PHD THESIS POSITION: INSITU/EXSITU SOLID STATE NMR CHARACTERIZATION OF ELECTRODE

Company Description

CIC energiGUNE is the research centre for the storage of electrochemical and thermal energy, and a member of the Basque Research & Technology Alliance BRTA and a strategic initiative of the Basque Government. CIC energiGUNE was created in 2011 to generate research excellence in materials and energy storage systems, maximising the impact on results for the Basque business fabric, through collaboration with universities, research centres and companies. Located in the Alava Technology Park, it is considered one of the 3 reference centres in Europe, thanks to the positioning of its research lines, its research team and its characterisation, testing and prototyping platforms that make it the reference laboratory in southern Europe. The centre works with an extensive network of collaborators, including clusters, initiatives, companies, universities and research institutes, all of which are benchmarks in the international field of energy storage. These collaborations aim to obtain valuable results for both electrochemical and thermal storage applications. The CIC energiGUNE has recently been awarded the "HR Excellence in Research" by the European Commission, which reflects its commitment to fair and transparent recruitment and evaluation procedures, and certifies the existence of a stimulating and favourable working environment for the institution's researchers.

Information

Deadline: 2021-03-31
Category: Business
Province: Araba / Álava
Country: Basque Country
City: Vitoria-Gasteiz

Company

CIC energiGUNE

Main functions, requisites & benefits

Main functions

The present PhD project is focused in the insitu/exsitu analysis of electrode materials by solid state NMR. The goal of the studies performed will be the development of the insitu NMR technique, the rational design of improved materials and the understanding of the degradation mechanisms and postmortem characterization. While long-range structural information is normally accessible from diffraction methods, solid-state NMR is an exceptionally useful tool for characterizing the local structure in electrode materials. Furthermore, since NMR spectra do not require ordered structures, it is a very suitable technique to detect and analyze disordered materials and minor amorphous compounds formed for example as a byproduct of the material degradation. These components are crucial for the correct understanding of the failure mechanisms in electrode materials and they are not easily accessible by other diffraction techniques. The quantitative nature of solid-state NMR can be used to describe the ion populations that are removed on charging the battery, their pathways in the structure, the phase transitions involved in the electrodes and how the local structures are modified after extended cycling. NMR is also sensitive to molecular and ion dynamics at a large window of kinetic rates. Since the battery function is related to dynamics and rearrangement of charge carriers, ion dynamics are also important factors required for the correct understanding of the electrode performance. NMR experiments can be implemented to obtain information of the structure of the materials, the oxidation states of the elements involved in the electrochemistry, the effect of ion dynamics, cathode decomposition, the phase transitions present in the electrodes upon battery cycling, the presence of irreversible phases, the effects of dopants in the structures and their influence in the ion mobility and the material stability. The implementation of such experiments in our recently acquired insitu NMR system will further situate our center as leaders in this field. TECHNIQUES TO BE USED: Structural, microstructural and physico-chemical characterizations: Solid-state NMR, X-ray diffraction, electron microscopy, chemical analysis. In-situ or operando techniques (solid-state NMR, conventional and synchrotron X-ray diffraction, magnetic meaurements). Electrode preparation according to industrial standards, electrochemical performance tests. Advanced electrochemical characterizations of the charge-discharge kinetics (PITT, GITT, impedance spectroscopy).

Requisites

Holding a Master's degree with academic background in solid state physics, solid state chemistry or materials science. Excellent speaking and writing skills in english. A good team player who can collaborate with other scientists. Highly motivated person and interested in research.

Benefits

A predoctoral employment contract that covers the whole period of the thesis elaboration. A competitive salary within the category. Integration in an enthusiastic and multidisciplinary young group with great projection and commitments with sustainability and research quality.