Novel materials and Supercapacitors: fundamental & applied approaches

Olivier Fontaine,
Institut Charles Gerhardt Montpellier, ICGM, University of Montpellier, France
E-mail: olivier.fontaine@umontpellier.fr

Thematic Area: Nanomaterials, Nanostructures and Environment

Abstract

Electrolytes are at the heart of batteries and supercapacitors, and their primary role is to conduct ions, even if their specifications are more complex: chemical and thermal stabilities, large cell voltage, cost, cycle life. However, depending on the design of the molecules that compose the cation and the anion, their function could be extending by adding organic function as redox molecules.

In recent years, the concept of redox shuttles has begun to appear in the literature to increase performance. This concept applies to almost all technologies: lithium-ion, lithium-air, lithium-sulfur, organic radical's batteries, redox flow, and supercapacitors. Depending on the nature of the device, the parameters that undergo an increase are not the same. For example, whereas in a lithium-air battery, the main objective is to catalyze lithium peroxide, which is an electrical insulator (therefore the power of the battery), in a supercapacitor the aim will be to increase the energy density. The choice of redox molecules will then be different depending on the device.

Common to all these technologies, the critical step is the electron transfer when approaching a redox molecule a few nanometers from the interface. This redox reaction generates a Molecular upheaval both to re-organize electrical charges and to establish electroneutrality. This molecular upheaval will of course depend on the nature of the electrodes but also on the chemical nature of the redox mediator. This is what I propose to address in this presentation through our recent results on redox mediators for Li-air batteries and redox mediators for supercapacitors. We will try to help in the choice of redox molecules in the field of energy. To do this, we will rely on the formalism of Marcus' theory, revisited to include the particular properties of electrodes

Keywords: Materials, Li-air batteries, redox mediators, supercapacitor