Fabrication of copper objects through lithography-based metal manufacturing

Adrien Resch, Marilyne Roumanie, Céline Croutxé-Barghorn

FABRICATION OF COPPER OBJECTS THROUGH LITHOGRAPHY-BASED METAL MANUFACTURING (LMM)

Adrien Resch[1], Marilyne Roumanie[1] and Céline Croutxé-Barghorn[2]

[1]Univ Grenoble Alpes, CEA-LITEN, DTNM, SA3D, F-38000 Grenoble
[2]LPIM, Université de Haute Alsace, F-68000 Mulhouse

Overview of the process

Main strengths :

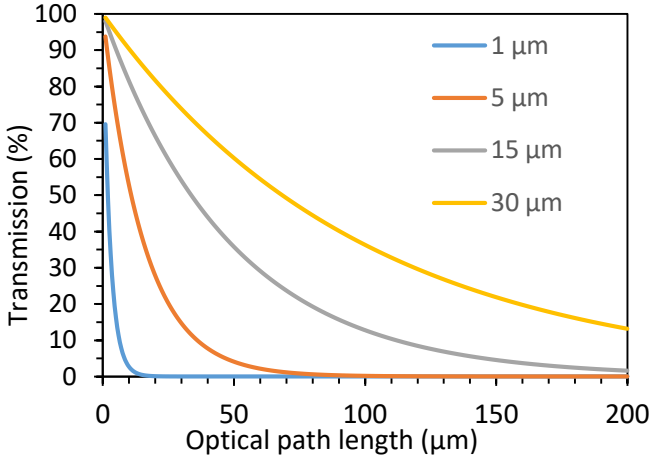
- High 3D resolution
- New geometries affordable

Main issues :

- High UV absorption of copper particles at 365 nm : limitation of printed thickness
- High thermal & electrical conductivities
  - High loading rate
  - Low C/O contaminations
  - Part integrity

New Subject
Limited background

Modeling of UV transmission in a layer according Mie's theory



$$T = \exp\left(-N \times l \times \sigma_{ext}\right)$$

σ_{ext} : extinction cross section (m^{-2})
N : Particle concentration ($ptcl.m^{-3}$)
l : optical path length (m)

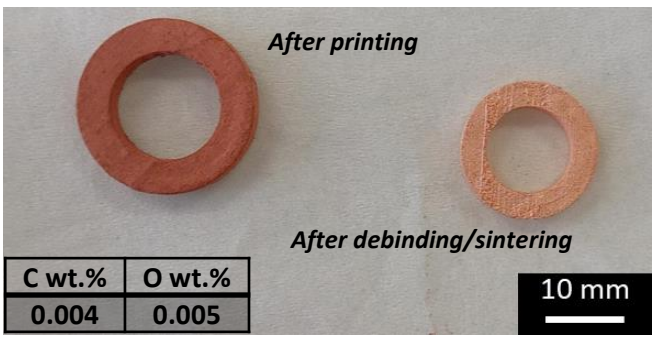
45 wt.% (=10 vol.%) @ 365 nm

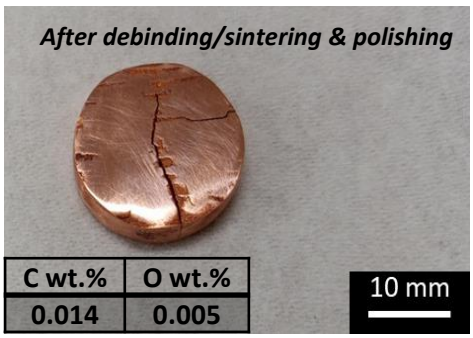
Large particle diameter
→ enables a high depth penetration of light

Printing and thermal treatments of the first objects

- d_{50} = 18 µm & **90 wt.%**
- Layer thickness = 25 µm
- Exposition time = 5.1 s
- Irradiance = 84 $mW.cm^{-2}$
- λ = 365 nm

Part for characterization





Conclusions

✓ Printing copper parts by LMM with a high loading rate
✓ Low C&O contents → no impact on conductivities
✓ Part integrity achieved with wall thickness < 2mm

Perspectives

Achievement of crack free objets for characterizations (thermal & electrical conductivities)

- ↘ polymer crosslinking density
- optimized thermal debinding