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Magneto-transport properties, thermally activated flux flow and activation energies in Ba(Fe0.95 Ni0.05)2As2 and Ba(Fe0.94 Ni0.06)2As2 superconductors

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Thermally assisted flux flow (TAFF) is studied in bulk Ba(Fe0.95 Ni0.05)2As2 (Tc = 20.4 K), Ba(Fe0.94 Ni0.06)2As2 (Tc = 18.5 K) superconductors by transport measurements in magnetic fields up to 18 T. In addition, the upper critical field μ0Hc2(0) and the coherence length ζ(0) are determined. The data is analyzed in the context of the widely accepted Anderson-Kim model and Fischer model. The onset TAFF temperature and the crossover temperature Tx from TAFF to flux flow are determined. The flux pinning activation energy U is modeled as U(T,H) = U0(H) f(t) where f(t) is some temperature function and the modified Anderson-Kim model is used to extract U0, which is graphed as a function of magnetic field μ0H near Tc. The resistive regime is observed, which is caused by fluctuations. Fisher's model is applied to determine the glass melting transition temperature; it occurs in the upper TAFF state and not in the expected, zero resistivity, vortex solid regime. Furthermore, the resistive transition width is proportional to μ0H, in contrast to Tinkham's prediction. The H-T phase diagram is drawn.

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