Ni-supported three-dimensional microporous graphene as self-standing anode in lithium-ion batteries

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Three-dimensional (3D) graphene-based architectures can combine the two-dimensional properties of graphene with the high surface-to-volume ratio required for a large variety of technological applications. Their use as electrode active material in lithium batteries strongly depends on the level of defects. Indeed, while graphene flakes are promising for alkali metal concentration, the Li cyclability may be hindered by the high density of edges and impurities, with unsaturated bonds able to trap the Li adatoms [1].

We propose 3D few-layer microporous graphene (MPG) structures, with a very low density of defects/edges and of unsaturated bonds [2], as anode in lithium-ion batteries. Such MPG, provided by CNR-IMM (Bologna, Italy), was grown on a high surface area nickel foam, that is here conveniently adopted as current collector for stable, self-standing electrodes.

Electrochemical tests, aimed at elucidating lithiation/de-lithiation processes, were combined with x-ray photoemission spectroscopy, to correlate Li cyclability with its binding properties on the MPG.

The issue of irreversible capacities, typically observed with these types of carbon-based electrodes, was also assessed, by properly modifying the lithium-conducting electrolyte solution. Finally, the applicability of MPG self-standing anodes (thanks to the Ni skeleton) in lithium-ion batteries, with an olivine $LiFePO_4$ cathode, was demonstrated.

References

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