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Influence of picosecond and femtosecond laser impact on magnetic and transport characteristics of the HTS tape

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It is well known that the second generation high-temperature superconductor (HTS) tapes have local inhomogeneities of magnetic and current-carrying characteristics. These features of the material often limit the length of tape suitable for applications. The main purpose of present work is to improve the magnetic and transport characteristics of 2G HTS tapes by creating an ordered lattice of artificial pinning centers. By using pico- and femto-second laser exposure we have performed modification of HTS GdBa2Cu3O7-δ industrial tape produced by SuperOx (Russia). To modify superconducting film we have used automated FEMTO-T laser complex [1]. Laser complex includes an adjustable laser-energy attenuator, a focusing system, a CCD video camera, a three-coordinate system for positioning objects and a control PC with all necessary interfaces. The pulse width can be varied from 150 fs to 3 ps, the wavelength is 870 nm and 1064 nm. The pulse energy varied from 50 to 4000 nJ. We have created the local lattice of defects with the period 50 μm and the size of every hole up to 1 μm which is close to the diffraction limit of the laser system. It was investigated the influence of the laser exposure on the structure of the film in the area where artificial defects were created. We have performed the measurements of the magnetization, local trap field and current distribution in samples before and after modifications. Also the critical current dependence on magnetic field was measured and dependencies of the pinning force and n-values on the energy of laser pulse were obtain. So we have shown that the created pinning centers lead to the appearance of point pinning centers that can improve the local critical current of tape.
[1] A.V. Gordienko, O.B. Mavritskii, A.N. Egorov, A.A. Pechenkin, D.V. Savchenkov // Quantum Electronics 44 (12), 2014, pp. 1173 – 1178

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