Title:	A high-performance rotating graphite fiber brush air-cathode for microbial fuel cells
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Abstract:	Microbial fuel cells (MFC) represent an emerging technology to harvest electric energy from waste streams like wastewaters. To further increase MFC performance, the individual fuel cell processes, such as the cathodic oxygen reduction (ORR) need to be further improved. The commonly used, two-dimensional air-cathodes usually show limited performance due to a low three-phase ORR interface and a low oxygen mass transfer rate. To address these issues, a binder-free rotating three-dimensional air-cathode that provides a larger three-phase ORR interface and an enhanced oxygen mass transfer rate is reported in this paper. The cathode is prepared by coating a self-supporting N and P co-doped carbon ORR catalyst layer onto a graphite fiber brush current collector (GB/NPC). No binder and diffusion layer are used to avoid the limitations associated with these components. The electrochemical tests demonstrate enhanced ORR electrocatalysis under rotation conditions. In MFCs, a high performance was achieved by operating the GB/NPC air-cathode at a slow rotation speed. For example, at 20 rpm, it delivered three times higher cathodic current (1.02 ± 0.05 mA cm−2) and two times higher power output (879 ± 16 mW m−2, normalized to the projected surface area of air-cathode) than its counterpart non-rotating, static air-cathode (0.35 ± 0.03 mA cm−2 and 486 ± 11 mW m−2, respectively). The rotating conditions increased the availability of catalytic sites for the ORR, and improved oxygen diffusion and OH− transport at or within the air-cathode. This study thus presents a promising approach for enhancing the performance of air-cathodes, which is often the major performance-limiting component of the MFCs.
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