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Sputter coating of Nb_3Sn into SRF cavity using stoichiometric target

Sunday 10 August 2025 15:00 (3 hours)

Nb_3Sn has emerged as a leading alternative material due to its higher superconducting critical temperature (T_c) and superheating field (H_{sh}), promising a viable solution to the intrinsic performance limit currently faced by Nb superconducting radiofrequency (SRF) cavities. We sputter-coated Nb_3Sn inside Nb SRF cavity using a stoichiometric Nb_3Sn tube target in a DC cylindrical magnetron sputter coater. The target was fabricated by growing an estimated $>20\mu\text{m}$ thick Nb_3Sn layer on a Nb tube via Sn vapor diffusion using Jefferson Lab's coating system. Approximately 150 nm thick Nb-Sn films were sputter-deposited onto flat Nb samples at positions representing the beam tubes and equator of a 2.6 GHz Nb cavity. Post-deposition annealing at 950°C for 3 h resulted in the formation of Nb_3Sn . Microstructural analysis of the annealed films was carried out to investigate the morphology and structure of the Nb_3Sn films. Later, a 2.6 GHz Nb SRF cavity was coated with a $\sim 1.2\mu\text{m}$ thick sputtered Nb-Sn film using a stoichiometric Nb_3Sn target, followed by annealing. Cryogenic RF testing of the annealed cavity demonstrated a T_c of 17.8 K, indicating the formation of Nb_3Sn . After a light Sn recoating treatment, the cavity achieved a quality factor (Q_0) of $6.7\text{E}+08$ at lower field at 2.0 K.

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Yes

Footnotes

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Yes

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