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Synthesis and transport properties of 112-type iron pnictide superconductors $Ca_{1-x}Ce_xFe_{1-y}Co_yAs_2$

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ABSTRACT

We studied the electronic transport properties in the 112-type $Ca_{1-x}Ce_xFe_{1-y}Co_yAs_2$ ($0.18 \leq x \leq 0.27$, 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 $Ca_{0.8}Ce_{0.2}Fe_{0.975}Co_{0.025}As_2$ 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 $Ca_{0.73}Ce_{0.27}FeAs_2$ 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 $Ca_{0.8}Ce_{0.2}Fe_{0.975}Co_{0.025}As_2$, 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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