Workshop on Radiation Effects in Superconducting Magnet Materials 2015 (RESMM'15)

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Measurement of the damage rate of copper irradiated with 125 MeV protons at 12 K and comparison with calculated result with the PHITS code

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Content :

To validate Monte Carlo code PHITS for the prediction of radiation damage in metals, the damage rate (defect-induced electrical resistivity changes / particle fluence) related to the displacement cross-section of copper were measured with 125 MeV proton irradiation under 12 K at the FFAG facility in the Kyoto University Research Reactor Institute. The sample was a copper wire with a 250-μm diameter and 99.999% purity and was cooled by conduction cooling. After 125 MeV proton irradiation with 1.45 × 10^{18} protons/m^{2} at 12 K, the total resistivity increase was 4.94 × 10^{-13} Ωm (resistance increase: 1.53 μΩ), while the resistivity of copper before irradiation was 9.49 × 10^{-12} Ωm (resistance: 29.41 μΩ). Comparison with other experimental results indicated that the damage rate by 125 MeV protons is almost same with those by 1.1 GeV protons and is higher than the damage rate by 14 MeV neutrons by a factor of 1.4. For the comparison with the PHITS results, the experimental data is smaller than the calculated result without the defect production efficiency by a factor of about 2.5 and that with the defect production efficiency by a factor of about 1.4, respectively. It indicates that the defect production efficiency in PHITS gives a good quantitative description of the displacement cross-section.

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