MATERIALS SCIENCE AND TECHNOLOGY

CRT/CIM 4.0/DISAT - Development of new alloys for laser-based additive manufacturing

Funded By	Competence Industry Manufacturing 4.0 S.C. A R.L. [P.iva/CF:12039730010] Dipartimento DISAT FONDAZIONE CRT CASSA DI RISPARMIO DI TORINO [P.iva/CF:06655250014]
Supervisor	FINO PAOLO - paolo.fino@polito.it
Contact	LOMBARDI MARIANGELA - mariangela.lombardi@polito.it
Context of the research activity	Actually the materials available for metal additive manufacturing systems are limited to few conventional alloys (e.g., 316L stainless steel, Ti6Al4V, Inconel 718, AlSi10Mg) that are not originally designed for the unique thermal and solidification conditions of additive manufacturing processes such as Laser Powder Bed Fusion or Directed Energy Deposition. Further compositions will be developed for overcoming some drawbacks such as cracking due to high thermal gradients and residual stresses, poor printability (e.g., segregation, delamination) and microstructural inhomogeneity observed in additive manufactured conventional alloys. Different strategies can be applied for developing new alloys for additive manufacturing. As concerning high-Strength Aluminum Alloys, in orde to avoid cracking observed for traditional Al alloys (e.g., 7075, 2024), Scandium-modified Al alloys (e.g., Al-Sc-Zr) with improved grain structure and printability were produced. As concerning alloys with high strength, ductility, and thermal stability, High entropy alloys with equiatomic or near-equiatomic multi-principal element alloys (e.g., CoCrFeMnNi) were studied. Oxide Dispersion Strengthened alloys were studied for understanding the influence of nano-oxides (Y_2O_3, TiO_2) on creep and oxidation resistance. Metastable, ultra-strong, or amorphous alloys were developed in order to exploit rapid solidification for creating non-equilibrium phases and nanostructured materials not possible in casting. The new compositions will be processed by gas atomization, varying the conditions for having powders with different properties. The influence of starting compositions on the processability of metal powders and their final physical properties must be studied.
Objectives	The main research objectives of this PhD thesis includes: o Definition of new compositions of metallic alloys and metal matrix composites for studying their gas atomization process o Characterization of produced powders in view of their processing by additive manufacturing

	o Reuse strategies for definition of new alloy composition o Processability tests of the new compositions

Skills and competencies for the development of the activity	Candidates should have a solid engineering background and strong motivation to learn through advanced research. Expertise in materials science, advanced processes and technologies, mechanical and functional behavior and characterization of metallic materials is a plus. Problem solving ability is also appreciated.