PhD in Materials Science and Technology

Research Title: Innovative polymer-based composites and relevant processing paths

Funded by	Politecnico di Torino

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Contact	

Context of the research activity	Nanotechnology and novel processing methods offer the opportunity for producing innovative polymer-based materials and composites for both functional and structural applications. For instance the addition to polymer matrices of micro and nano-fillers (CNTs, GNPs, carbonaceous fillers in general) provide materials with improved mechanical and functional (thermal and electrical conductivity) behaviour. Also laser technology makes possible to achieve functionalities (conductivity, piezoresistivity) through laser treatments performed on composites with low filler-content and/or low filler-cost. This kind of functionalization offers the opportunity to develop a new class of functional materials for wide applications in several industrial fields. The dispersion of the fillers inside the matrix, in particular when fillers with different aspect ratio are contemporaneously used to produce hybrid composites, entails the greatest importance to obtain the expected functionalities. For this reason several production methods should be developed and compared in order to achieve the expected results with the lower possible cost. Among these methods selective laser sintering (SLS), which is an example of additive manufacturing, should be exploited for industrial applications. In the frame of the principles of the circular economy, novel polymer-based composites and the relevant processing method should be designed in order to make easy the recycling at the end of life of the goods made with these materials and to optimize the use of resources.

	These research activities will be carried out in the frame of existing partnerships and cooperations with important companies that have research and industrial production activities settled in the Piedmont region.

Objectives	The objectives of the research program can be summarized as follow: • To develop polymer-based composites filled with carbonaceous micro or nano-fillers to provide a novel combination of useful properties, • To develop hybrid composites integrating different kind of fillers (also using natural products or by-products from other manufacture processes) with the aim of keeping the cost as low as possible, thus promoting industrial applications, • To design, test and compare different production processes such as: compounding assisted by ultrasounds or three rolls mill, additive manufacturing processes (SLS) and laser treatments for functionalization, • To design the manufacture processes in view of EoL material/components re-use, and to develop and demonstrating the recycling methods.

Skills and competencies for the development of the activity	The candidate should have extended competencies in the field of materials science and engineering, which entails multi-disciplinary skills (engineering, chemistry etc.). The candidate should know the main techniques for material processing and material characterization in terms of microstructure, mechanical, thermal and electrical behaviour.