# Hybrid Graphene Nanocomposites for Use as Electrode in Energy Storage Devices

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## Abstract

Energy storage is increasingly recognized as a key technology to enable renewable electricity generation. Therefore, the search for the next generation of energy-storage materials and devices is extremely important.[1] The high energy density of rechargeable lithium batteries (LIB's) has transformed portable electronics over the past two decades. However, to meet the needs of new markets new generations of lithium batteries are required with increased energy and power density, improved safety, and lower cost. Supercapacitors (SC's) are already used in a variety of applications. The power capability far exceeds that of lithium batteries but their energy density is low. If they are to make maximum impact, new generations are required with higher energy density and lower cost.
Owing to its superior mechanical, thermal, and electrical properties, graphene is a perfect candidate to improve the performance of LIB's and SC's. The design of hybrid materials based on graphene is an obvious path for the exploitation of multifunctional properties and the creation of synergies between the hybrid components. In principle the possible range of materials to be combined with graphene is huge and the choice should be based on the final properties sought for the composite. We will present an overview of our recent work dealing with the use of graphene for the synthesis of electrode materials to be used either in LIBs or SCs. In the first case electroactive but poorly conductive LiFePO4 is modified with graphene-like layers (Figure 1a). In the case of SCs, graphene not only provide a conducting substrate for the anchoring of electroactive polyoxomatalates (Figure 1b) but also contribute to energy storage leading to electrode materials with a dual storage mechanism (capacitive from graphene and faradaic from the inorganic clusters).[2]

## References

(1) Choi, N.-S.; Chen, Z.; Freunberger, S. A.; Ji, X.; Sun, Y.-K.; Amine, K.; Yushin, G.; Nazar, L. F.; Cho, J.; Bruce, P. G. *Angewandte Chemie International Edition* **2012**, *51*, 9994.

(2) Suarez-Guevara, J.; Ruiz, V.; Gomez-Romero, P. *Physical Chemistry Chemical Physics* **2014**, *16*, 20411.

## Figures

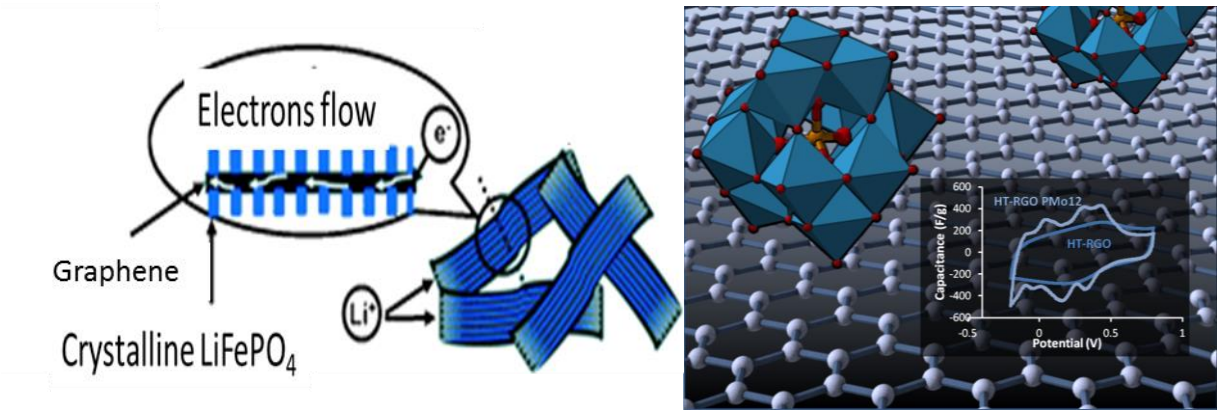


**Figure 1** (a)$LiFePO_4$ hybrid composite to use as cathode in LIB's (b)hybrid supercapacitor electrode by a novel reduction of GO with simultaneous incorporation of polyoxometalate.[2]