Highlights

Superconductivity - 2016

Research Update: Structural and transport properties of (Ca,La)FeAs2 single crystal


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APL Materials 4, 020702 (2016)

Structural and transport properties in the normal and superconducting state are investigated in a Ca$_{0.8}$La$_{0.2}$FeAs$_2$ single crystal with $T_c=27$ K, belonging to the newly discovered 112 family of iron based superconductors. The transport critical current density $J_c$ for both field directions measured in a focused ion beam patterned microbridge reveals a weakly field dependent and low anisotropic behaviour with a low temperature value as high as $J_c(B=0)=10^5$ A/cm$^2$. This demonstrates not only bulk superconductivity but also the potential of 112 superconductors towards applications. Interestingly this superconducting compound undergoes a structural transition below 100 K which is evidenced by temperature-dependent X-ray diffraction measurements. Data analysis of Hall resistance and magnetoresitivity indicate that magnetotransport properties are largely dominated by an electron band, with a change of regime observed in correspondence of the onset of a structural transition. In the low temperature regime, the contribution of a hole band to transport is suggested, possibly playing a role in determining the superconducting state.

Left: Resistivity vs $T$ measurement of a Ca$_{0.8}$La$_{0.2}$FeAs$_2$ single crystal. Inset: IB image of the FIB patterned crystal. Center: Resistivity transition for magnetic fields $B=0$ and $B=7$T, applied both parallel ($B||c$) and perpendicular ($B \perp c$) to the c-axis. Inset: $B_{c2}$ up to $B_{c2}=7$T for $B||c$ and $B \perp c$. Right: Transport $J_c$ measurements at fixed temperatures as a function of $B||c$ and $B \perp c$. Inset: $V-I$ curves measured at $T=3$K at different perpendicular ($B^c||c$) fields.