Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Evidence of Interface-Enhanced T_c in Rare-Earth Doped Ca122
C.W. CHU, BING LV, LIANGZI DENG, FENGYAN WEI, YU-YI XUE, MELISSA GOOCH, BERND LORENZ, Texas Center for Superconductivity, University of Houston — Nonbulk superconductivity with an onset-T_c up to 49 K has been observed in single crystalline rare-earth doped $CaFe_2As_2$ [$(Ca_{1-x},RE_x)122$] recently. Such a T_c is more than $\sim$ 20 K higher than any known compounds that consist of one or more of the Ca, RE, Fe and As elements at ambient or under high pressures. The unusually high onset-T_c has therefore been attributed to interface effect. We have made systematic magnetic, transport, calorimetric and structural studies. They show: a chemically homogeneity of $\Delta x < 0.005$ over a 1μm; less than 5 % of a bulk superconducting volume fraction; a doping-insensitive onset-T_c in samples with or without the "collapsed phase", varying from $\sim$ 42 K for RE = Nd to 49 K for RE = Pr with a doping sensitive superconducting volume fraction, suggesting that the high onset-T_c cannot be due to chemical doping or the effect of the "collapsed phase"; an unusually high magnetic anisotropy up to 200, in contrast to the value of 4 from the sample geometric anisotropy, suggesting that the superconducting body has a very high aspect ratio; several steps in the magnetic susceptibilities along both the c- and ab-directions in the field range between 10^{-3} to 10^{+3} Oe, demonstrating the sample consisting of Josephson-Coupled superconducting islands imbedded with nano-scale interfaces; and the presence of superparamagnetic clusters associated with minute As-vacancies, consistent with theoretical calculations. The present studies therefore present the strongest evidence for interface-enhanced T_c to date.

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Date submitted: 20 Nov 2012 Electronic form version 1.4