Resistivity and Carrier Mobility of the SmBa$_2$Cu$_3$O$_{6+x}$ Superconductor with Different Oxygen Doping Levels

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DC conductivity measurements between 15 and 300 K are reported for SmBa$_2$Cu$_3$O$_{6+x}$ samples with different oxygen doping amounts ($x$) produced by annealing under appropriate high temperature and oxygen pressure conditions and quenching.

Samples with $x \geq 0.5$ are superconductors: $T_c \sim 60$ K at $x = 0.7$, $T_c > 80$ K at $x = 0.9$. The transition from superconduction to non-superconduction corresponds to the tetragonal to orthorhombic structural transition and to the transition from semiconducting to metallic temperature dependence of the resistivity.

Oxygen doping causes a sudden increase of hole mobility near $x = 0.5$. Below this threshold, the behavior of the carrier mobility is in agreement with an Anderson localization.