Contribution ID: **59** Type: **Oral presention (by invitation only)**

Progress with bipolar HiPIMS-deposited Nb3Sn films on Cu for SRF applications

Tuesday 31 May 2022 15:12 (9 minutes)

CERN has successfully operated a number of Nb coated Cu cavities for a number of years, most notably in the LEP, LHC and HIE ISOLDE accelerators. In order to meet the requirements for the Future Circular Collider (FCC), an increase in the quality factor of the accelerating cavities, while maintaining the operating temperature of 4.5 K, is required. Because of its lower BCS resistance and increased critical temperature of 18.3 K, Nb3Sn is a potential candidate to allow coated Cu cavities to achieve these requirements. The feasibility of depositing Nb3Sn films onto Cu substrates using DC MS has previously been demonstrated at CERN. The resultant films displayed good RF performance and a critical temperature up to 16 K [1]. Given the superconducting performance improvements observed with HiPIMS-deposited Nb films, its use in the synthesis of Nb3Sn films was proposed.
This work focuses on the elaboration of Nb3Sn films on Cu substrates using the bipolar HiPIMS technique. A variety of deposition parameters were explored in order to deposit a stable A15 phase. The influence of the deposition parameters on the resulting film morphology, crystalline structure and superconducting properties were studied. The challenges experienced due to the use of Cu as a substrate as well as methods for overcoming these will also be presented.

[1] E. A. Ilyina et al., "Development of sputtered Nb 3 Sn films on copper substrates for superconducting radiofrequency applications,"Supercond. Sci. Technol., vol. 32, no. 3, p. 035002, Mar. 2019, doi: 10.1088/1361-6668/aaf61f.

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Session Classification: Technology

Track Classification: SRF Programme