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Current review of the 2G-HTS wires production for high-field applications at SuperOx

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In the past 2 years SuperOx has invested significant resources into developing the next generation 2G-HTS wires for high magnetic field applications and created state-of-the-art production facilities in Japan and Russia, aiming at the fusion, MRI, accelerator magnets and motors markets.

Our current major product is based on the novel YBCO composition fabricated by PLD process on the Hastelloy substrate with IBAD-MgO based buffer. It allows for producing wires with very high critical current at low temperature and high magnetic field. In the typical process, wires of 350-600m with the I_c of 160-230A/4mm at 20K and 20T (B//c) and 400-500 A/4mm at 4.2K can be fabricated. The important structural feature of these wires is an absence of the correlated columnar defects, which are usually perceived as necessary condition for strong pinning under the specified conditions. In contrast, the developed HTS wire contains randomly placed nano-sized Y_2O_3 particles with a uniform size distribution, and it seems to be a peculiar feature of the materials fabricated by highly non-equilibrium PLD process. Further modification of the base YBCO composition can provide HTS wires with better performance in moderate magnetic field (e.g. 30K and 5T) and at high temperature and low magnetic field (of 65-70K and 0.5-1T) that will be also reviewed in this presentation.

The combination of the 40 μ m thin substrate and 5 μ m copper top layer allows achieving J_e values of over 1000 A/mm² at 20K and 2000 A/mm² at 4.2K and 20T. It should be emphasized that such properties are demonstrated for over thousand commercially produced wires rather than for a short laboratory scale sample.

The overall production capacity of two companies is approaching 2,000 km of 4mm HTS wires in 2021. The large volume of acquired statistical data helps to conclude that developed manufacturing process is robust and reproducible.

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