2D N-doped Porous Carbon Nanomaterials for ORR Electrocatalysis and All-Solid State Supercapacitors

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Abstract (Century Gothic 11)
For the first time, a 2D nitrogen-doped porous carbon nanomaterial (2D-NPC) as both highly efficient ORR electrocatalyst and supercapacitor electrode was constructed by adopting N-containing monomers as well as taking polyacrylonitrile -functionalized graphene as structure-directing template. Electrochemical analyses indicate that 2D-NPC shows excellent ORR activity through a four-electron pathway. Additionally, a three-electrode system based on 2D-NPC demonstrates high specific capacitance and exceptionally high cycling stability. Moreover, a 2D-NPC based all-solid-state supercapacitor (ASSS) manifests the maximum energy density of 16.2 Wh kg^{-1} at 0.1 A g^{-1} and the maximum power density of 5000 W kg^{-1} for a reduced energy density of 7.2 W h kg^{-1} at 10 A g^{-1}. This work confirms that 2D N-doped porous carbon nanomaterials may be able to exhibit advanced performance in both ORR electrocatalysis and all-solid-state supercapacitors.

References

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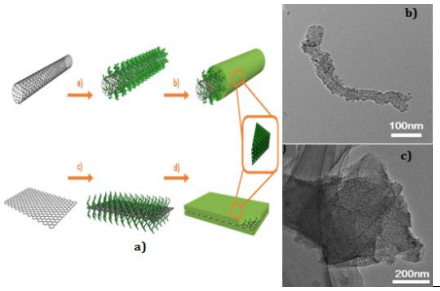

Figure 1: a) Schematic illustration of the syntheses of 1D-NPC and 2D-NPC; b, c) TEM images of 1D-NPC and 2D-NPC.

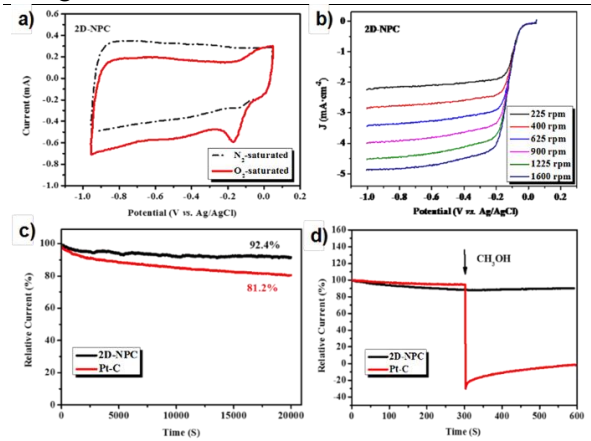

Figure 2: a) CV curves of 2D-NPC in O_2 and N_2-saturated 0.1 M KOH solution at 100 mV s^{-1}; b) RDE voltammograms of 2D-NPC at 10 mV s^{-1} with different rotation rates; c) The stability and d)methanol-tolerance evaluation of 2D-NPC and Pt-C tested at -0.4 V (*vs.* Ag/AgCl) in O_2-saturated 0.1 M KOH solution.

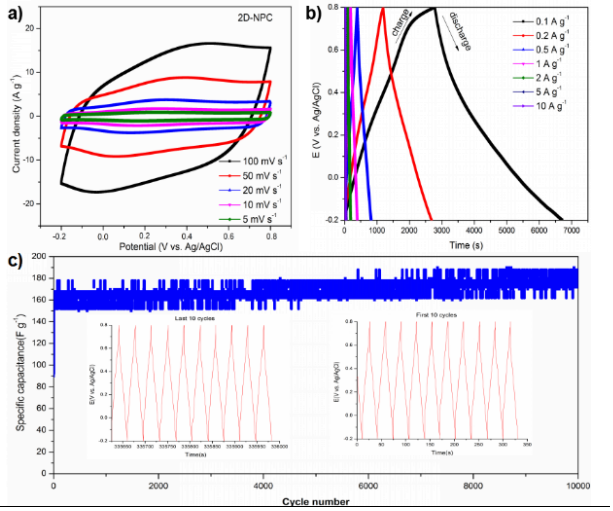

Figure 3: a) CV curves of 2D-NPC at different scan rates; (b) Galvanostatic charge-discharge profiles of 2D-NPC at different current densities; c) Cycle performance of the supercapacitor based on 2D-NPC for a 10000-cycle charge-discharge test at a current density of 10 A g^{-1}.