

PhD in INGEGNERIA DEI MATERIALI / MATERIALS ENGINEERING - 40th cycle

THEMATIC Research Field: VITRIMERIC AND THERMOPLASTIC MATRIX COMPOSITES FOR SMART AND REPAIRABLE AEROSPACE STRUCTURES

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	The proposed research is embedded in the EU funded Pleiades project "Advancing aerospace composites through induction welding and new vitrimeric formulations enhanced by integrated photonic sensors, providing data to digital supply chain, SHM, maintenance" (Grant agreement 101192721). Vitrimer matrix composites have the potential to deliver more readily manufacturable, repairable and recyclable aerospace structures. The goal of the present activity is to assess the suitability of newly formulated vitrimers and selected thermoplastics as matrices for composite aerospace structure, taking into consideration ease of manufacturing, in particular welding, repairing, and end-of-life managing as well as the possibility to embed sensing capabilities. The work conducted during this research will heavily contribute to the final goal of the Pleiades project, i.e. a vitrimer matrix composite assembled aerospace substructure with embedded sensing capabilities.
Methods and techniques that will be developed and used to carry out the research	The PhD candidate will develop the thesis in an experimental laboratory, applying knowledge and techniques for composite material characterisation research, with a specific focus on manufacturing, repairs, and end-of-life management. The following steps are envisaged: 1) A full characterisation campaign will be conducted on different type of matrices:



	different type of matrices: a. Thermo-rheological characterisation of the vitrimer matrix to assess flow and consolidation behaviour, and curing kinetics; b. Thermo-rheological characterisation of the thermoplastic matrix; c. Mechanical characterisation of bulk vitrimer and thermoplastic matrix composites;
	2) Moreover, a new methodology will be developed to assess the effects of welding, repairing and reprocessing on the micro- and meso-scale behaviour and properties of the vitrimer and thermoplastic matrix composite materials;
	3) Design, development, modelling, and prototyping of end-of-life strategies for vitrimer matrix composites;
	4) The evaluation of the effects of embedded sensors on the material properties, and vice-versa the possibility to maintain the sensing capabilities, throughout manufacturing, repairing, and reprocessing.
Educational objectives	 The PhD candidate will learn methodologies and techniques for: 1) Multiscale composite materials characterisation, both mechanical and thermo-rheological; 2) Multi-scale composite materials behaviour analysis; 3) Design, development and prototyping of manufacturing, repairing, and end-of-life processes.
Job opportunities	 The candidate will acquire the skills to find positions as: R&D specialist of material development and manufacturing processes for the overall composite industry, and aerospace sector; R&D specialist of recycling processes for the overall composite industry; Researcher in public and private research centres, such as academic postdoctoral researcher or research engineer.
Composition of the research group	1 Full Professors 3 Associated Professors 3 Assistant Professors

POLITECNICO DI MILANO



	7 PhD Students
Name of the research directors	Prof. Marco Luigi Longana

Contacts

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ricerca/polyenglab/

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	
Housing - Out-of-town residents (more than 80Km out of Milano)	

Scholarship Increase for a period abroad		
Amount monthly	700.0 €	
By number of months	6	

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Confidentiality: since this is a thematic scholarship, the management of Confidential Information, Results and their publication is subordinate to the restrictions agreed upon with the funding company. Upon acceptance of the scholarship, the beneficiary may sign a specific commitment.

Educational activities (funding for participation in courses, summer schools, workshops and conferences) - financial aid per PhD student per year: 1st year: around 1.900 euros 2nd year: around 1.900 euros 3rd year: around 1.900 euros

Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD student: There are various forms of financial of for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities within the limits allowed by the regulation.