Magnetometry Study of the Superconducting Properties of $CuBa_2Ca_3Cu_4O_{10+\delta}$

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$CuBa_2Ca_3Cu_4O_{10+\delta}$ (Cu-1234) is a promising high-temperature superconductor owing to its high critical temperature, relatively low anisotropy and the absence of toxic elements. Understanding its properties in both bulk and thin-film forms is important for future superconducting applications.

The bulk sample exhibits a sharp superconducting transition at $T_c \approx 117.5$ K and excellent intrinsic superconducting properties. Magnetization measurements reveal a high upper critical field ($\mu_0 H_{c2}(77\ \text{K}) \approx 91$ T, extrapolated $\mu_0 H_{c2}(0) \approx 186$ T) together with $\mu_0 H_{irr}(77\ \text{K}) \approx 21$ T. Analysis of the magnetic data confirms a short coherence length and strong intrinsic superconducting performance. However, the intergranular critical current density is reduced by approximately four orders of magnitude compared with the intragranular value, demonstrating that weak grain-boundary coupling remains the principal factor limiting practical applications.

Preliminary transport measurements of the Cu-1234 thin film reveal a superconducting transition at $T_c \approx 109$ K. Quantitative magnetic characterization is currently limited by the dominant magnetic contribution of the substrate, indicating the need for further optimization of thin-film growth and characterization. These results demonstrate the considerable potential of Cu-1234 for superconducting applications and motivate further development of high-quality bulk and thin-film materials.