Contribution ID: **19** Type: **Poster Presentation (120m)**

The mechanical research on high strength CICC jacket with YS>1500MPa@4.2K used for future fusion magnets

Wednesday 24 July 2024 12:30 (15 minutes)

Increasing magnetic field intensity in limited space is an important strategy to obtain high parameter plasma and improve the fusion power. The next generation of fusion magnets will have a peak magnetic field greater than 17T, such as China Fusion Engineering Test Reactor (CFETR) central solenoid magnet. The development of high strength and high toughness jacket has become one of the challenges in the application of high-field cable-in-conduit conductors (CICC) for CFETR. 0.2% proof stress of jacket should be over 1500 MPa at 4.2 K for CICC, thus 316LN and JK2LB jackets developed by ITER do not meet the requirements. Nitronic 50 (N50) super-austenitic stainless steel material has great optimization potential for the development of jacket. ASIPP has developed the the modified N50 material together with China Iron and Steel Research Institute, Metal Research Institute, etc, and the CICC jacket was made some R&D work. The entire process of CICC preparation, including extrusion, bending, straightening and aging, was simulated using the modified N50 stainless steel jacket. The circle-in-square jackets prepared showed a yield strength higher than 1550 MPa, fracture elongation is higher than 30% and a fracture toughness KIC better than 260 MPa·m1/2 after cold work and aging at 4.2 K. This paper will focus on the preparation, cold work processing and performance test of the modified N50 jacket. This study will present experimental data and discuss the feasibility of modified N50 as a high-magnetic field jacket material for next-generation fusion reactors.

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Session Classification: Wed-Or9

Track Classification: Tracks ICEC 29 Geneva 2024: ICEC 10: Cryogenic applications: large magnet systems