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M2Po2A-01 [25]: Microstructural Characterization of Tl-1223 Superconducting Thin Films for the CERN Future Circular Collider (FCC-hh) Beam Screen

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CERN has lately defined the features of the possible next-generation high-energy hadron-hadron collider (FCC-hh): it would be located in a 100 km circumference ring, with a target center-of-mass energy of 100 TeV, achievable through the collision of counter-rotating proton beams with an energy of 50 TeV. Because of their high energy, the proton beams circulating in the accelerator would produce several tens of watts of synchrotron radiation per meter; therefore, a beam screen is necessary in order to prevent this radiation from impinging on the dipole magnets. The beam screen would be kept at 50 K for cryogenic efficiency. Beam stability reasons require to minimize its surface impedance and, in order to guarantee a better performance than copper would allow, the only alternative materials are High Temperature Superconductors: a good candidate is Tl-1223, whose deposition process should be scalable to the size of the FCC-hh components. An important requirement is a high critical current density J_C. In the case of HTS, it is strongly dependent on the grain boundary misalignment and is drastically suppressed if the misorientation angles are too big, i.e. the grains are not well connected. To explore the microstructural features of Tl-1223 thin films deposited on differently processed Ag and SrTiO₃ substrates, we employ Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM). In particular, we investigate the homogeneity of the formed Tl-1223 phase and the grain boundaries misalignment. Furthermore, we relate the analyzed microstructure to the magnetic characterization of the superconducting samples, performed with Scanning Hall Probe Microscopy. The results will help to better understand the potential of the still little-known Thallium based superconductors to advance the FCC design project.
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