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Nb/Cu thin film HiPIMS coatings optimization for SRF applications

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The Future Circular Collider (FCC) study focuses on the design and technology developments of a new research infrastructure capable of hosting the next generation of particle colliders at CERN. CERN developed significant know-how in the design and fabrication of niobium-coated copper superconducting radiofrequency (SRF) cavities for accelerators, from the Large LEP, to the LHC, and HIE-ISOLDE. Niobium thin-film on copper technology was a reliable option for these projects, complying with the performance criteria established for SRF cavities. While 400MHz Nb-coated Cu cavities are being considered for the leptonic machine variants of the FCC, further performance optimization is required as their quality factor suffers a strong decrease with increasing accelerating fields. To comply with FCC specifications, their performance must be optimized so that they can sustain accelerating fields up to 10 MV/m with quality factors Q0 above 2x109, while maintaining the operational temperature at 4.5K.

The work presented focuses on recent R&D efforts performed at CERN on the Nb thin film-coatings, to ultimately raise the performance of the Nb/Cu cavities, as they constitute key elements to achieve running-feasibility for the FCC. Fundamental studies performed on samples, where correlations between specific deposition parameters and the morphology, crystalline structure and superconducting properties of the films were found, will be summarized. Recent advances and planned activities on the 400MHz Nb/Cu coatings program at CERN will also be presented.

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