Hydrodynamic assembly of graphene-carbon nanotube hybrid nanomesh and its energy application

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There has been extensive research on hybrid materials with percolation network structure as electrode materials for transport devices and energy storage/conversion devices. Various assembly techniques have been demonstrated, but an efficient and scalable method still needs to be developed to produce fine and robust percolation structure without using additional chemical processes. We demonstrate a facile assembly method to produce large-area conductive hybrid nanomesh using a biological template. By using a genetically engineered M13 bacteriophage with strong binding affinity toward graphitic surface as biological glue, single-walled carbon nanotubes (SWNTs) were assembled into a conductive hybrid nanomesh through a hydrodynamic mechanism. A diffusion-based hydrodynamic phenomenon with biomimetic interactions enabled a nanoscale mesh structure with extremely fine and uniform nanostructures over a large area to be produced. Graphene nanosheet and SWNTs were assembled into a hybrid nanomesh to serve as an anode material. The hybrid nanomesh anode showed specific capacity of 800 mAh/g and stable electrochemical cycling properties.