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Strength evaluation of high-purity niobium single crystals considering crystal orientation

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The relationship between crystal orientation and the strength of single-crystal niobium was evaluated. First, several single-crystal blocks were cut from a niobium ingot, and bar tensile testing specimens were taken from each block. In previous studies, a niobium ingot was sliced to produce a disk, from which a small single-crystal flat specimen was cut; however, this time, round bar specimens were used. This distinction is one of the features of this study. The longitudinal orientation of each test specimen was measured using EBSD, after which tensile tests were performed. The Schmidt factor was calculated, assuming a {110} slip system, revealing a correlation with the 0.2 % proof stress that satisfies Schmidt's law. The CRSS was 36.5 MPa. Next, a method was developed to extract test specimens with orientations that maximized and minimized the Schmidt factor. Test specimens targeting (1 1 1) and (9 2 20) were successfully produced. As anticipated, the 0.2 % proof stress was maximized and minimized during tensile tests. Based on these findings, we examined the derivation of the minimum strength required for designing LG niobium cavities.

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Footnotes

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