# Development of Copper electrical conductors by Electron Powder Bed Fusion process (E-PBF)

**Alizée THOMAS**

Supervisors: J.-J. Blandin et G. Martin
Co-supervisor: G. Fribourg

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**Jury :**

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| BRIGITTE BACROIX, DR CNRS ILE-DE-FRANCE VILLEJUIF | Rapporteur |
| STEPHANE GODET, PROFESSEUR ASSISTANT UNIVERSITE LIBRE DE BRUXELLES | Rapporteur |
| PATRICE PEYRE, DR CNRS DELEGATION ILE-DE-FRANCE VILLEJUIF | Examinateur |
| LUC SALVO, PROFESSEUR DES UNIVERSITES GRENOBLE INP | Examinateur |

**Abstract**: Electrical conductors are usually made of pure copper because of its outstanding electrical conductivity (from 95 to 100\%IACS, depending on work hardening level). Additive manufacturing can be used to further improve the performances of electrical conductors because it enables to consider sophisticated geometries impossible to be fabricated by conventional processing routes such as casting or machining. In this work, the E-PBF (Electron Powder Bed Fusion or E-PBF) technology was chosen to avoid the problem of reflectivity of copper with conventional laser. Copper exhibits very high electrical and thermal conductivities, which requires specific melting conditions and adaptation of the process parameters.

A preliminary study consisting in identifying the conditions to achieve the required degree of powder consolidation to process pure copper has been conducted, to adjust the preheating conditions. A miniaturized building chamber has been custom-designed and used to limit the amount of powder required for a build.

A design of experiment is carried out using this miniaturized chamber on high purity copper powder to identify the processing window. It allows to build samples with a density higher than 99.9% and without cracks. Specific specimens are built with different orientations in order to measure the volume electrical conductivity using the 4 probes method and to determine the mechanical properties. Properties comparable to those of annealed pure copper are obtained, both electrically (100 %IACS) and mechanically. Moreover, copper is taken as a model material to introduce the concept of "digital metallurgy". Indeed, by controlling the process parameters and the shape of the resulting melt pool, the microstructure can be tuned.

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