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M2Or1A-05: Nuclear transmutation effect by thermal neutron on degradation in superconductivity of ReBCO tapes

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GdBCO, EuBCO and YBCO tapes were irradiated at Japan Research Reactor #3. The samples were bundled and wrapped with cadmium foil with 25 μm thick. The first bundle was wrapped with aluminum foil and no cadmium foil. The second bundle was wrapped with three turns (75 μm) of cadmium foil and the third was wrapped with five turns (125 μm) of cadmium foil. The maximum thermal neutron and the fast neutron were $8.29 \times 10^{22} \text{ n/m}^2$ and $1.46 \times 10^{21} \text{ n/m}^2$, respectively. The GdBCO tape showed heavy degradation in its superconductivity and the EuBCO tape showed less degradation than the GdBCO tape. The YBCO tape showed almost no degradation. The degradation behavior is strongly connected with the cross section of $\{n,\gamma\}$ reaction of the rear earth elements. The coated layers of the irradiated samples were peeled and scratched out and the gamma ray spectrum was investigated by a Ge detector. The Ge detector analysis showed that the isotopes of Gd and Eu were detected but no isotopes of Y was measured. From these results, the degradation process and mechanisms were considered. The thermal neutron capture by Gd and Eu generated the radio isotopes of Gd and Eu, and the radio isotopes decay by electron capture or beta decay. During the decay process, the nuclear transmutation of Gd and Eu continues and the electron exchange on the nucleus will disturb the electron state on CuO_2 planes which sandwich the rear earth element. The disturbance will perturb the superconducting current flow and the degradation behavior could be observed.

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