Graphene directed architecture of fine engineered nanostructures with electrochemical applications

Thanks to its high performance as a conducting or/and chemically active support material, graphene has offered unique opportunities for developing novel nanostructured materials to meet various demands. The assembly of graphene with other nanoscale building blocks such as metals, metal oxides, and polymers has led to the possibility to create new electroactive and multifunctional nanostructures, which can serve as promising material platforms for electrochemical purposes. However, the precise control and fine-tuning of material structures and properties are still challenging and in demand. In this review, we aim to highlight some recent efforts devoted to rational design, assembly and fine engineering of electrochemically active nanostructures using graphene or/and its derivatives as soft templates for controlled synthesis and directed growth. We organize the contents according to the chemically classified nanostructures, including metallic nanostructures, self-assembled organic and supramolecular structures, and fine engineered metal oxides. In these cases, graphene templates either sacrificed during templating synthesis or retained as support for final products. We also discuss remained challenges and future perspective in the graphene-templating design and synthesis of various materials. Overall, this review could offer crucial insights into the nanoscale engineering of new nanostructures using graphene as a soft template and their potential applications in electrochemical science and technology. We hope this review would also stimulate new ideas and approaches for relevant ongoing research.

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