Contribution ID: **348** Type: **Poster Presentation (120m)**

Characterization of XM-19 forge products at 4K for their use in fusion energy devices.

Tuesday 23 July 2024 14:00 (2 hours)

Driven by the electrification of industries and economic development in emerging economies, the global demand for electricity is anticipated to surge in the coming decades. It is in this framework that a growing interest in fusion energy devices as a sustainable energy solution emerges. Among the different concepts, SPARC stands out as one of the most promising ones: a compact high –field tokamak built with high temperature superconductors (HTS) with the ambitious goal of being the world's first confined net energy fusion system (Q>1). In this quest, Commonwealth Fusion Systems (CFS) has developed groundbreaking HTS magnets that enable for significantly stronger magnetic fields in the plasma that permit for a much smaller device size. However, when adopting these technical solutions, a critical need arises for structural materials capable of withstanding significantly higher stresses to counteract the increasing Lorentz forces in smaller sections. Under these extreme conditions, XM-19 austenitic stainless steel, known for its exceptional strength and corrosion resistance, has emerged as a promising candidate for structural components within these compact devices.
XM-19, a nitrogen-strengthened austenitic stainless steel, exhibits a promising combination of mechanical properties at cryogenic temperature, but it necessitates precise forging techniques for its full utilization in large scale components. Through extensive cryogenic material characterization at 4 K, including tensile testing and fracture toughness assessment, this study provides critical insights into the behaviour at low-temperature of XM-19. Additionally, microstructural analysis, identification of secondary phases, chemical composition analysis, and assessment of magnetic permeability contribute to a comprehensive understanding of XM-19's properties and its potential as structural component for high field tokamaks. These findings deepen our comprehension of this high strength austenitic stainless-steel grade, crucial for fusion energy applications.

This work was supported by Commonwealth Fusion Systems

Submitters Country

Switzerland, Germany, USA

Author: RODRIGUEZ CASTRO, Enrique (University Carlos III (ES))

Co-authors: CUARTERO MONDONO, Alonso (University Carlos III (ES)); PEREZ FONTENLA, Ana Teresa (CERN); Mr DENNETT, Cody (CFS); Ms TAMMANA, Deepthi (CFS); Ms YURYEV, Dina (CFS); AVILES SANTILLANA, Ignacio (CERN); BUCHANAN, Katie Elizabeth (CERN); Mr KIND, Markus (Rolf Kind GmbH); STAN, Markus (Rolf Kind GmbH); Mr KIND, Ralf (Rolf Kind GmbH); Dr SGOBBA, Stefano (CERN)

Presenter: RODRIGUEZ CASTRO, Enrique (University Carlos III (ES))

Session Classification: Tue-Po-1.4

Track Classification: Tracks ICMC Geneva 2024: ICMC 10: Structural and 3D printed materials processing and properties