Contribution ID: **380** Type: **Invited Oral**

M3Or3J-04: [Invited] Overview of the effect of ion irradiation in cuprate and iron-based superconductors

Wednesday 12 July 2023 15:00 (20 minutes)

Cuprate and iron-based superconductor cables offer powerful opportunities for increasing capacity, reliability, and efficiency of the electricity grid. Superconducting coils can provide an alternative to rare-earth permanent magnets used in rotary machines and generators. In this presentation, I will provide an overview of recent studies on the enhanced critical current density in cuprate and iron-based coated conductors using various ion irradiation. We demonstrated a roll-to-roll irradiation process on production-scale cuprate coated conductors that resulted in uniform enhancement of flux pinning at various dosage. At temperatures below 65K, we observed more than doubling of in-field critical current density Jc using roll-to-roll Au-ion irradiation process. Controlled annealing leads to a further enhancement of Jc at high temperatures and a recovery of the Tc reduction in the irradiated samples with high dosages. Superconducting properties and structural relations of the irradiated samples were characterized by using high resolution transmission electron microscopy (HRTEM) and atomically resolved electron energy loss spectroscopy (EELS) before and after the annealing. In iron-based superconductors, we have grown iron-chalcogenide superconducting films on various single crystal substrates and metal substrates with enhanced transition temperature Tc and high Jc. Simultaneous increase of Tc and Jc was observed in iron chalcogenide FeSe0.5Te0.5 films by low energy proton irradiation. Extensive HRTEM analysis provides direct atomic-scale imaging of cascade defects and maps of strain field. Tc is enhanced due to the nanoscale compressive strain induced by the irradiations and proximity effect, whereas Jc is doubled under zero field at 4.2 K through strong vortex pinning by the cascade defects and surrounding nanoscale strain. Enhanced critical current in FeSe0.5Te0.5 films at all magnetic field orientations is observed by scalable gold ion irradiation. This robust and scalable route opens up an avenue to improve the performance of coated conductors.

Authors: Prof. LI, Qiang (Stony Brook University/Brookhaven National Laboratory); OZAKI, Toshinori (Kwansei Gakuin University)

Presenter: OZAKI, Toshinori (Kwansei Gakuin University)

Session Classification: M3Or3J: Latest Development in Flux Pinning & Critical Current - non-REBCO