ORGANIC ELECTRODE MATERIALS, A NEW OPPORTUNITY FOR LOW COST AND SUSTAINABLE LITHIUM BATTERY ?

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Nowadays electrodes of lithium batteries are mainly constituted by inorganic compounds based on transition metals such as cobalt, nickel or manganese. Although their performances are satisfying, these materials present several important drawbacks. Indeed these compounds are expensive because they are prepared due to energy-consuming techniques from rare mineral precursors. Moreover, some metals are toxic and often hard to recycle. Eventually their reactivity leads to safety issues in abusive conditions.

Organic compounds such as nitroxide based polymers or quinones offer a cost-effective and environmental friendly alternative to conventional active materials for electrochemical storage.[1] Interestingly these products can be prepared from low cost precursors which can even come from biomass using classical organic and polymer chemistry techniques. Moreover these compounds are easy to recycle or reuse at their end of life. But until now, their use in electrodes is still challenging due to their high solubility in common electrolytes and their very low electronic conductivity.

On one hand, our work is focused on the synthesis and the grafting of nitroxide radical on a polymer backbone such as poly(2,2,6,6-tetramethyl-1-piperidinyloxy-4-ylmethacrylate) [PTMA] in order to develop organic radical battery (ORB) for high power application. But our team also develops new molecules such as thioquinone which are able to perform mutli-electron redox reaction leading to high specific capacity for high energy battery. On other hand, electrolyte compositions is also optimized in order to prevent the active materials from leaching into the solvent of electrolytes during cycling and our development of specific formulation allows us to implement these types of materials in electrodes of lithium batteries. Some impressive electrochemical performances have been obtained for high power but also high energy lithium battery.[2]

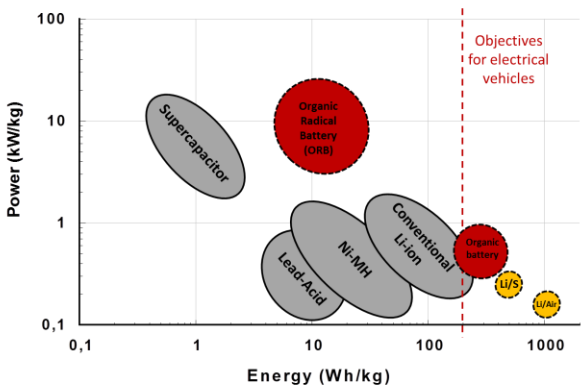

Fig1. Organic battery performances compared to conventional energy storage technologies

[1] P. Poizot *et al*, *Energy Environ. Sci.*, 4 (2011) 2003-2019 ; Y. Liang *et al.*, *Adv. Energy Mater.*, 2 (2012) 742-769
[2] Gutel *et al.*, Patent WO2013156899 (2012) ; Iordache *et al.*, *J. Power Sources*, 267 (2014) 553-559