PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 41st cycle

THEMATIC Research Field: LASER MICROPROCESSING FOR NEXT GENERATION SOLID STATE BATTERY MANUFACTURING

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	With an increase in energy demand in several areas, from mobility to consumer products, the need for high-energy, fast-charging, and safe batteries has increased. Solid-state batteries (SSBs) are an overall solution to these challenges. On the other hand, for the widespread use of these batteries, their manufacturing cycles should become robust and economical. Compared to conventional Li-ion batteries, the types and variety of electrode and separator materials differ significantly in solid-state batteries. Pure Li anodes with Cu collectors are often employed together with metallic anodes. Separator materials can be made of ceramics or polymers, which can often be integrated into the cathode material.The large-scale production of these components requires high-quality, robust, and flexible separation and surface functionalization processes. Laser-based manufacturing processes stand out as a key tool for these operations. High-power pulsed laser sources can be flexibly manipulated to process large surfaces for texturing or small kerfs for cutting operations. On the other hand, the laser industry today provides a vast range of options to choose from. The correct choice of laser source and beam-steering equipment should take into account the laser wavelength, pulse duration, pulse repetition rate, use of burst modes, and beam-shaping options. Given the high reactivity of the employed materials, the process design should consider safe and economical ways to test these materials with multiple

	laser solutions. Such comparative analyses should also benefit from digital tools such as process simulations. The PhD project will combine modelling and experimental approaches to develop laser-based cutting and texturing solutions for a wide range of solid-state battery materials from this perspective.
Methods and techniques that will be developed and used to carry out the research	1. Implementation of an experimental protocol for processing SSB materials with multiple laser solutions. 2. Developing multi-scale modelling solutions for laser-material interaction in pulsed wave regime. 3. Process development and investigation of the industrial scalability with the data gathered.
Educational objectives	We provide doctoral candidates with high-level scientific training, fostering and refining research and problem solving abilities by focusing on both theoretical and experimental skills. A PhD in Mechanical Engineering will be able to layout, draft and carry on original research, by leading a research group or working in a team.
Job opportunities	Our last survey on MeccPhD Doctorates highlighteda 100% employment rate within the first year and a 35%higher salary, compared Master of Science holders in thesame field. List of Universities, Companies, Agencies and/or National or International Institutions that are cooperating in the research: -TU Munich -University of Stuttgart -Comau
Composition of the research group	2 Full Professors 1 Associated Professors 1 Assistant Professors 5 PhD Students
Name of the research directors	Prof. Ali Gökhan Demir

Contacts
Research director: aligokhan.demir@polimi.it ph: 0223998590 https://www.mecc.polimi.it/ricerca/sezioni/tecnologie-meccaniche-e-produzione/ 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.