Graphene/MXene based self-assembling structures for energy storage applications

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Abstract
The morphology of nanomaterials has significant influence on their properties and the performance of the devices made of such materials. Creating 3D structures by self-assembling 2D nanomaterials could dramatically improve the overall performance of 2D materials for energy storage and conversion, especially where high surface area and porous structure are needed. Template-assisted methods are the most popular way to fabricate 3D structure. Freeze-casting using ice as template is considered as an environmental-friendly and simple method. However, it is still challenging to achieve the desirable 3D structures due to the uncontrollable ice crystals growth and the limitation of 2D materials dispersion in the system. I will present an innovative method that we developed recently based on self-assembling 2D materials, as example graphene and MXenes, into 3D hollow spheres (Fig. 1). Differently from the 3D porous network obtained from conventional freeze-drying method,[1] such innovative and simple method allow us to prepare uniform graphene/MXene hollow spheres with controllable size and spherical structure. In this way, we produced a series of graphene hollow spheres with different size and 3D structure. Advanced *in-situ* characterization methods were used to understand the formation of the 3D hollow structures.[2] Used as electrode materials, the 3D hollow spheres exhibited superior electrochemical performance in terms of specific capacitance and rate capability thanks to their spherical structure. Our method is very simple and can be scaled up for industrial synthesis, with great potential for practical applications.

References

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Figures

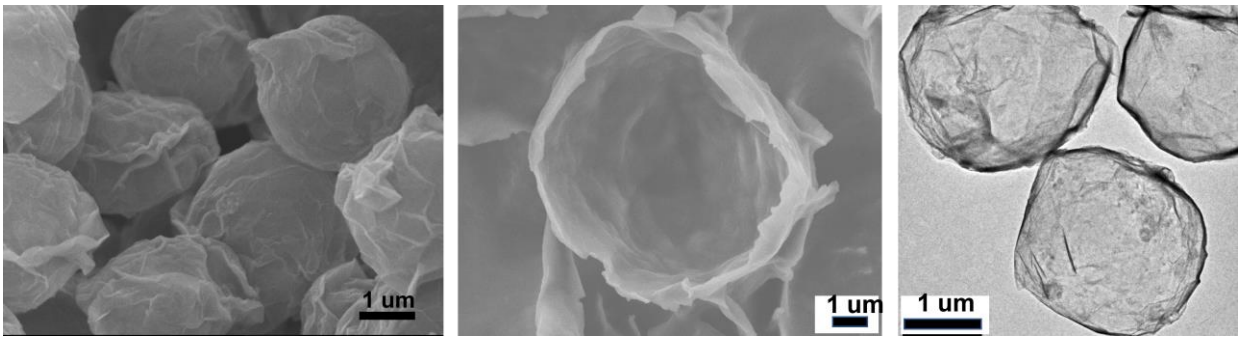

Figure 1: The SEM and TEM images of as-prepared graphene/MXene hollow spheres.