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Nb3Sn growth by sequential sputtering: film morphology and its RF properties

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Due to higher superconducting critical temperature and superheating field, and lower BCS surface resistance, Nb3Sn is considered a promising alternative to standard niobium for SRF application. Multilayer sequential sputtering method is a promising alternative to the conventional vapor diffusion method to grow Nb3Sn films inside a niobium cavity. In this method, multiple thin layers of Nb and Sn are annealed at high temperature to fabricate Nb3Sn. The thickness of multilayers can be varied to adjust the film stoichiometry, which significantly affects the superconducting properties of Nb3Sn films. We have examined the growth process of Nb3Sn films by varying the deposition conditions (thickness, annealing temperature, annealing time, and substrate temperature during growth). The film properties were characterized by scanning electron microscopy, transmission electron microscopy, X-ray diffraction, atomic force microscopy, and energy-dispersive X-ray spectroscopy. The DC superconducting properties of the films were characterized by the four-point probe technique down to cryogenic temperatures. RF surface resistances of some films were studied using the surface impedance characterization system at the Jefferson Lab. For both measurements, the films showed superconducting properties close to bulk Nb3Sn.

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