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M2Or3C-04: Niobium tube fabrication using tube equal channel angular extrusion

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High purity Niobium possesses superconducting properties that make it a particularly suitable material for superconducting radio frequency (SRF) cavities. Most SRF cavities are made from rolled Nb sheet material, by deep drawing dishes, cutting a central hole, and joining the dishes with seam welds. Fabrication of seamless Nb tubes by hydroforming could lead to improved economics for seamless Nb cavities. In addition, hydroforming would eliminate welding defects such as inhomogeneous microstructure and inclusions that degrade SRF cavity performance. In this study we compare the microstructure variations that can be obtained in Nb by a severe plastic deformation technique based on equal channel angular extrusion designed specifically for tubes (tECAE). One of the key features of this technique is that the total strain imparted to the Nb tube can be controlled without a significant change in tube dimensions. Multiple passes of tECAE were performed on RRR Nb to increase the total plastic strain. The aim of this processing is to achieve uniform through thickness strain. Indications are that recrystallization behavior is influenced by tECAE deformation history, and micro-texture. Mechanical properties of RRR Nb after tECAE processing are compared to those after annealing heat treatments. Results are discussed in terms of strength variations, and ductility which are both critical to SRF structures.

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