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Co-sputtering of Nb3Sn into SRF cavity using composite target and optimizing surface homogeneity

Nb_3Sn is a promising alternative to bulk Nb for superconducting radiofrequency (SRF) cavities due to its higher critical temperature (Tc ˜18.3 K) and superheating field (Hsh ˜400 mT), enabling improved cryogenic efficiency. Nb_3Sn coating method for superconducting radiofrequency (SRF) cavity has been developed following co-sputtering of Nb-Sn composite target using a DC cylindrical sputter coater. Deposition parameters and annealing strategies were optimized for uniform Nb_3Sn coating. 1.5 µm Nb-Sn film was deposited onto 2.6 GHz Nb SRF cavity and annealed at 600℃ for 6 h, followed by 950℃ for 1 h. Cryogenic RF testing confirmed Nb_3Sn formation with Tc = 17.8 K. A post-annealing light Sn recoating process improved the cavity's performance, achieving $Q_0 = 8.5 \times 10^8$ at 2.0 K.

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