3D hierarchical ultrathin MnO_2 nanoflakes on silicon nanowires for high performance micro-supercapacitors in Li-doped ionic liquid

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Abstract

Building of hierarchical core-shell hetero-structures is currently the subject of intensive research in the electrochemical field owing to its potential for making improved electrodes for high-performance micro-supercapacitors. Here we report a novel architecture design of hierarchical MnO_2@silicon nanowires (MnO_2@SiNWs) hetero-structures directly supported onto silicon wafer coupled with Li-ion doped 1-Methyl-1-propylpyrrolidinium bis(trifluromethylsulfonyl)imide (PMPyrrBTA) ionic liquids as electrolyte for micro-supercapacitors. A unique 3D mesoporous MnO_2@SiNWs in Li-ion doped IL electrolyte can be cycled reversibly across a voltage of 2.2 V and exhibits a high areal capacitance of 13 $mFcm^{-2}$. The high conductivity of the SiNWs arrays combined with the large surface area of ultrathin MnO_2 nanoflakes are responsible for the remarkable performance of these MnO_2@SiNWs hetero-structures which exhibit high energy density and excellent cycling stability. This combination of hybrid electrode and hybrid electrolyte opens up a novel avenue to design electrode materials for high-performance micro-supercapacitors.