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The optimization of the bronze-method Nb3Sn coatings on Cu substrates

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Nb3Sn thin films are mainly used on superconducting radio frequency (SRF) cavities, single-photon detectors and RF logic circuits. Copper-based Nb3Sn thin-film SRF (TFSRF) cavities are promising for particle accelerators because they may combine the advantages of high thermal conductivity and high gradient. In this paper, a bronze method, including multi-layer deposition and heat treatment, was used to generate Nb3Sn thin film on copper substrates. We first made a precursor by sputtering a niobium layer on the copper substrate and then electroplating a thicker bronze layer. Then we annealed the precursor in a vacuum tube furnace to synthesize Nb3Sn film. Considering the morphology and superconductivity of the Nb3Sn films, we compared the effects of various annealing temperatures and optimized the preparing conditions. The samples characterization of the morphology and superconductivity showed that high-quality Nb3Sn thin films had been successfully deposited on copper substrates. The superconducting transition temperature Tc can reach higher than 17.0 K. This synthesis route provides a new approach towards high-stability Nb3Sn TFSRF copper cavities.

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