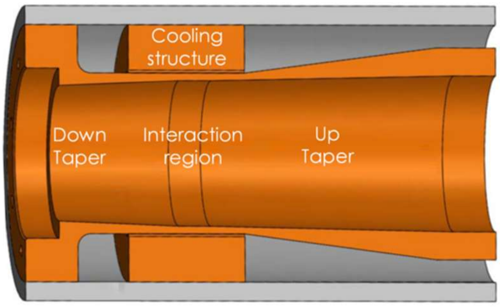
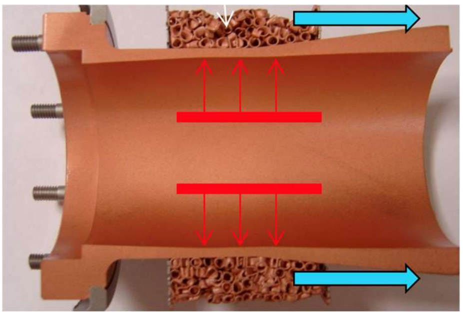
Master Thesis Project / Internship Topic

Additive manufacturing of Glidcop gyrotron cavities by Laser Powder Bed Fusion (LPBF)





Description

Gyrotron cavities for high-power millimeter-wave applications, specifically for nuclear fusion, experience extreme thermal and electromagnetic loading. The RF fields deposit heat within a skin depth of the cavity wall, and the overall device performance is limited by how efficiently this heat can be removed while preserving dimensional stability and ultra-high-vacuum compatibility.

Glidcop, a dispersion-strengthened copper alloy containing a fine alumina phase, offers a unique combination of very high electrical and thermal conductivity together with excellent creep and high-temperature strength. These properties make it an ideal material for gyrotron cavities, which must be baked at elevated temperatures and operate for long periods without deformation. However, present-day manufacturing methods for Glidcop components are labour-intensive and geometrically restrictive, preventing the integration of advanced cooling structures close to the RF surface.

This project investigates whether Laser Powder Bed Fusion (LPBF) can be used to fabricate high-quality Glidcop components with smooth, hollow cylindrical geometries representative of gyrotron cavities. The central objective is to assess achievable surface roughness, density, and electrical conductivity in additively manufactured Glidcop, and to evaluate whether LPBF can enable novel internal cooling structures and reduce the production complexity of gyrotron cavities.

Individual tasks

- **Literature review** on LPBF of copper alloys and Glidcop, including process challenges and achievable surface qualities.
- **Familiarization with LPBF** workflow, machine parameters, and practical considerations for printing hollow cylindrical parts.
- **Fabrication & characterization** of Glidcop test samples, focusing on density, conductivity, and inner-surface roughness.
- **Optimization of process parameters** to achieve smooth, cavity-like geometries suitable for integrating advanced cooling features.

Laboratories

The project is a collaboration between:

- **Swiss Plasma Center (SPC), EPFL** – providing the application context and performance requirements for gyrotron cavities.
- **LMTM-Neuchatel** – providing expertise and infrastructure for LPBF processing and microstructural/physical characterization, hosting the student.

Contact

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