Advances in Nanoscale Analysis of Hf Doped Nb_3Sn Wires Using Atom Probe Tomography

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***Abstract* — The Future Circular Collider (FCC) will require Nb_3Sn dipole magnets that can operate up to 16 T [1], however, achieving this demanding specification will require conductors with an exceptionally high critical current density (Jc) of 1500 Amm^{-2} whilst maintaining a residual resistivity ratio (RRR) of 150. Despite a great deal of research into new manufacturing techniques and heat treatments for Nb_3Sn wires, it remains a very challenging and ambitious target. All commercial Nb_3Sn strands use Ta and/or Ti doping for high field performance but in this study, we look at the impact of also adding Hf, which has been shown to increase flux-pinning and thus may help Nb_3Sn wires reach the FCC target specifications. To determine how Hf affects the superconducting properties of the Nb_3Sn it is important to use a nanoscale microscopy technique to visualize how the Hf is modifying the Nb_3Sn layer. This study uses Atom Probe Tomography (APT) to locate secondary phases, segregation at grain boundaries and discusses the origin of O in the sample.**

***Keywords (Index Terms)* –Future circular collider, critical current, pinning force, atom probe tomography, backscattered detector, transmission electron microscopy, electron probe microanalyser, energy dispersive x-ray spectroscopy**

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