POLITECNICO DI MILANO

PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 40th cycle

INTERDISCIPLINARY Research Field: SUSTAINABLE SOLID-STATE BATTERIES FROM DESIGN TO MANUFACTURE AND REUSE

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 "**MATERIALS ENGINEERING**". See https://www.dottorato.polimi.it/?id=422&L=1 for further information. The current push towards electrification of mobility will generate an extensive transformation both in society and in the industry. The need for energy storage devices will abruptly increase as automobiles, trains, ships, drones, and other vehicles adopt the electric energy. Solid state battery (SSB) technologies will be essential to achieve the energy density and the power required by traction applications by also providing improved safety. The SSB technologies are of strategic importance for the democratic use of energy, appropriate use of the resources, and the fight against the climate change. For a production in the industrial scale the use of correct material chemistries, digital and flexible manufacturing, recycling, and recovery processes are required. This project aims to design the next generation SSBs exploiting advanced materials and manufacturing processes enabling with a traceable and benign environmental impact from conception to end of life.
Methods and techniques that will be developed and used to carry out the research	The research will involve two departments of the Politecnico di Milano namely the Department of

	Politecnico di Milano namely the Department of Mechanical Engineering (DMEC), and Department of Chemistry, Materials and Chemical Engineering "Giulio Natta" (DCMC). DMEC group will provide the digital manufacturing processes based on laser technology for a safe, digital, and sustainable production chain at SITEC - Lab for Laser Applications. The DCMC group will provide the expertise on the solid-state battery technology with advanced materials and functionalization expertise at SEE Lab. The interdisciplinary project will constitute an exceptional platform combining competences that span over electrochemistry, material science, and manufacturing processes required as the basis for the giga-factories of the future. The Li-metal based anodes, solid eletroclytes, and cathodes will be produced considering their ease of recovery and use. The laser-based surface functionalization, separation, and welding processes, as well ablation based selective material recovery processes will be investigated. The project aims to demonstrate the production of prototype battery systems i-house made based on synthesized, recovered, and recycled materials and electrically characterized providing benchmark data highly required by the industry. The project will carry out LCA for all the envisaged cases indicating the most suitable recovery and recycling solutions.
Educational objectives	The provided tools will bridge the knowledge between chemistry, materials science, production engineering making use of environmental assessment tools to provide solutions to produce in large scale SSBs in Italy and Europe. Only with the aid of these tools, the resources can be used in an efficient manner during manufacturing, usage, and end-of-life phases. - Design and develop manufacturing and reuse processes - Develop and synthesize new materials - Benchmark electrochemical behaviour of pristine and reused battery systems - Carry out LCA
Job opportunities	Italy and Lombardy Region have leading positions in construction and manufacturing worldwide. PhD students

	are employed within the first year in national and international companies and academic and non-academic research institutions, engaged in innovation, research and technical development. List of Universities, Companies, Agencies and/or National or International Institutions that are cooperating in the research: TU Munich, Solvay Specialty Polymers Italy
Composition of the research group	2 Full Professors 1 Associated Professors 3 Assistant Professors 10 PhD Students
Name of the research directors	Prof. Ali Gökhan Demir, Prof. Luca Magagnin

Contacts
Phone +390223998590 *Email* aligokhan.demir@polimi.it https://www.mecc.polimi.it *Phone* +390223993124 *Email* luca.magagnin@polimi.it www.cmic.polimi.it For questions about scholarship/support please contact phd-dmec@polimi.it

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	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, funding for participation in courses, summer schools, workshops and conferences) for a total amount of euro 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 the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.