Nanohybrid TiO_2 decorated Graphene for Energy Applications

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Nowadays, graphene has an increasing interest as a fundamental material for energy harvesting and storage devices, like batteries and supercapacitors (SCs).
TiO_2 is also considered to be a promising material for this purpose, due to its high specific energy density, low cost, nontoxicity and abundancy[1]. In order to further enhance performances of the electrochemical devices, one of the main successful strategies is combining graphene with transition metal oxides, which introduce pseudo-capacitive effects, allowing an improvement in specific capacities of the devices [2].
In this work we have investigated nanostructured materials based on TiO_2-graphene in order to enhance performances of electrochemical energy storage devices.
Decoration of graphene with TiO_2 has been obtained by two different approaches: hydrothermal synthesis and laser conversion.
In the hydrothermal route, graphene obtained by thermal exfoliation of graphite oxide (TEGO) is combined with different TiO_2 precursors, such as titanium isopropoxide (TTIP), titanium hydride and titanium binolate $((BINOLate)_6\ Ti_4\ (\mu 3\text{-}OH)_4)$ [3], promoting the growth of TiO_2 nanoparticles (NPs) directly on the graphene layers.
The laser synthesis approach allows to obtain TiO_2-NPs on graphene (LSGO, LightScribe Graphene Oxide), starting from TTIP and graphite oxide (GO) with Lightscribe® technique [4]. The two mixed precursors have been deposited on a sheet of polyethylene terephthalate (PET) and converted into graphene decorated with TiO_2 by means of a DVD burner laser.
The nanocrystallinity and the morphology have been revealed by means of high resolution transmission electron microscopy, X-ray diffractions and Raman spectroscopy.
We have also tested the materials as electrodes in lithium-ion batteries and SCs, giving the best result in the case of SCs (TiO_2-LSGO) with values of specific capacity 300% higher than results on a pure LSGO supercapacitor [5].
The improvement of performances was ascribed to the combination of the graphene-based material with metallic oxides NPs, to form a hybrid nanoscale-mixed composite electrode.

References

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Figure

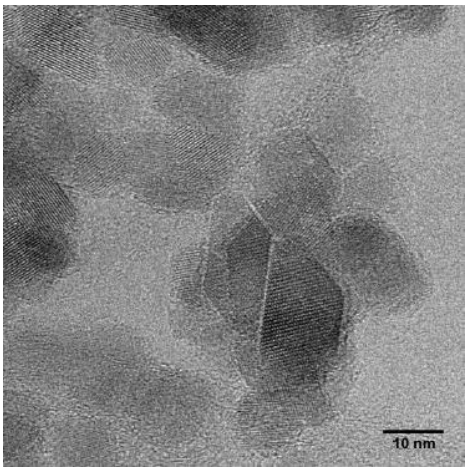

Figure 1: HRTEM of TiO_2 anatase nanoparticles on graphene sheets