Effect of Dy_2O_3 doping on the morphology and critical parameters of MgB_2 material

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We present the microstructure, crystal structure, and critical parameters (e.g., critical temperature (T_c), irreversible magnetic field (B_{irr}), and transport critical current density (J_c)) of Dy_2O_3-doped MgB_2 wires. Transmission electron microscopy (TEM) was performed on longitudinal sections of the MgB_2 wires. The results show that Dy_2O_3 addition significantly affects the microstructure, promoting and accelerating the formation of the MgB_2 phase.

Transport measurements indicate that Dy_2O_3 doping, combined with low-temperature annealing, enables the achievement of high transport critical current densities at 25 K and 30 K. X-ray powder diffraction (XRPD) results confirm that short-term annealing leads to a higher fraction of the MgB_2 phase in Dy_2O_3-doped wires compared to undoped samples.

Moreover, Dy_2O_3 doping improves both T_c and B_{irr}, particularly at range of high temperatures. TEM analysis suggests that the dopant contributes to the formation of the MgB_2 phase without contamination. Complementary scanning electron microscopy (SEM) observations reveal that Dy_2O_3 doping significantly modifies the grain morphology and size distribution compared to undoped MgB_2 wires. Overall, the results demonstrate a beneficial effect of Dy_2O_3 addition on both the microstructure and superconducting performance of MgB_2 wires, especially under conditions of solid-state Mg annealing.