General synthetic method for graphene-entrapped mesoporous metal oxide

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In this work, general synthetic method of mesoporous metal oxide@N-doped macroporous graphene composite reported. Electrostatically co-assembled amine functionalized mesoporous silica/metal oxide composite and graphene oxide are heat-treated and subsequent silica etching simultaneously produces mesoporous metal oxide and N-doped macroporous graphene. Through this simple approach, representative five mesoporous metal oxides are successfully encapsulated in N-doped macroporous graphene. Particularly, we demonstrate potential of mesoporous reduced tungsten oxide@N-doped macroporous graphene (m-WO3-x@NM-rGO) as a promising anode material for sodium-ion hybrid supercapacitors (Na-HSCs), resulting in not only outstanding rate capability, but also stable cycle life as a consequence of the structural merits. Additionally, ex situ analyses reveal the electrochemical reaction mechanism of m-WO3-x@NM-rGO based on Na+ intercalation/de-intercalation reactions. To best of our knowledge, this is first report that presenting Na+ intercalation/de-intercalation properties of WO3 and its application to Na-HSCs.