Contribution ID: **5** Type: **Oral presentation**

Electrochemical deposition for generating Nb3Sn films with low surface roughness and stoichiometry

Thursday, 12 November 2020 11:20 (25 minutes)

Reducing surface roughness and attaining stoichiometry of Nb3Sn superconductors are required for radio-frequency accelerator applications. We explore the electrochemical deposition of Sn, Nb, and Nb-Sn films, and also investigate the thermal annealing of the plated films to Nb3Sn. Current progress shows that high quality Sn pre-depositions via electroplating on the Nb surface can significantly reduce the surface roughness of the resultant Nb3Sn superconductors with pure stoichiometry, owing to sufficient Sn supply and uniformly distributed events during nucleation. We find that the surface roughness of Nb3Sn is minimized to an average roughness of 65 nm that is 5 times lower than the values from conventional vapor diffused samples. Fast Fourier transformation tests confirm a dramatic reduction in power intensity at medium spacial frequencies that are important for moderating the field enhancement. Structural and superconducting property measurements demonstrate a Nb3Sn A15 phase with a stoichiometry of 25 at% Sn that is crucial to the superconducting properties and thus achieving a high critical temperature of 18 K (Nb3Sn limit) at zero magnetic field. Ongoing efforts include the electrochemical deposition of Nb and Nb-Sn films, and they will also be briefly discussed in the workshop.

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Session Classification: Growth Studies

Track Classification: Growth studies