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Parameters and process study of copper chamber coating with niobium thin films in DC and HIPIMS modes

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This study primarily investigates the parameters and processes involved in depositing Nb thin films on copper cavities under DC and HIPIMS modes. For this purpose, a high-power magnetron sputtering system was designed, conducting a total of 36 experiments. Improvement and optimization of parameters such as duty cycle (under HIPIMS mode), peak current, and bias voltage were undertaken to enhance film quality and performance metrics such as density. Surface morphology and superconducting properties of the films were characterized using SEM, XRD, Tc measurements, and other analytical methods. It was found that the Nb film deposited at a bias voltage of 100 V and a peak current of 150 A exhibited better performance. Lateral analysis of films deposited on different areas of the cavity revealed that in the DC mode, film grain sizes at the cell level were smaller with more defects, whereas in the HIPIMS mode, the niobium film exhibited finer and elongated grains, with grain sizes across various parts of the cavity being closer and defects reduced. This resulted in greater internal uniformity within the entire cavity, contributing to the enhancement of Q and E.

Footnotes

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