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Engineering Reduced Graphene Oxides with Enhanced Electrochemical Properties through Multiple-Step Reductions

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Abstract: Currently, the most common approach to preparing graphene is based on oxidation of graphite to graphene oxide (GO), followed by the reduction of GO to reduced graphene oxide (rGO). Currently, most reduction methods only focus on one-step reduction by either thermal annealing or chemical reduction. This is no conclusive understanding which reduction method is superior to the other. Here, using the same GO precursors, we systematically studied various reduction methods to achieve optimal electrochemical properties. We found that, to improve electrochemical properties of rGO, multiple step reduction of GO was more effective when compared to individual methods including thermal annealing, microwave treatment, hydrazine reduction, and borohydride reduction. To evaluate electrochemical performance, rGOs were studied by using cyclic voltammetry to evaluate their electrochemical accessible surface areas and double layer capacitance. Their steady-state oxygen reduction reaction (ORR) activities were