PhD in Chemical Engineering

Research Title: Innovative materials for smart Li-ion cells

Funded by	CARS@polito interdipartimental lab and cofunded by DISAT

Supervisor	Silvia Bodoardo

Contact	Silvia Bodoardo DISAT, Politecnico di Torino, Corso Duca degli Abruzzi, 24- 10129 Torino silvia.bodoardo@polito.it_ Tel: 011 0904638_

Context of the research activity	The new energy transition passes through the use of renewable energies, which are intermittent, and of electric vehicles. Both needs electric energy storage systems with ever increasing performance in term of energy and power densities. All this stimulates the development of improved rechargeable lithium batteries or other rechargeable battery systems with higher performance, lower cost and very low environmental impact. State of art Li ion batteries are limited in terms of specific and volumetric energy density, thus there is the need to develop new solutions toward high-tech advances. In terms of technical characteristics, next generation batteries will have to approach theoretical limits of storage capacity, enhance their power capability and power density, increase the cycling lifetime in order to guarantee long and stable operational life, be safe even in extreme low and high temperatures conditions. For these reasons there is the need to study new battery materials or chemistries that can assure better performances compared to the state of art materials currently used. Furthermore, a perfect knowledge of battery interfaces will allow to select new designs. Finally, smart-sensing will be also a requirement for new and safe batteries in particular for high energy density batteries for EV application. The topic of this Doctoral Research will be developed in the context of a new Flagship initiative, namely Battery 2030+, in the frame of the European Community Projects and perfomed within the CARS@polito interdipartimental laboratory.

Objectives	One of the main objectives of the research will be the development of smart battery cells and intelligent functionalities because they will enable to achieve safer and durable batteries.

	Smart batteries need embedded sensors to monitor the complex reactions that happen inside the batteries themselves. These new and advanced batteries can completely change the paradigm of cells, making them to become highly reliable and safe in particular for EV applications. Another objective is to realize new battery designs, and innovative electrodes based of blended materials that can sustain high power and high energy densities and will assure safety requirements needed for battery commercialization. A disruptive vision like this needs functionalities integrated into the battery, capable of spatially and time-resolved monitoring. Sensing systems development will serve to identify defective components or local spots of the cell that need to be repaired. Embedded smart sensors will also need to redesign battery packs, BMS and electronic and electrical connections.

Skills and competencies for the development of the activity	Candidates must have an interest in the proposed topics and interested in electrochemical testing and microscopic analysis. Candidates are required to have a graduation in one of the followings: Chemical Engineering, Chemistry, Material Science, Material Engineering, Mechanical Engineering, Energetic Engineering.