MATERIALS SCIENCE AND TECHNOLOGY

AMMIN - Development of additive manufacturing for functional inorganic materials

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Context of the research activity	Inorganic functional materials exhibit specific physical, chemical, or mechanical properties that enable them to perform particular functions beyond mere structural support. As concerning electrical conductivity, functional materials range from insulating to conductive behaviuor, depending on the material's structure and composition. As concerning thermal stability, functional materials are able to maintain functionality at high temperatures, crucial for applications in harsh environments such as in space or energy applications. Inorganic functional materials are foundational to advancements in electronics, energy, healthcare, and environmental technologies. Their diverse properties and applications continue to drive innovation across multiple industries. Materials like silicon and gallium arsenide are essential in electronic devices, including transistors, solar cells, and integrated circuits, due to their controlled electrical conductivity. Ceramics such as alumina, zirconia, and silicon carbide are known for their high strength, thermal stability, and chemical resistance. Certain inorganic compounds exhibit magnetic properties, making them suitable for applications in data storage, sensors, and actuators. The possibility to process inorganic functional materials by additive manufacturing technologies give the opportunity to produce complex, multifunctional, and miniaturized components previously unattainable with conventional methods implying relevant improvements in electronics, energy, biomedical, and aerospace sectors. Additive manufacturing of inorganic functional materials is transitioning from prototyping to industrial production. New strategies for applying direct additive manufacturing technologies must be developed in order to facilitate their industrialization. For this reason, it is necessary to study and understand the relations among compositions, process and final properties in order to optimize microstructures and functional behavior in the working conditions.
	The main research objectives of this PhD thesis includes: o Characterization of starting powders for additive manufacturing. o Process optimization for additive manufacturing of functional inorganic materials.

Objectives	o Study of material microstructures, physical, functional and mechanical properties, defining their influence on mechanical and functional performances of final components. o Study and optimization of post-processing heat treatments, defining their influence on mechanical and functional performances of final components.

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, functional and mechanical behavior and characterization of inorganic materials is a plus. Problem solving ability is also appreciated.