

11th International Workshop on Thin Films and New Ideas for Pushing the Limits of RF Superconductivity - TFSRF2024



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Nb₃Sn on Cu in High Field

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Nb₃Sn has shown much promise in recent years for use in superconducting radio frequency SRF cavities. Applying and reacting a large-area thin film homogeneously on the inside of a cavity requires new ingenuity in material science. We present methods to form a range of Cu-Sn composition on Cu substrates using evaporation, and we achieve Cu-Sn phases with high tin activity to facilitate optimization of Nb₃Sn film properties. Subsequent deposition of Nb leads to Nb₃Sn films, where we compare a “hot bronze” route, where high deposition temperature leads to instant reaction upon arrival of Nb atoms, to post-reaction routes, where Nb₃Sn forms via solid state reaction after a Nb film has grown. Challenges of achieving uniform, continuous, and homogeneous Nb₃Sn thin films with good properties are presented by porosity, stress cracking, oxidation, Cu-Sn phase changes, and management of the coefficient of thermal expansion mismatch. For example, films with critical temperature as high as 17.5 K have been demonstrated, but microstructural observations suggest dis-connection between Nb₃Sn grains. Films with uniform, well-connected microstructure exhibit a sharp critical temperature transition, suggesting homogeneous properties, but with a critical temperature onset of 15.5 K.

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