Effect of Thermal Cycle on the Lattice Structure in RHQ-Nb_3Al Superconducting Wire

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Abstract - In A15 superconducting wires, it is known that the critical current has a dependence on the strain in a high magnetic field. Therefore, RHQ-Nb_3Al wires are being studied to develop a high field magnet. Since the wire was composited by three or more materials usually, residual strain is induced by different coefficients of thermal expansion in materials in the cooling process after A15 phase transformation. In neutron diffraction measurements at room temperature, we previously reported that the residual strain of Nb_3Al filaments in the wire is tensile. We also reported that t he smaller tensile residual strain at room temperature is better for mechanical performance of the superconducting wire. These results indicate that reduction of the residual strain is needed. In this study, we effectively reduced the residual strain by using a thermal cycle method after A15 phase transformation. By applying one thermal cycle process, the tensile residual strain was decreased by approximately 0.08%. The thermal cycle method will be useful to improve the mechanical strength of RHQ-Nb_3Al wire. In this paper, we report the details of the thermal cycle method, its effect on the lattice structures of Nb_3Al and Cu at room temperature, and the analysis results from the perspective of material strength in strain recovery and its hysteresis.

Keywords - neutron diffraction, A15, Nb_3Al, RHQ, residual strain, multi-peak analysis

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