Effect of Ru addition on the superconducting properties of the Eu-123 system

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Effects of an Ru addition on the structural and superconducting properties of the Eu-123 system were studied. Samples of EuBa$_2$Cu$_{3-x}$Ru$_x$O$_{7-δ}$ with $x$ ranging from 0 to 0.7 were prepared by the solid state reaction technique from Eu$_2$O$_3$, BaCO$_3$, CuO and RuO$_2$ precursors at the temperature of 1050 °C for 72 h in flowing oxygen and oxygen-annealed at 580 °C for 24 h. X-ray diffraction data show the presence of another Ba-Eu-Ru-O phase, for $x \geq 0.03$, in addition to the superconducting phase. AC and DC magnetization characteristics were measured by a compensation method using the second-order SQUID gradiometer at $\sim$77 K and the QD SQUID magnetometer MPMS XL-7 at 20 K. The superconducting properties, $T_c$, $\Delta T_c$ and magnetization $M(H)$, deteriorate with increasing the Ru content; e.g., $T_c$ ranges from 92.6 K to 76 K.