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Development and Optimization of Mechanical Polishing for Superconducting Accelerating Cavities

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Performances of superconducting accelerating cavities, in particular made of bulk Niobium, depend on the purity and crystallographic quality of the material exposed to an intense radio-frequency electromagnetic field. The preparation of the cavity walls has been and is still one of the major challenges in SRF accelerator technology. In order to avoid performance degradation, the damaged layer (˜ 100-200 um) induced by Niobium sheets manufacturing and cavity forming and welding (lamination, rolling, deep-drawing ⋯) has to be removed to recover optimal superconducting properties. Buffered chemical polishing (BCP) and electro-polishing (EP) techniques are commonly used but both methods are very expensive, hazardous and don't ensure an optimal surface roughness. This thesis aims at investigating alternative polishing techniques, more particularly mechanical polishing methods, known to produce unsurpassed surface quality which could not only improve nowadays Niobium cavity performances but also produce high quality substrates for thin-film deposition of alternative superconducting materials. The most appropriate polishing method and the optimized recipe will be presented as well as preliminary results of surface characterization. Future work and strategy will finally be detailed.

Auteurs principaux: M. HRYHORENKO, Oleksandr (IPNO); CHABOT, Marin (IPNO); LONGUEVERGNE, David (IPNO)

Orateur: M. HRYHORENKO, Oleksandr (IPNO)

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