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Defect-induced Superconductivity up to 49 K in (Ca1-xRx)Fe2As2 L.Z. DENG, B. LV, K. ZHAO, F. Y. WEI, Y. Y. XUE, Z. WU, Texas Center for Superconductivity at the University of Houston, C.W. CHU, Texas Center for Superconductivity at the University of Houston; Lawrence Berkeley National Laboratory, Berkeley, California — To explore the origin of the unusual non-bulk superconductivity with a Tc up to 49 K reported in the rare-earth-doped CaFe2As2 , the chemical composition, magnetization, specific heat, resistivity and low temperature annealing effect are systematically investigated on nominal (Ca1-xRx)Fe2As2 single crystals with different x's and R = La, Ce, Pr and Nd. All display a doping independent Tc once superconductivity is induced, a doping dependent low field superconducting volume fraction f, and a large magnetic anisotropy η in the superconducting state, suggesting a rather inhomogeneous superconducting state in an otherwise chemically "homogeneous" superconductor. The wavelength dispersive spectroscopy, specific heat and magnetization measurements show the presence of defects which form superparamagnetic clusters for R = Ce, Pr and Nd, but not for La and display both inter and intra-cluster interactions, implying that defects are locally self-organized. Low temperature annealing reduces only the residual strain in the samples without varying x and suppresses f profoundly; however, the Tc was unaffected. The above observations are consistent with the interface-enhanced superconductivity recently proposed and also demonstrates the crucial role of defects in the occurrence of the unusually high Tc ˜49 K in (Ca1-xRx)Fe2As2.

Liangzi Deng
Texas Center for Superconductivity at the University of Houston

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