Scanning tunneling spectroscopic studies of the iron-arsenic superconducting $\text{Ba(Fe}_{1-x}\text{Co}_x\text{)}_2\text{As}_2$ single crystals

M.L. TEAGUE, H. CHU, R. T.-P. WU, N.-C. YEH, Dept. of Physics, Caltech, Pasadena, CA 91125, USA, P. CHEN, B. SHEN, H.-H. WEN, Institute of Physics, Chinese Academy of Sciences, China — Scanning tunneling spectra of $\text{Ba(Fe}_{1-x}\text{Co}_x\text{)}_2\text{As}_2$ ($x=0.06, 0.08, 0.12$) single crystals are studied as a function of temperature ($T$) and magnetic field ($H$). For $H = 0$, direct evidence for two-gap superconductivity at energies $\omega = \Delta_\beta$ and $\Delta_{\alpha,\gamma/\delta} \approx 2\Delta_\beta$ and for magnetic resonance modes at $\Omega \approx \Delta_\beta + \Delta_{\alpha,\gamma/\delta}$ are found for all samples at $T < T_c$. Fourier transformation of the tunneling spectra reveals $x$- and $\omega$-dependent quasiparticle interference (QPI) wave-vectors $\mathbf{q}_2$ near $(\pm \pi,0)/(0,\pm \pi)$ and $\mathbf{q}_1$ near $(\pm 2\pi,0)/(0,\pm 2\pi)$. The spectral intensity of $\mathbf{q}_2$ exhibits strong $\omega$-dependence, peaking sharply at $\omega = \Delta_\beta, \Delta_{\alpha,\gamma/\delta}$ and $\Omega$. This is in stark contrast to the Bragg diffraction peaks that are independent of $\omega$, $T$ and $x$. For $H > 0$, additional QPI wave-vector $\mathbf{q}_3$ appears near $(\pm \pi, \pm \pi)$. These findings are consistent with the sign-changing $s$-wave pairing symmetry. Additionally, for the optimally doped sample, a pseudogap at $\omega \sim \Delta_{\gamma/\delta}$ is found inside the vortex core, possibly due to coexisting superconductivity and spin density waves. This result is in contrast to the zero-bias conductance peaks observed inside the vortex core of $\text{(Ba}_{1-x}\text{K}_x\text{)}\text{Fe}_2\text{As}_2$, implying asymmetry in the hole and electron-doping of the iron arsenides. This work was supported by NSF DMR-0907251.

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Date submitted: 15 Nov 2011

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