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Niobium Polishing for SRF applications

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This work deals with the development and qualification of micro-mechanical polishing (MMP) of niobium complex parts for superconductive radio-frequency (SRF) applications. The aim of the mechanical polishing study was to evaluate the possibility to recover RF surfaces by changing their topographic structure, the smoothening of the surface defects, such as scratches or impacts, and the limitation of the material removal quantity by the electro/chemical etching (BCP, EP). However the softness and the high ductility of niobium make its surface finish very difficult and challenging. The qualification of the MMP process was based on several niobium specimens with initial different surface roughness and various shape complexity (weld bands or interior form). Two types of micro-cutting-tools were used during MMP treatment and the maximal material removal was targeted. The improvement of surface topography in terms of Ra & Rz was measured by optical machine and contact device. The thickness and dimensional measurements were realized to evaluate the material removal and its uniformity. The SEM observation of the MMP polished surfaces was carried out to identify the size of incrusted microtools and therefore the thickness of affected layer to be removed. The chemical and electrical polishing (BCP, EP) was performed and the final SEM observation was done to confirm the contamination removal. The surface roughness measurements was repeated as well to evaluate the gain in term of surface finish when using the MMP technology in SRF parts preparation. The qualification was positive mainly for the combination of MMP & EP where all inclusions of media were removed and the uniform mirror-like surface of Ra about 0.02-0.03 μm was obtained. First trials on the copper and niobium 1.3 GHz cavities were realised.

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