VERTICAL GRAPHENE-BASED NANOSTRUCTURES FOR ENERGY STORAGE APPLICATIONS

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Vertical graphene (VG) is a 3D nanostructure where graphene nanosheets are aligned vertically to the substrate surface. As compared to the conventional 2D horizontal graphenes which often have the “re-stacking” issue during solution processing, VG is mechanical rigid to avoid structural collapse and preserve the well-defined porosity in various liquid solutions. VG also has a high density of electrochemically-active edge planes, which enables a range of energy storage applications such as batteries and supercapacitors. Here we firstly show that the structure (e.g., height, morphology, interfacial adhesion and surface functionality) of VG can be controlled to a large extent in the plasma-enhanced chemical vapor deposition (PECVD) process. Next, the composites of VG with other active materials, including CNTs, metal oxides, and transition metal dichalcogenides (TMDs), are integrated in electrodes to improve the electrochemical performance of supercapacitors and batteries. Lastly, the new generation of VG with more active edges and various dopants and their implications for energy storage will also be discussed.

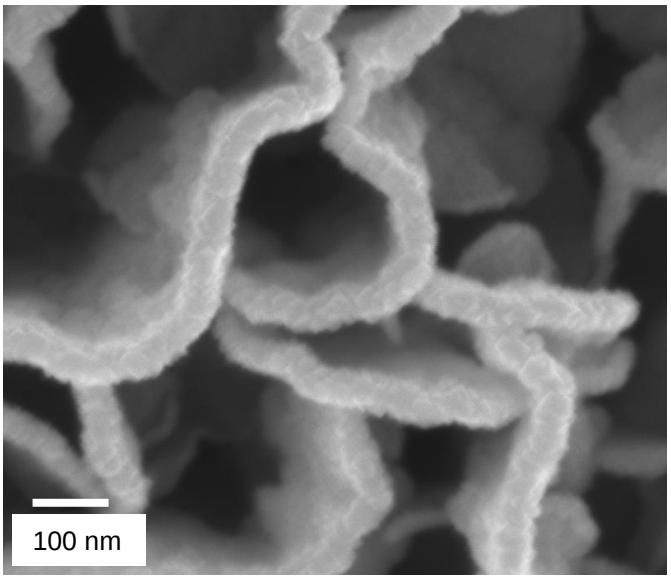

Figure. VG coated with uniform RuO_2 nanofilms.