POLITECNICO DI MILANO

PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 41st cycle

INTERDISCIPLINARY Research Field: THERMALLY AND ELECTRICALLY HEALABLE ALUMINIUM-BASED ALLOYS

Monthly net income of PhDscholarship (max 36 months)
1500.0 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	Interdisciplinary PhD Grant The PhD research will be carried out in collaboration with research groups of the PhD programme in "**AEROSPACE ENGINEERING**". See https://www.dottorato.polimi.it/?id=422&L=1 for further information. The ability of metallic alloys to self-heal without external intervention is of great interest in contexts where conventional repair is impossible or highly constrained—due to harsh environments, limited equipment or know-how, or risks associated with standard repair techniques. In some “healing materials,” damage can be repaired by applying an external stimulus, such as a controlled thermal cycle or the passage of an electric current. Such healable materials can significantly improve component longevity and operational continuity.This doctoral project aims to advance self-healing metallic materials for high-temperature (HT) structural and functional applications. The specific objectives are: 1. Develop and exploit healable aluminum alloys suitable for HT service, with particular attention to alloys produced by additive manufacturing (AM). 2. Design localized thermal and/or electrical cycles as robust methods to trigger, control, and optimize healing, especially in materials that are creep-damaging or creep-damaged.

Methods and techniques that will be developed and used to carry out the research	Developing a repair process capable of restoring both functional and structural performance in aluminum alloys requires expertise in: metallurgy; advanced alloy design and fabrication; microstructural characterization; high-temperature mechanical testing (including creep); assessment of multifunctional properties across a wide temperature range; and modeling of self-healing mechanisms.This PhD project represents a further step in the development of self-healing metallic materials for HT and functional applications. The focus will be on material produced by additive manufacturing, considered as new or serviced material, to be substituted or healed in aerospace and/or industrial systems.
Educational objectives	The project will be carried out in an interdisciplinary environment at Politecnico, with close collaboration planned with the DAER Department (Prof. Antonio Mattia Grande), and within an international research team. The focus will be on additively manufactured material, considered either as newly produced or as serviced material, intended to be substituted or healed in spatial and/or industrial systems.By the end of the PhD, the candidate will be able to define, design, and conduct original research projects, working effectively within a multidisciplinary team and/or leading a research group in the field of advanced materials. Opportunities will be available for visiting periods hosted by project partners to support scientific collaboration.
Job opportunities	Employment statistics of PhDs can be found https://cm.careerservice.polimi.it/en/employment-statistics/ The PhD project will be partly carried out within the 5-year project ELISHA - ELectrIc current effects on the Self-Healing of Al alloy, in collaboration with the Austrian Universities TU Graz (Coordinator) and University Leoben.
Composition of the research group	2 Full Professors 2 Associated Professors 3 Assistant Professors 5 PhD Students

Name of the research directors	Prof. E.Gariboldi (DMEC) A. M. Grande (DAER)

Contacts
For questions about scholarship/support phd-dmec@polimi.it

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

Scholarship Increase for a period abroad	
Amount monthly	750.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Financial aid is available for all PhD candidates (purchase of study books and materials, fundingfor participation in courses, summer schools, workshops and conferences) for a total amount of € 6.114,50. Our candidates are strongly encouraged to spend a research period abroad, joining high-level.research groups in the specific PhD research topic, selected in agreement with the Supervisor.An increase in the scholarship will be applied for periods up to 6 months (approx. 750 euro/month- net amount). Teaching assistantship: availability of funding in recognition of supporting teaching activitiesby the PhD candidate. There are various forms of financial aid for activities of support to theteaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.