J_c enhancement in 2G coated conductors by ion irradiation

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Superconductors offer powerful opportunities for increasing capacity, reliability, and efficiency of the electricity grid. Superconducting coils can provide a lower cost alternative to rare-earth permanent magnets used in rotary machines and generators for wind turbines. Although the present high temperature superconducting technology is positioned to play an important role in addressing the global energy challenges, its full potential has not yet been achieved. The critical current density, J_c, achieved today in commercial YBCO coated conductors approaches 20% of the theoretical depairing current density. Significant progress in J_c enhancement has been achieved by the in situ growth of correlated and random defects; however, progress has been gradually slowing. Here, we present our recent studies aimed at moving closer to the theoretical current-carrying capacity in RE-123 based superconductors by designing a mixed defect landscape created by growth induced pinning centers and those produced by ion irradiation. The ion irradiation process can be tailored to create defects of various dimensionalities and morphologies and provides an excellent method to correlate specific defect structures with actual J_c enhancements. We observed remarkable enhancement of J_c at low temperature and at fields up to 35 T in commercial 2G coated conductors by low-density defects created by various ion irradiations. In this presentation, we will examine the defect structures attained with the ion irradiations and correlate them with J_c enhancement at different temperatures and fields.

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