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Recent Advances in High-Fidelity Irradiations of REBCO High-Temperature Superconductors and Implications for High-Field Fusion Devices DANIEL KORSUN, LEIGH ANN KESLER, MIT Plasma Science and Fusion Center, BRANDON SORBOM, Commonwealth Fusion Systems, STEVEN JEPEAL, ZACHARY HARTWIG, MIT Plasma Science and Fusion Center — REBCO, or rare-earth barium copper oxide, is a family of high-temperature superconductors (HTS) that is being examined as a magnet material for future fusion devices. Compared to low-temperature superconductors, REBCO can carry greater current densities at higher temperatures and external magnetic fields, enabling it to be used to generate extremely strong magnetic fields. As fusion power density scales with the fourth order of magnetic field strength, the stronger fields produced by REBCO magnets enable the design of compact fusion devices with large power outputs. However, the response of REBCO to irradiation by fusion neutrons is far from fully understood, and the extent to which REBCO magnets can sustain large neutron fluences will determine the lifetimes of compact fusion devices. Further complicating radiation damage studies of REBCO is that neutron irradiation is often difficult, costly, and causes significant activation. To emulate the neutron damage that will be seen in future fusion reactors, recent upgrades to experimental facilities at MIT have enabled newly high-fidelity proton irradiations of REBCO, and the results from these experiments may hold large implications for high-field fusion devices.

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