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Nb3Sn films on Cu by Magnetron Sputtering for SRF cavities at INFN-LNL

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"he development of Nb3Sn films on copper as coatings for the accelerating cavities of next generation particle accelerators is mainly driven by the sustainability goals being at the core of the I.FAST project. The successful development of a Nb3Sn/Cu scalable prototype would allow for the operation of the SRF system at 4.5 K, resulting in a reduction of the needed cryogenic power by a factor 3 with respect to what normally needed for bulk Nb cavities, operated at 2 K. Several research activities are carried out at the INFN-LNL laboratories to develop new technologies for the application of Nb

Sn, including seamless spinning of cavity prototypes, surface chemical preparation, cavity coating, and testing. Also, the Liquid Tin Diffusion (LTD) technique is being explored to produce Nb3Sn cylindrical targets for elliptical cavity coatings. At the same time, an optimized recipe for Nb

Sn films deposited via DCMS was first established on small flat samples and is discussed in this work. The recipe delivered films showing a critical temperature Tc ≈ 17 K at deposition temperatures ≤ 650 ℃ on a copper substrate pre-coated with a 30

m thick buffer layer of Nb. The deposition recipe was then validated on bulk Nb by measuring the RF properties on a QPR sample, with the results being also discussed in this work. A surface resistance of 23 nΩ at 4.5 K (at 20 mT, 417 MHz, with quench field > 70 mT) was measured, which is about one order of magnitude larger than the baseline specifications for the LHC Nb/Cu cavities, and already fulfills the requirements for the FCC-ee. Finally, the next challenge lies in the scalability of the coating recipe from small flat samples to an elliptical cavity prototype."

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