MATERIALS SCIENCE AND TECHNOLOGY

DISAT - Lithium protection and use for ammonia production and energy storage systems

Funded By	Dipartimento DISAT
Supervisor	BELLA FEDERICO - federico.bella@polito.it
Contact	BELLA FEDERICO - federico.bella@polito.it GATTI TERESA - teresa.gatti@polito.it
Context of the research activity	This PhD position concerns the use of lithium both in devices for the electrochemical production of ammonia and in Li-based energy storage systems. The activity concerns the development of materials and prototypes to this purpose, as well as the evaluation of performance, sustainability and cost-effectiveness of the developed processes. Progetto LOTUS: Bando Fare - Progetto LOTUS - 1215/2022 Lithium prOtecTion for robUst and Safe batteries (codice ugov 54_RID22_BEF01) CUP E13C22002510005
Objectives	The research activity focuses on electrochemistry-based technologies for the energy and ecological transition. In particular, the activity of the PhD student will be based on Li-mediated processes. In the 1st and 2nd year, the activity will be based on Li-mediated electrochemical nitrogen reduction, i.e. to develop an alternative solution to the Haber-Bosch process for ammonia (NH_3) production. Electrochemical N_2 reduction reaction (E-NRR) to NH_3 under mild conditions is the Holy Grail in the current industrial chemistry scenario and represents the core of the ERC project SuN2rise, which till grant the first 2 years of this PhD position. The electrochemical conversion of N_2 to NH_3 is currently accompanied by a wide list of experimental operative hurdles, concerning the preparation/formulation of electrocatalysts and electrolytes, the engineering of electrochemical reactors and interfaces, and the overall process analysis in terms of costs and environmental impact. The PhD student will focus on: i) Materials design and engineering to obtain electrodes and electrolytes for E-NRR, coupled with deep electrochemical and physico-chemical in-depth analysis; ii) Modeling of relevant components activity; iii) Chemometric methods to ensure a solid and reproducible research protocol. In the 3rd year, the PhD student will focus on Li metal protection, targeting - as a second device - Li-based batteries. High reactivity of lithium requires an adequate protection strategy to make devices safe and with controllable performance. This aspect (i.e., the protection of Li) is at the center of the project LOTUS, which will pay the 3rd year activity. The common aspect

	between Li metal-based batteries (e.g., Li-S) and E-NRR reactors concerns the presence of a Li metal electrode to be protected. Polymers targeting this objective will be developed, characterized and tested in laboratory-scale prototypes.

Skills and competencies for the development of the activity	Candidates are required to have defended a MSc Thesis in: Chemical Engineering, Material Engineering; Industrial Chemistry; Chemistry; Materials Science; Industrial Biotechnologies. Previous activities of the candidates in the field of electrochemistry and/or sustainable chemistry&materials constitute a preferential skill for the selection process. Capacity to work in a multidisciplinary team and to prioritize the own work for accomplishing deadlines.