MATERIALS SCIENCE AND TECHNOLOGY

DISAT - Advanced characterization of functional materials for electrochemical energy storage

Funded By	Dipartimento DISAT
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Context of the research activity	Advanced characterization of functional materials for electrochemical energy storage, with particular focus on battery electrode materials. The project aims to investigate structural, chemical, and electronic properties of energy storage materials using advanced experimental techniques in order to understand performance and degradation mechanisms. Dipartimento di Eccellenza 2023-2027 - Ministero dell'Università e della Ricerca".
Objectives	The development of efficient, safe, and sustainable electrochemical energy storage systems is a major scientific and technological challenge, with strong impact on electric mobility, renewable energy integration, and advanced energy applications. In this context, functional materials used in battery electrodes play a central role in determining the performance, stability, and lifetime of energy storage devices. A detailed understanding of the structural, chemical, and electronic properties of these materials is essential to elucidate the mechanisms governing electrochemical reactions and degradation processes occurring during battery operation. Advanced characterization techniques are therefore required to probe materials at the atomic and electronic scale and to establish reliable structure–property–performance relationships. This PhD project focuses on the experimental study and advanced characterization of functional materials for electrochemical energy storage. The research activity will include the preparation and optimization of electrode materials for rechargeable batteries, followed by their structural, chemical, and electronic characterization using advanced techniques, with particular emphasis on X-ray–based spectroscopic methods such as X-ray absorption spectroscopy (XAS). The project will investigate changes in oxidation state, local coordination environment, and electronic structure of active elements during electrochemical cycling. Results obtained from advanced characterization will be integrated with complementary techniques, such as X-ray diffraction, electron microscopy, and electrochemical analysis, to achieve a comprehensive understanding of material behavior.

	By correlating advanced characterization data with electrochemical performance, the project aims to identify key mechanisms affecting stability, efficiency, and degradation of battery materials. The outcomes of this research will support the optimization and rational design of functional materials for improved electrochemical energy storage systems.

Skills and competencies for the development of the activity	Candidates should hold a Master's degree in Chemistry, Materials Science, Physics, Engineering, or related disciplines. Basic knowledge of materials chemistry and/or electrochemistry, interest in advanced characterization techniques, experimental laboratory skills, data analysis ability, problem-solving attitude, and good written and spoken English are required.