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Superconducting properties of production 2G HTS wires based on YBCO with Y2O3 nanoparticles in magnetic field up to 16 T

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We performed characterization of superconducting properties of production 2G HTS wires based on YBCO with Y2O3 nanoparticles, which were developed recently specifically for application in high magnetic field [1], including magnets for compact fusion reactors and particle accelerators. We measured magnetization curves using vibrating sample magnetometer (VSM) in the Quantum Design PPMS (in the 0-9 T range, at 4.2-77 K) and a Cryogenics magnet (in the 0-16 T range, at 20 and 77 K). In-field performance was accessed by calculating lift-factors (LF) as the ratio of a sample's magnetic moment at a certain temperature and magnetic field to that of the same sample at 77 K, 0 T. We will discuss the application of Zhang's [2] fit model, to extrapolate the magnetic field dependences of lift-factors to 20 T. We also measured resistivity curves of the samples using PPMS in the field range from 0 to 9 T, and the samples were rotated from orientation H||c ($\theta = 0°$) to H||ab ($\theta = 90°$) at 30° increments. The curves were obtained by the 4-probe technique with a 100 mA measuring current. The microstructural characterization was performed by TEM, and it confirmed the presence of semi-coherent Y2O3 nanoparticles in the YBCO film matrix. In the talk, we will discuss the correlation between the HTS layer microstructure in the samples and the magnetic field, temperature and angular dependences of their superconducting properties.

[1] Molodyk, A., Samoilenkov, S., Markelov, A. et al. Development and large volume production of extremely high current density YBa2Cu3O7 superconducting wires for fusion. Sci Rep 11, 2084 (2021). https://doi.org/10.1038/s41598-021-81559-z

[2] Zhang, X., Zhong, Z., Ruiz, H. S., Geng, J. & Coombs, T. A. General approach for the determination of the magneto-angular dependence of the critical current of YBCO coated conductors. Supercond. Sci. Technol. 30, 025010 (2017).

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