IPAC '23

Contribution ID: **1528** Contribution code: **THPM021**   Type: **Poster Presentation**

Laser powder bed fusion of pure niobium for particle accelerator applications

Thursday, 11 May 2023 16:30 (2 hours)

Niobium is particularly appreciated for its superconductive properties. One of the main applications of this metal in Nuclear Physics is the production of superconducting radiofrequency (SRF) cavities for particle accelerators. Additive Manufacturing (AM) gives the chance to fabricate objects with very complex shapes; also, high melting temperature and hard-to-machine materials can be easily processed. However, AM is not free from challenges, and the creation of devices such as the SRF cavities is not trivial. In this work, the characterization of pure niobium produced by Laser Powder Bed Fusion (LPBF) and a fine-tuning of the printing parameters have been carried out. Much emphasis was put on the development of innovative contactless supporting structures for improving the quality of downward-facing surfaces with very small inclination angles. A relative density higher than 99.8% was achieved and the efficiency of such innovative supports was demonstrated, as they made the fabrication of seamless SRF cavities possible. Smoothing surface treatments and performance tests on AMed cavities were also performed.

Funding Agency

Footnotes

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Session Classification: Thursday Poster Session

Track Classification: MC7: Accelerator Technology and Sustainability: MC7.T35: Advanced Manufacturing Technologies for Accelerator Components