Mo.A-P18 - Superconductivity in high entropy alloys

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High entropy alloys (HEAs) are solid solution alloys that contain five or more principal elements in equal or near equal atomic percent [1]. High entropy of mixing can stabilize disordered solid solution phases with simple structures like a body-centred cubic or a face-centred cubic with small unit cells of the edge length about three angstroms only. Due to the problems in growing homogeneous samples of macroscopic size only few different HEAs have been studied so far. They show enhanced mechanical properties (e.g. hardness) while their physical properties remain mostly unexplored.
The HEA with the composition of $Ta_{34}Nb_{33}Hf_8Zr_{14}Ti_{11}$ (in at. %) has been synthesized and its physical properties determined. [2] The temperature dependent resistivity and susceptibility measurements show a transition to a superconducting state at a critical temperature of Tc = 7.3 K. A 100 % Meissner effect and temperature dependent specific heat measurements led us to the conclusion that the superconductivity is a bulk effect, where the entire specimen becomes superconducting below critical temperature. The magnetization curves between 2 K and 8 K show a typical type II superconductor behaviour with the first critical field of 32 mT at 2 K. The upper critical field extrapolated to T = 0 is approximately 8.3 T.
Very recently a superconductivity at even a little bit higher critical temperature of approx. 7.7 K has been detected in another HAE composed of transition metals Ta-Nb-Hf-Zn, showing superconductivity as a common feature of this type of HEAs.

[1] Y. Zhang et al, Progress in Materials Science 61 (2014) 1-93
[2] P. Ko×elj et al, Phys. Rev. Lett. 113 (2014) 107001