PHD THESIS POSITION: DEVELOPMENT OF BIFUNCTIONAL CATHODES BY EXPLOITING BIOLOGICAL

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: 2020-12-15
- Category: Business
- Province: Araba / Álava
- Country: Basque Country
- City: Vitoria-Gasteiz

Company

CIC energiGUNE

Main functions, requisites & benefits

Main functions

Lithium-ion batteries, which currently dominate the battery market, present low energy density for some targeted applications (100-265 Wh/kg) where metal-air batteries (MaBs) based on zinc and sodium can overcome this drawback thanks to their high theoretical energy density (theoretical energy densities of 1370 and 1100-1600 Wh/kg, respectively) and the low cost and natural abundance of the salts (Na, Zn). Primary aqueous Zn-air batteries (ZaBs) are a century old technology which came back to the limelight thanks to the development of efficient electrocatalysts. Concerning aprotic chemistry, lithium-air batteries (LaBs) were firstly explored due to their outstanding energy density. However, the instability of superoxide species in LaBs turns Na-air batteries (NaBs) into a more suitable alternative – greater rechargeability - despite its lower energy density. Three main challenges prevent these technologies for achieving higher TRL values and be closer to the market: i) the complex chemical reactions which lead to sluggish oxygen reduction and evolution reaction (ORR & OER) kinetics and ii) the electrolyte degradation by the highly reactive oxygen radicals (NaBs) and iii) anode corrosion by hydrogen evolution (HER) in ZaBs and contamination in NaBs. Coupling the advantages of these promising batteries with the vast potential of electrocatalytic active biomolecules present in nature offers an interesting, sustainable and eco-friendly strategy to overcome the abovementioned challenges of MaBs. The complex solution-based oxygen reactions occurring inside cells during cellular respiration are very similar to those in MaBs. Thus, the highly efficient biochemistry existing in this living organism could be mimicked to manufacture bioinspired, environmentally friendly cathode materials. This PhD proposal therefore aims to exploit biological systems to bridge fundamental science and applied research to achieve highly efficient, sustainable, safe and environmentally friendly MaBs, not available today. TECHNIQUES TO BE USED: Production of 2D and 3D graphene materials. Functionalization of graphene sheets with small biomolecules. Physicochemical characterization of graphene materials and post-mortem characterization of battery electrodes by atomic force microscopy (AFM), transmission electron microscopy (TEM), Raman spectroscopy, gas physisorption, thermogravimetric analysis (TGA), Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD) and X-Ray photoelectron spectroscopy (XPS). Electrode preparation and electrochemical performance tests (rotating disk electrode, galvanostatic cycling). In-situ or operando techniques (e.g. synchrotron X-microscopy). Advanced electrochemical characterizations of the charge-discharge kinetics (e.g. impedance spectroscopy).

Requisites

Holding a Master's degree with academic background in material science and/or electrocatalysis. Good 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