# PhD in Materials Science and Technology

## Research Title: Development of new alloys and composites by Laser Powder Bed Fusion

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<th>Funded by</th>
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**Context of the research activity**

The research activity for this PhD is in the field of Additive Manufacturing (AM), in particular in the field of Laser Powder Bed Fusion (LPBF) techniques, where a metallic alloy is prepared by laser melting powders of metal. The LPBF technique guarantees a very high cooling speed for the alloy, allowing the stabilization of phases and microstructures that are normally not possible with standard techniques. This open the way for a complete redesign of the alloys used in the AM/LPBF field. The standard alloys, prepared by forging or casting, are not necessarily effective also at high cooling rates, so that new materials must be developed to fully exploit the peculiar characteristics of the LPBF technique. Particular interest is currently put in literature on aluminum alloys, due to their low weight and acceptable cost, even if there are many materials currently used where the modification of the composition of the alloy could bring to improved performance of LPBF-prepared materials: titanium, copper, steel, nickel, etc. Also the field of composite materials is particularly interesting, since new alloys can be coupled with ceramic nano- or micro-particles to extend further the field of application of such materials.

**Objectives**

The objectives of this PhD are:
- design of new alloys and composites with properties specifically adapted to LPBF technique
- preparation of new alloys and composites by in-situ or ex-situ mixing of powders, followed by laser melting in a LPBF machine.
- characterization of new alloys and composites, and identification of specific applications

The main alloys considered are aluminum-based, even if it is not excluded to consider other base materials during the PhD work. The composites will be also based mainly on aluminum, due to its low density and consequently inherent high specific properties.

**Skills and competencies for the development of the activity**

In order to properly develop the activity, the candidate should be proficient in metallurgy and materials science, in particular thermodynamics and properties of metal alloys and characterization techniques of metals and metal matrix composites.