Critical Current in PLD-YBCO Coated Conductors Investigated by High-resolution Hall Scan Measurements

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Abstract — The limiting effect of grain boundaries (GBs) on the global critical current density (J_c) is one of the main obstacles for producing HTS wires and tapes for high-field applications. GBs are inherent to every growth method and much research has been devoted to decrease the angle between adjacent grains to avoid the strong decrease in J_c at larger angles. However, many other questions remain about the physics and correlation of the local current flow in the material and the underlying GB network. Recent results on PLD-YBCO coated conductors (CC) based on cube-textured NiW substrate with oxide buffer layers and ABAD-YSZ coated stainless steel substrates with an additional CeO_2 buffer layer show a good transfer of the substrate texture to the superconductor. Large grain size of YBCO in the range of 40-80 µm is observed on the NiW template while the ion-beam textured tapes have YBCO grains with dimensions below 1 µm. It is found that the adjacent YBCO grains have larger misorientation angles in NiW tapes as compared to ion-beam textured template. The imperfect texture of the YBCO on NiW is reflected in the trapped field profile measured using a high-resolution scanning Hall probe device. It is found that local currents in the YBCO grains dominate the signal and the grain boundaries greatly inhibit the macroscopic current flow. The correlation of the grain misalignments and the local current percolation is studied. The results of YBCO on NiW tape are compared with those of the much finer grain structure on the ABAD template having a much smaller degree of misalignment. In-field measurements and trapped field profiles at different temperatures are analyzed to determine the extent of the current limitation by the GBs in these coated conductors.

Keywords (Index Terms) — Coated conductors, YBCO, RABITs, critical currents.