Fluctuation conductivity of $SmFeAsO_{0.85}$ and $SmFeAsO_{0.8}F_{0.2}$ single crystals

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We have synthesized superconducting single crystals of $SmFeAsO_{0.85}$ and $SmFeAsO_{0.8}F_{0.2}$ by a self-flux method, of which growth pressure and temperature were 3.3 GPa and 1350–1450 °C, respectively. The lattice constants are estimated to be a = 3.909 Å and c = 8.435 Å from synchrotron-irradiated X-ray diffractometry. High-resolution transmission electron microscopy images reveal a well-defined tetragonal structure with alternating SmO and FeAs layers along the c-axis. Temperature-dependent transport measurements showed the critical temperature, T_c, at ~50 K for $SmFeAsO_{0.85}$ and ~42 K for $SmFeAsO_{0.8}F_{0.2}$ with a sharp superconducting transition width of 0.5 K. Applied with perpendicular magnetic field along the c-axis, the fluctuation conductivity, σ_{fl}, was obtained from $\sigma_{fl} = 1/\rho(T) - 1/\rho_n(T)$, where $\rho(T)$ is the in-plane resistivity and $\rho_n(T)$ is the normal-state resistivity, linearly extrapolated from high temperature region above $2T_c$. Respective scaling behavior of σ_{fl} from $SmFeAsO_{0.85}$ and $SmFeAsO_{0.8}F_{0.2}$ single crystals was in good agreement with a two-dimensional (2D) theory suggested by Ullah and Dorsey [1], which confirms 2D nature of superconductivity in these iron-based compounds.

Keywords : FeAs-based superconductor, fluctuation conductivity, superconducting dimensionality

[1] S. Ullah and A. T. Dorsey, Phys. Rev. B 44, 262 (1991); ibid., Phys. Rev. Lett. 65, 2066 (1990).