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Bi-epitaxial grain boundaries in $YBa_2Cu_3O_{7-x}$ thin films prepared by pulsed laser deposition and pulsed organometallic beam epitaxy: Direct comparison of transport properties and grain boundary structure

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A set of 45° [001] bi-epitaxial $YB_2Cu_3O_{7-x}$ thin film grain boundaries was studied to compare the effects of the microstructure on transport properties. The grain boundaries were made using two different deposition techniques: pulsed laser deposition (PLD) and pulsed organometallic beam epitaxy (POMBE). The transport properties were highly dependent on the specific growth conditions used, resulting in both fully resistive and superconducting grain boundaries. Subsequent microstructural analysis of the measured boundaries showed that both types (superconducting and resistive) meandered on the length scale of hundreds of nanometers. The major structural difference between the boundaries was at the atomic scale where the resistive boundary had a 1 nm wide disordered region. The direct correlation of microstructure to transport properties demonstrates the importance of the atomic scale structure in the resulting transport behavior.

Keywords: Defects; Superconductors; Thin film
Materials: $YBa_2Cu_3O_{7-x}$

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