Contribution ID: **868** Contribution code: **WED-PO2-604-08** Type: **Poster**

Jc performance under the transverse compressive stress on the bronze matrix reinforced Nb3Sn multifilamentary wires

Wednesday, November 17, 2021 10:30 AM (20 minutes)

Typical Cable In Conduit (CIC) typed Nb3Sn conductor applied for the fusion magnets are manufactured by twisting multiple Nb3Sn strands based on the current-carrying specification. Jc degradation by the cyclic loading in the CIC conductors was confirmed. This is caused by the Nb3Sn filament breakage by applying the huge electromagnetic force (i.e. transverse compressive load). Therefore, the mechanical strength improvement of Nb3Sn strand will become a critical issue to realize a future CIC conductor.
We approached the bronze matrix reinforcement using the Cu-Sn-Zn and Cu-Sn-In ternary bronze alloy. The Zn and In elements of the ternary bronze alloy remained in the matrix material after Nb3Sn synthesis heat treatment, and the bronze matrix after Nb3Sn formation was transformed to the solid solutions containing Zn or In elements. These solid solutions improved the mechanical strength of the Nb3Sn wire.
We evaluated the Jc performance under the transverse compressive stress on the bronze matrix reinforced Nb3Sn multifilamentary wires, and the effects of the solute elements on the Jc property under compressive stress was investigated.
On the conventional bronze processed Nb3Sn wire, Jc property was decreased monotonously around 30 MPa. In the case of the bronze matrix reinforced Nb3Sn wire using Cu-Sn-Zn alloy, however, no Jc deterioration was observed within 100 MPa. The irreversible compressive stress (σirr), which is defined as the stress that maintains the initial Jc value after unloading the compressive stress, was estimated to be approximately 160 MPa. This value was almost corresponded to the yield stress of Nb3Sn wire using Cu-Sn-Zn ternary alloy matrix after heat treatment. This suggested that the (Cu, Zn) solid solution transformed from the Cu-Sn-Zn ternary alloy acted as a protective material for the Nb3Sn filaments. The comparisons between Zn and In solute elements on the Jc performance under the compressive stress were also investigated.

Primary author: Prof. HISHINUMA, Yoshimitsu (National Institute for Fusion Science)

Co-authors: Dr OGURO, Hidetoshi (Tokai University); Mr TANIGUCHI, Hiroyasu (Osaka Alloying Works Co.,Ltd); Prof. AWAJI, Satoshi (Tohoku University); Dr KIKUCHI, Akihiro (National Institute for Materials Science)

Presenter: Prof. HISHINUMA, Yoshimitsu (National Institute for Fusion Science)

Session Classification: WED-PO2-604 Low Tc Wires and Cables