FeOOH/Cyanographene hybrid material for efficient operation in organic electrolytes as supercapacitor electrode

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Abstract

Supercapacitors (SCs) are considered as a promising clean energy storage device. However, to meet the continuously rising energy demand for portable power, it is crucial to enhance the energy density of present SCs, without sacrificing their power and high life-cycle. Toward this goal, integration of pseudocapacitive materials (such as iron oxides, FeOx) has been pursued. High-performance FeOx-based electrodes are mostly prepared by employing hydrothermal, chemical vapor, atomic layer or electro-deposition methods, and even with the combination of these methods which require current collectors other than the commercial Al thin foils. Therefore, a significant amount of inactive mass is added to the device and the fabrication is incompatible with the currently used roll-to-roll paste-deposition processes. Importantly, they operate in low-voltage aqueous electrolytes, limiting their energy. Hence, we developed FeOx-based material with high affinity for organic electrolytes owing to hybridization with a covalently functionalized graphene derivative (cyanographene, G-CN) used as compatibilizer and charge carrier support for the FeOOH nanoparticles. After a facile, cost-effective and up-scalable 15 min microwave-assisted synthesis, the hybrid was casted as paste on Al foil for the assembly of symmetric SCs. Therefore, exploiting the properties of G-CN to purposefully modify the features of FeOOH, a combined high energy and power density was achieved (with respect to total mass of the electrodes, i.e. including current collectors), surpassing previous FeOx-based SCs.

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