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High-performance Mn_3O_4/onion-like carbon (OLC) nanohybrid pseudocapacitor: Unravelling the intrinsic properties of OLC against other carbon supports

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ABSTRACT:

The electrochemical performance of the tetragonal hausmannite Mn_3O_4, when embedded on various carbon materials, onion-like carbon (OLC), carbon nanotubes (CNT), reduced graphene oxide (RGO) and activated carbon (AC) (i.e., OLC/Mn_3O_4, CNT/Mn_3O_4, GO/Mn_3O_4, and AC/Mn_3O_4), has been investigated as electrode material for symmetric and asymmetric pseudocapacitor device. The nanohybrid electrode materials demonstrated higher electrochemical performance (in terms of specific capacitance and rate capability as energy storage devices) compared to the pure Mn_3O_4. The OLC/Mn_3O_4-based symmetric pseudocapacitor device exhibited higher specific capacitance of 195 F g^{-1}, specific energy of 4.3 Wh kg^{-1} and power density of 52 kW kg^{-1} compared to other carbon nanohybrid materials studied. From the symmetric experiments, the best-performing OLC/Mn_3O_4 nanohybrid has been further explored as highvoltage asymmetric pseudocapacitor, with maximum energy and power densities of ca. 19 Wh kg^{-1} (at 0.1 A g^{-1}) and 45 kW kg^{-1} (at 10 A g^{-1}) respectively. The high-performance of the OLC-based system compared to the other carbon systems is ascribed to the combined unique intrinsic properties of the OLC; high electrical conductivity, highly accessible outer surface and large interparticle pore volumes. The above properties have ensured OLC/Mn_3O_4 nanohybrid as a suitable candidate for the high-voltage asymmetric pseudocapacitor device.