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Flux pinning and dynamics in pnictide superconductors

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First and third harmonics of ac susceptibility along with resistivity of Ba0.56 K0.44 Fe2As2 (Tc=37.6 K) and Ba(Fe0.91Co0.09)2As2 (Tc=25.3 K) polycrystalline samples are measured as a function of excitation ac field amplitude (0.1-10 Oe), frequency (10-2000 Hz), and applied dc magnetic field (0-18 T) in a detailed study. The excitation frequency f influence on flux dynamics is studied. The shift of Tp, temperature of the peak of the imaginary part χ"of ac susceptibility, does not show the single linear ln f vs 1/Tp fit, predicted by the Arrhenius Anderson-Kim model of thermally activated flux flow. The ln f vs 1/Tp plot has 2 separate lines with different slopes, showing that the selected excitation ac field frequency range impacts the size of the measured flux pinning energy. The pinning energy is measured as a function of the applied dc and ac magnetic fields, driving ac frequency, and temperature. The results are compared with energies extracted from resistivity measurements. Peaks, troughs and inflection points in the third harmonic of ac susceptibility are analyzed to get additional insight into the flux behavior. Ac losses and flux penetration, visible even in a zero resistivity state, are examined.

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