PhD in Materials Science and Technology

Research Title: A novel approach to fabricate bioinspired programmable composite materials: the 3D Printing way

Funded by	Politecnico di Torino with funding by Compagnia di Sanpaolo

Supervisor	Prof. Marco Sangermano: marco.sangermano@polito.it Prof. Fabrizio Pirri: fabrizio.pirri@polito.it

Context of the research activity	**3D printing** is a groundbreaking technology that is becoming the playground for the manufacturing of complex three dimensional structures with programmable properties and it is predicted to revolutionize our actual production process, overcoming the economy of scale. If the 3D printing is already used to make some niche items, such as medical implants, and to produce plastic prototypes for engineers and designers, **additive manufacturing**—the industrial version of 3-D printing— is just around the corner. In particular, recent developments on the printing of multiple materials paved the way for a much wider design space beyond unusual micron- and sub-micron fabrication methodologies. A new dimension for the development of next-generation materials can be explored through the control of the orientation of anisotropic particles used as building blocks during a direct ink-writing process.

Objectives	If the 3D printing is largely used by engineers and designers, this is yet an undeveloped field in material science. Thus, the first objective of the BioProg3DP project is to bridge this gap by fabricating tailor-made complex multiple-elemental objects containing oriented magnetic nanoparticles for programmable actions. To achieve this objective a deep knowledge of both chemical and physical phenomena occurring during the printing process are necessary. The research project wil be persuing in cooperation with Polytechnique Palaiseau in Paris, where the PhD student will sped 18 months.

	The development of photocurable formulations containing magnetic nanoparticles will be persued and the crosslinked materials fully characterized. The nanocomposites will be investigated through electron microscopy-related techniques. In particular, a new experimental set up will allow to follow in real-time the photocuring process within a transmission electron microscope.

Skills and competencies for the development of the activity	Good knowledge of Polymers and microscopy techniques. Knowledge on UV-curing and magnetic particles synthesis.