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Suppression effect on Nb3Sn films: Effects of Coating Growth Duration on the Topography of Sn Vapor-Diffused Nb3Sn

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While Nb3Sn theoretically offers better superconducting RF cavity performance (Q0 and Eacc) to Nb at any given temperature, peak RF magnetic fields consistently fall short of the ~400 mT prediction. The relatively rough topography of vapor-diffused Nb3Sn is widely conjectured to be one of the factors that limit the attainable performance of Nb3Sn-coated Nb cavities prepared via Sn vapor diffusion. Here we investigate the effect of coating duration on the topography of vapor-diffused Nb3Sn on Nb and calculate the associated magnetic field enhancement and superheating field suppression factors using atomic force microscopy topographies. It is shown that the thermally grooved grain boundaries are major defects which may contribute to a substantial decrease of achievable accelerating field. The severity of these grooves increases with total coating duration due to the deepening of thermal grooves during the coating process.

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