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Fabrication of microstructured devices for grain boundary investigations in unconventional superconductor $CeCoIn_5$

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The study of grain boundaries (GB) in superconductors has both fundamental and applied interests. In high-temperature cuprate superconductors studies of the critical currents (Jc) across GBs have provided important information on the symmetry of the superconducting order parameter and are critical for the observation of spontaneously generated half-flux magnetic quanta [1,2]. Similar to cuprate superconductors, heavy fermion superconductors (HFS) host rich physics in the form of unconventional superconducting phases with nodal quasiparticles. However, there have been relatively few phase-sensitive measurements of the superconducting order parameter thereby emphasizing the need for investigations of J_c across GBs in HFS.

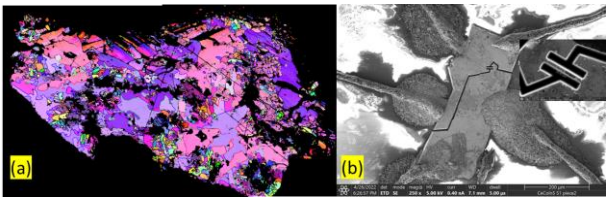

Fig. 1: (a) Shows an EBSD image of the differently oriented grains present in polycrystalline $CeCoIn_5$ sample and (b) shows the SEM image of a microstructed fabricated across a 90° GB using FIB milling.

In this talk, I will present results on GBs in polycrystalline samples of the HFS $CeCoIn_5$. Electron backscatter diffraction (EBSD) performed on well-polished samples of polycrystalline $CeCoIn_5$ reveal that majority of grains are not randomly oriented as one would expect but grow at a misorientation angle of 90° with respect to their neighboring grain. We performed J_c studies across various such GBs by fabricating microstructured devices using focused ion-beam milling. Our investigations are crucial in understanding the superconducting order parameter symmetry of $CeCoIn_5$ and its potential use in devices for quantum information science.

[1] H. Hilgenkamp et al., Rev. Mod. Phys. 74, 485, 2002.

[2] C. C. Tsuei and J. R. Kirtley, Rev. Mod. Phys. 72, 969, 2000.