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Effect of 2 and 10 MeV Au-ion irradiation on superconducting properties in GdBa₂Cu₃O_y coated conductors

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Development of high temperature superconducting REBa₂Cu₃O_y (REBCO, RE: Y and rare earth) coated conductors (CCs) would enable cost-effective magnet applications in rotation machines, generators for wind turbine and magnet use in medical imaging machines. To use for these applications, precipitates and structural defects with nano-meter size have been introduced in REBCO films to enhance vortex pinning, resulting in an increase of J_c in magnetic fields. Recently, a low-energy ion irradiation received a renewed interest as a practical method for improving J_c in magnetic fields in REBCO tapes. Low energy systems can be relatively inexpensively implemented for economic large-scale irradiation of REBCO tapes. We have demonstrated an enhancement of J_c by using low-energy ion irradiation, in which we created small cascade and cluster-like defects in iron-chalcogenide superconducting films.[1]

In this talk, we present comparative study of superconducting properties and damage structures in GdBCO CCs irradiated with 2 and 10 MeV Au-ions. In the both irradiation energies, The T_c of the GdBCO CCs gradually decreased with increasing irradiation dose, and started to drop sharply at around 8.0×10^{11} Au cm⁻². As for the critical current properties calculated from magnetization measurement, over 70% J_c enhancement was achieved around 3 T at 30 K after 10 MeV Au-ion irradiations, indicative of effective pinning defects by the irradiation. We also observed a clear decrease in J_c near H_{ab} in $J_c(\theta)$ measurement after the irradiation. This would be attributed to the the damage of stacking faults and intrinsic pinning upon the irradiation. We will also compare superconducting properties in GdBCO films irradiated with different energy and dose.

1) T. Ozaki et al., Supercond. Sci. Technol. 33, 094008 (2020).

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