Graphene and MXene hollow spheres for high-performance supercapacitors

Ruiqi Chen[1], Jinhua Sun[1*]

[1]*Materials and Manufacture, Department of Industrial and Materials Science, Chalmers University of Technology, Göteborg, Sweden*

INTRODUCTION: The assembly structure and morphology of the nanomaterials have significant influence on their properties and the performance of the corresponding devices made by those 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 the high surface area and porous structure are needed. Template-assisted methods are the most popular way to fabricate 3D structure, and freeze-casting using ice as template was considered as an environmental-friendly and simple method. However, it is always challenging to achieve the desirable 3D structures.

METHODS: Novel soft template method to form 3D graphene and MXene hollow spheres. Advanced in situ Cryo techniques was used to understand the formation mechanism of the 3D hollow structures.[1]

RESULTS: I will present an innovative method that we developed recently to self-assemble 2D materials for example graphene and MXene into 3D hollow spheres (Fig. 1). Different from the 3D porous network obtained from conventional freeze-drying method,[2] such innovative and simple method allow us to prepare uniform graphene/MXene hollow spheres with controllable size and spherical structure. A series of graphene hollow spheres with different size and 3D structures were prepared. Using as electrode materials, the as prepared 3D hollow spheres exhibit superior electrochemical performance in terms of specific capacitance and rate capability thanks to the spherical structures.

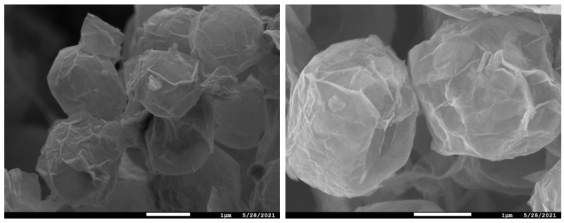

Fig. 1: SEM images of 3D graphene and MXene hollow spheres.

DISCUSSION & CONCLUSIONS: Our method is very simple and can be scale up for large scale synthesis with great potential for practical applications. The as-synthesized materials with hollow spherical structure show high performance for electrochemical energy storage for example batteries and supercapacitors.

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