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Computational and experimental investigation of hydroformed niobium tubes for superconducting RF cavities

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Superconducting radio frequency (SRF) cavities are a well-established technology for imparting energy to the charged particles. Hydroforming technique has been researched to achieve higher accelerating fields and drastic reductions in resonator production time and costs. This study discussed the characterization of hydroformed niobium tubes to support for the subsequent hydroforming of Nb tube into seamless cavities. The niobium tubes were heat treated and characterized by tensile strength, residual resistance ratio (RRR), and grain size. The optimally heat treated Nb tubes were subjected to hydraulic bulge testing. Finally, finite-element models (FEM) incorporating constitutive relationships analytically derived from the tensile and bulge tests, respectively, were constructed to replicate the bulge test. In addition, crystal plasticity model incorporating microstructure was investigated.

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