High-efficiency oxygen reduction to hydrogen peroxide catalysed by oxidized carbon materials

Hydrogen peroxide ($\text{H}_2\text{O}_2$) is a valuable chemical with a wide range of applications, but the current industrial synthesis of $\text{H}_2\text{O}_2$ involves an energy-intensive anthraquinone process. The electrochemical synthesis of $\text{H}_2\text{O}_2$ from oxygen reduction offers an alternative route for on-site applications; the efficiency of this process depends greatly on identifying cost-effective catalysts with high activity and selectivity. Here, we demonstrate a facile and general approach to catalyst development via the surface oxidation of abundant carbon materials to significantly enhance both the activity and selectivity (~90%) for $\text{H}_2\text{O}_2$ production by electrochemical oxygen reduction. We find that both the activity and selectivity are positively correlated with the oxygen content of the catalysts. The density functional theory calculations demonstrate that the carbon atoms adjacent to several oxygen functional groups (-COOH and C-O-C) are the active sites for oxygen reduction reaction via the two-electron pathway, which are further supported by a series of control experiments.

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