# PhD offer:

Sinter-based Additive Manufacturing of bio-degradable metallic orthopedic implants

Additive manufacturing (AM) processes allow for the personalisation of orthopaedic implants in order to optimise the geometry of the medical device for each patient. AM of titanium alloy has been widely studied for biomedical applications and personalised implants are already used for surgery. However, permanent implants are not always suitable since, in many cases, the implant is no more needed once the fracture is repaired. As such, degradable implants would allow a temporary repair function and will degrade after few months. There are several metallic systems targeted for degradable implants, mainly iron, magnesium or zinc alloys. But AM of such alloys, specially magnesium has not been extensively studied.

In this PhD thesis, we will focus on sintering-assisted 3D printing techniques of magnesium. Either by direct-ink writing or metal lithography, two techniques available in our lab, the main challenge remains the optimization of debinding/sintering processes, as magnesium is one of the most reactive metal for oxidation issue. The PhD student will put his/her efforts on:

1) the production of dense parts using pressure-assisted sintering that will be used as references
2) the 3D printing of either porous or complex-shaped structures. This will be done by:
  - direct-ink writing, which is a 3D extrusion process followed by debinding/sintering ;
  - metal lithography, which is based on the curing of a photo-sensitive polymer to consolidate the metallic part, followed by debinding/sintering
3) the detailed characterisation of the parts, from the microstructure to the mechanical and the corrosion properties. The properties will depend on the precipitation-hardening strategy, which will be optimised.
4) As an alternative to magnesium alloy, a Zn alloy will be designed, produced and tested.
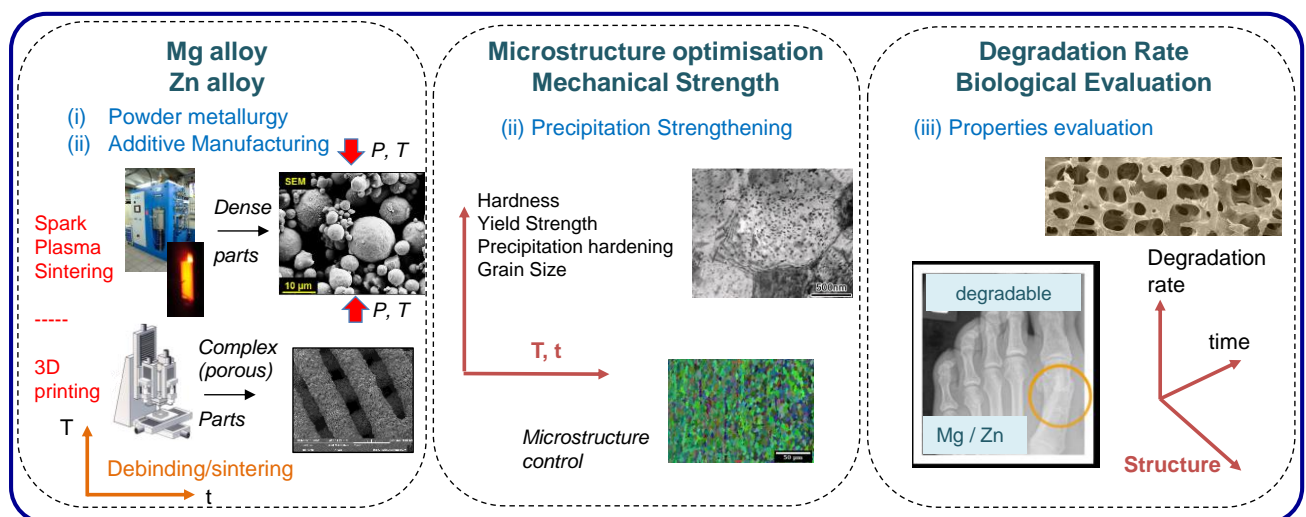
Contract dates: October, 2021 to September, 2024
The project will take place in the MATEIS Lab, INSA Lyon (Villeurbanne, France).

Expected candidates:

Masters in Materials Science and Engineering, Process Engineering or Mechanical Engineering

Fluent or at least professional English ; Good command in French ; German would be a plus.

Skills: Background in Physical Metallurgy, Thermodynamics, Materials Characterisation (metallography, electron microscopy, X-Ray diffraction, hardness, mechanical testing, etc)

Experience:
First experience in lab (private or academic) research project
Knowledge on AM processes, CAD design/slicing, debinding/sintering, heat treatments, would be a plus

Please send your CV, cover letter, and references to:

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Supervision: X. Boulnat ; L. Gremillard ; M. Perez ; O. Dezellus