Carbon-heteroatom bond formation by ultrasonic spray chemistry for energy storage system

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Abstract
The direct formation of C-N and C-O bonds, while essential in chemical/biological processes and energy storage systems, remains technologically challenging\textsuperscript{1-3}. We describe a simple and ultrafast method to form these bonds in reduced graphene oxide (RGO) and carbon nanotubes (CNTs) by ultrasonic chemical reaction for application in energy storage systems. Electrodes of nitrogen- or oxygen-doped RGO (N-RGO or O-RGO, respectively) are fabricated by the collision between N\textsubscript{2} or O\textsubscript{2} carrier gas molecules and ultrasonically activated RGO (Figure 1). The doped products exhibited much higher capacitance than the undoped material (133, 284, and 74 F g\textsuperscript{-1} for O-RGO, N-RGO, and RGO, respectively). Furthermore, doped two-dimensional RGO and one-dimensional CNT materials are deposited layer-by-layer by ultrasonic spray to form three-dimensional porous electrodes with very high specific capacitances (62.8 mF cm\textsuperscript{-2} and 621 F g\textsuperscript{-1} at 10 mV s\textsuperscript{-1} for N-RGO/N-CNT with 1/1 (v/v)), high cycling stability, and structural flexibility (Figure 2).

References