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Chemically activated graphite enhanced oxygen reduction and power output in catalyst-free microbial fuel cells

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Abstract: In search of a cost effective cathode material for microbial fuel cells (MFCs), graphite was chemically treated with H₃PO₄, HNO₃, ZnCl₂, urea or melamine, and the effect of chemical activations on the oxygen reduction reaction (ORR) was examined. The performance of MFCs with activated graphite as the catalyst-free cathodes was then compared to those with untreated graphite. Results suggested that H₃PO₄ and HNO₃ activations could improved ORR, showing the highest ORR activity in graphite treated with 14.62 M H₃PO₄ for 12 h at 30-50 °C. MFCs with H₃PO₄ and HNO₃ activated graphite cathodes generated maximum power densities (7.9 W/m³ and 6.5 W/m³, respectively) 2.4 and 1.8 times higher than that of the untreated control. The chemical activation process involves just a simple immersion step, and it does not require heating, electrochemical process or expensive chemicals. Therefore, it is a highly cost-effective approach to improve the performance of MFCs. We recommend an *in-situ* modification of graphite cathodes in scale-up MFCs with either H₃PO₄ or HNO₃ to optimize MFCs' various industrial applications.

Keywords: Activation, Cathode, Graphite, Microbial fuel cell, Oxygen reduction reaction

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