Graphene for Energy Storage

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Energy conversion and storage are two of the grand challenges that our society is facing. New materials and processes can improve the performance of existing devices or enable new ones that are also environmentally benign. In this talk I will start by reviewing recent progress on the application of graphene, related two-dimensional crystals, and hybrid systems for energy conversion and storage [1,2]. The versatility of graphene and related materials can lead to new power management solutions for portable and flexible devices, as well as integration in living environments. I will then focus on our recent development of a new class of lithium-ion batteries based on a graphene ink anode and a lithium iron phosphate cathode that displays an estimated energy density of about 200 $Whkg^{-1}$ and a stable operation for over 80 charge-discharge cycles [3]. I will argue that these unique properties are linked to the graphene nanoflake anode displaying crystalline order and high uptake of lithium at the edges, as well as to its structural and morphological optimization in relation to the overall battery composition. Our approach, compatible with any printing technologies, is cheap and scalable and opens up new opportunities for the development of high-capacity Li-ion batteries.

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[2] V. Tozzini, V. Pellegrini Phys. Chem. Chem. Phys. **15**, 80-89 (2013)
[3] J. Hassoun, et al. arXiv:1403.2161