Contribution ID: **674**

Type: **Contributed Oral Presentation**

M1Or2A-01: Pinning force enhancement in Nb3Sn wires via nano-particles doping

Monday 22 July 2019 11:00 (15 minutes)

Binary and ternary ZrO2-doped tube-type Nb3Sn wires were prepared by Hyper Tech Research Inc. for this study to investigate the effect of nanoparticle doping on the wire performance, with the aim of reaching the FCC 16T dipole-magnets requirements. The specimen, monofilamentary and multifilamentary wires, were characterized by magnetisation measurements in order to evaluate their critical temperature and critical current. For this purpose we used SQUID magnetometry, whereas the upper critical field was determined via resistivity measurements in a 17 T cryostat. We demonstrate an enhancement of the layer-Jc (at 12 T and 4,2 K) if compared with state-of-the-art binary and ternary wires (Ta or Ti-doped), which can be explained by the grain size refinement. By correlating these results with high-resolution transmission electron microscopy (TEM) and transmission Kikuchi diffraction (TKD) analysis it was possible to appreciate an average grain size of 63 nm (in the best sample), resulting in a high grain boundary density which increases the pinning force. In this sense, a pinning force scaling analysis was carried out, showing a shift of the peak position close to a reduced field of 0.3. Scanning Hall probe microscopy (SHPM) was used to perform scans of the remnant-field and Meissner state on the wires cross-section: from the latter it was possible to assess the effective A-15 superconducting cross-section of the sub-elements as well as the radial Sn concentration gradient (confirmed by EDX and SQUID-magnetometry data). Remnant-field scans were used for the evaluation of the currents from the field profiles at different temperatures. Monofilamentary wires were also subjected to a longitudinal inhomogeneity investigation: a 4mm sample was cut over its longitudinal axis and submitted to SHPM scans and SEM. The results show not negligible variations in the A-15 effective cross-section along the measured length, which explains the different magnetization data collected with SQUID-magnetometry.
Aknowledgments: This Marie Sklodowska-Curie Action (MSCA) Innovative Training Networks (ITN) receives funding from the European Union's H2020 Framework Programme under grant agreement no. 764879.

Authors: Mr ORTINO, Mattia (TU Wien); Dr BAUMGARTNER, Thomas (TU Wien); Dr EISTERER, Michael (TU Wien); Prof. SUMPTION, Mike (The Ohio State University); Mr PFEIFFER, Stephan (TU Wien); Prof. BERNARDI, Johannes (TU Wien); Dr PENG, Xuan (Hyper Tech Research, Inc.); Dr XU, Xingchen (Fermilab)

Presenter: Mr ORTINO, Mattia (TU Wien)

Session Classification: M1Or2A - A15 Conductors