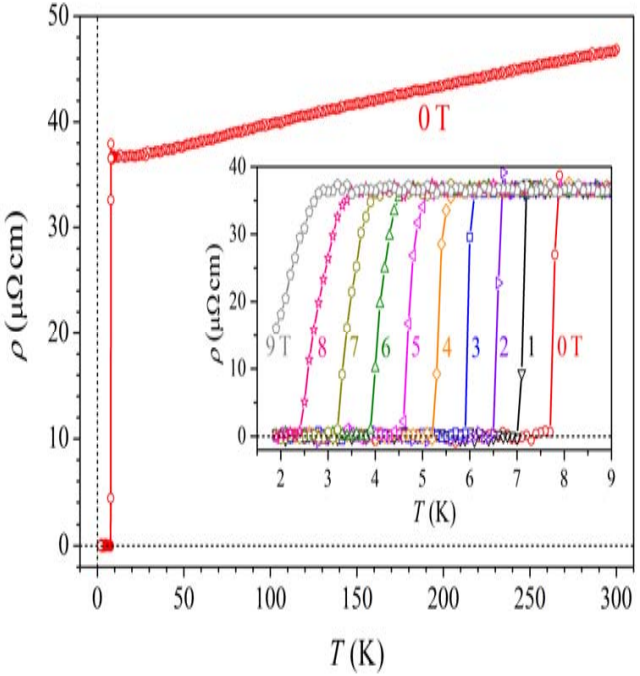
Thursday, 03.07.14, 17:00, HS 100
Reception with coffee & cookies 16:45

Prof. Janez Dolinšek, University of Ljubljana

A Superconducting High-Entropy Alloy

Abstract

High-entropy alloys (HEAs) are multicomponent mixtures of elements in similar concentrations, where high entropy of mixing can stabilize disordered solid solution phases with simple structures like body-centered cubic (bcc) or a face-centered cubic (fcc), in competition with ordered crystalline intermetallic phases. While HEAs exhibit enhanced mechanical properties, no exceptional physical properties were reported so far. We have synthesized a HEA with composition $Ta_{34}Nb_{33}Hf_8Zr_{14}Ti_{11}$ (in at. %), which possesses a disordered lattice with an average bcc structure of lattice parameter a = 3.36 Å. The measurements of the electrical resistivity, the magnetization and magnetic susceptibility and the specific heat reveal that the $Ta_{34}Nb_{33}Hf_8Zr_{14}Ti_{11}$ HEA is a type II superconductor with a moderately high transition temperature 7.3 K, an upper critical field 8.2 T, a lower critical field 35 mT and an energy gap in the electronic density of states at the Fermi level of 2.2 meV. The investigated HEA is close to a BCS-type phonon-mediated superconductor in the weak electron-phonon coupling limit, classifying as a "dirty" superconductor. The experimental parameters of the lattice degrees of freedom match well the theoretical ones calculated by the rule of mixtures, indicating completely random mixing of the elements on the HEA lattice, whereas the electronic degrees of freedom do not obey this rule, so that the electronic properties of a HEA are not a "cocktail" of properties of the constituent elements.



All of you interested in physics are cordially invited!

Contact: Dr. E.S. Zijlstra, More Information: uni-kassel.de/go/physikalisches_kolloquium