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Superconducting properties and microstructure of high performance Nb3Al wires fabricated by RHQT and mechanically alloyed methods

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High-performance Nb3Al superconducting wire has wide potential applications in high-field magnets, magnetic confinement fusion, high energy particle accelerator, etc. However, km-grade Nb3Al wires with high-performance are still not available to the large-scale engineering application due some fabrication problems and intrinsic physic-chemistry properties. In this paper, we reported the comparison study on the superconducting properties and microstructure of Nb3Al superconducting wires fabricated with two different techniques: The first is an in-situ powder-in-tube (PIT), which were made by using the mechanically alloyed Nb(Al)ss supersaturated solid solution, as well as the low temperature heat-treatment at 800 -950 C; and the second is a jelly-roll Nb3Al precursor long wire followed with different rapid heating and quenching (RHQ) heat-treatments. We found that both mechanical alloying and RHQ methods can produce the Nb(Al)ss supersaturated solid solution phase, however, the performance of the consequent Nb3Al wires are quite difference. The wires fabricated by RHQ method has a much better Tc and Jc than those prepared by mechanical alloying technique. Microstructure and compositional analyses reveal that these two methods results quite different microstructure and local chemical composition in nanometer scale, which may affect the superconductivity and flux pinning behavior in the Nb3Al wires.

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