Fluctuation-induced conductivity in melt-textured Pr-doped YBa2Cu3O7-δ composite superconductor

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In this study, the effects of thermal fluctuations on the electrical conductivity in melt-textured YBa2Cu3O7-δ, Y0.95Pr0.05Ba2Cu3O7-δ, and (YBa2Cu3O7-δ)0.95–(PrBa2Cu3O7-δ)0.05 composite superconductor were considered. The composite superconductor samples were prepared through the top seeding method using melt-textured NdBa2Cu3O7-δ seeds. The resistivity measurements were performed with a low-frequency, low-current AC technique in order to extract the temperature derivative and analyze the influence of the praseodymium ion on the normal superconductor transition and consequently on the fluctuation regimes. The results show that the resistive transition is a two-step process. In the normal phase, above the critical temperature, Gaussian and critical fluctuation regimes were identified, while below the critical temperature, in the regime near the approach to the zero-resistance state, the fluctuation conductivity diverges as expected in a paracoherent-coherent transition.

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