

Research on the relationship between microstructure and mechanical properties of CHSN01 jacket under cold deformation

Abstract

The development of cryogenic structural materials with high strength and toughness is critical for advancing the application of high-field cable-in-conductors (CICC). For future CICC jackets, the 0.2% yield strength (YS) must exceed 1500 MPa, and the fracture toughness (KIC) must be better than $130 \text{ MPa}\cdot\text{m}^{1/2}$ at 4.2 K. Currently, jacket materials such as 316L, 316LN, and JK2LB struggle to achieve the YS above 1100 MPa at 4.2 K, even after cold working. Based on Nitronic-50 (N50) super-austenitic stainless steel, China has developed a modified version, CHSN01 (Chinese High-nitrogen steel No.1). This study systematically investigates the mechanical properties of CHSN01 jackets under different degrees of cold working (0 % ~ 20 %) and two distinct heat treatment regimes: Nb₃Sn and Bi-2212 conductors. Additionally, the potential microstructure mechanisms affecting the mechanical properties of CHSN01 jackets at 4.2 K were investigated, providing a reference for the subsequent practical application of CHSN01 for future fusion applications.

Keywords: CHSN01, CICC jacket, Cold deformation, Mechanical properties.