

Abstract Submitted  
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**Superparamagnetism and interfacial superconductivity in rare earth Pr-doped Ca122**<sup>1</sup> L.Z. DENG, B. LV, F.Y. WEI, Y.Y. XUE, C.W. CHU<sup>2</sup>, Texas Center for Superconductivity and department of Physics, University of Houston, Houston, TX 77204-5002 — To better understand the origin of the non-bulk superconductivity with an unusually high onset- $T_c$  (49 K) and its superconducting behavior in the rare earth Pr-doped Ca122  $[(Ca_{1-x}Pr_x)Fe_2As_2]$ , detailed chemical analyses and magnetization measurements on both the as-synthesized and annealed single crystals were carried out. A small but non-negligible As-deficiency and superparamagnetic clusters (SPCs) were detected in the superconducting as-synthesized crystals, suggesting that the SPCs originate from the As vacancies. The magnetic moment of the SPC were found to be insensitive to the doping level  $x$ , while the SPC density ( $n$ ) is zero for  $x < 0.05$  in the non-superconducting region and increases monotonically with  $x$  for  $x > 0.1$  in the superconducting region. The superconducting volume fraction ( $f$ ) was shown to be very closely related with  $n$ . Noticeable inter-cluster interactions, from antiferromagnetic for  $x < 0.05$  (non -SC region) to weakly ferromagnetic for  $x > 0.1$  (SC region) were found, suggesting that the defects are ordered. Systematically annealing the crystals over 500-920° simultaneously suppress both  $n$  and  $f$ . Therefore, we propose that the ordered vacancies, and the associated interfaces, are responsible for the rather high onset- $T_c$ .

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