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Synthesis and transport properties of 112-type iron pnictide

superconductors $\text{Ca}_{1-x}\text{Ce}_x\text{Fe}_{1-y}\text{Co}_y\text{As}_2$

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ABSTRACT

We studied the electronic transport properties in the 112-type $\text{Ca}_{1-x}\text{Ce}_x\text{Fe}_{1-y}\text{Co}_y\text{As}_2$ ($0.18 \leq x \leq 0.27$, $y=0, 0.025$) single crystals. Upon Ce doping on the Ca site, it is found that the antiferromagnetic(AFM)/structural phase transition is enhanced and a weak superconductivity, possibly of filamentary superconductivity in origin, emerges. However, only a small amount of Co co-doping in $\text{Ca}_{0.8}\text{Ce}_{0.2}\text{Fe}_{0.975}\text{Co}_{0.025}\text{As}_2$ suppresses the AFM/structural transition completely and stabilizes a bulk superconductivity with $T_c=34.5$ K. Intriguingly, Hall measurements reveal a sign change of R_H only in $\text{Ca}_{0.73}\text{Ce}_{0.27}\text{FeAs}_2$ around ~ 80 K, which is presumably due to the band reconstruction driven by the AFM/structural transition. For other dopings, Hall coefficient (R_H) is negative and shows nonmonotonic T -dependence with a broad minimum feature. Moreover, the magnetoresistance (MR) is found to be progressively suppressed with increasing Ce concentrations. While the size of MR tends to saturate at low T for $\text{Ca}_{0.8}\text{Ce}_{0.2}\text{Fe}_{0.975}\text{Co}_{0.025}\text{As}_2$, it turns downward with decreasing temperatures below ~ 80 K for all Co-free samples. Finally, the Kohler's rule is strongly violated only below a characteristic temperature T^K , suggesting either a change of carrier number or exotic anisotropic scattering mechanism below T^K in this system.

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