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Micro-sized microbial fuel cells

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Next generation energy technology might originate from *bacteria*. Microbial fuel cells (MFCs) are rapidly gaining acceptance as an alternative "green" energy technology of the future, as they are powered by live microorganisms to efficiently catalyze degradation of a broad range of organic substrates under natural conditions, and, as such, offer clean and sustainable features. However, MFC technology has not yet been applied to any practical setting as their power generation is insufficiently low compared with other fuel cell technologies. Important strategies for enhancing MFC performance include genetically engineering microbes, optimizing microbial communities, and improving cultivation practices. To date, however, a surprisingly small number of bacteria strains and their optimal growth conditions have been investigated for use in MFCs, revealing a crucial lack of fundamental knowledge as to which bacteria species or consortia may be best suited for generating power in MFCs. This deficiency is caused by limitations in current screening methods based on larger scale two-bottle MFCs that require long start-up times (from days to weeks), significant space and materials (hundreds of milliliters to liters), and labor-intensive control for MFC experiments, either in series or in parallel circuits. This limitation has motivated efforts to miniaturize MFC arrays, such that the effective chamber volumes are reduced to the microliter scale in a well-controlled manner. However, existing micro-sized MFCs are generally limited by their relatively low power density and low energy efficiency, rendering them insufficient for the application. Dr. Choi revealed potential limiting factors that negatively affect the MFC performance as its size is scaled towards the micro regime. By minimizing these factors, he was able to increase the power density and energy efficiency up to 95 $\mu W/cm^2$ and 33%, respectively, representing the highest reported values for micro-sized MFCs and even comparable to those of macro-scale counterparts (Fig. 1). These impressive figures for the micro-sized MFCs assure their potential use as a versatile platform for fundamental microbial studies, as well as portable power supplies.

Biography

Seokheun Choi is currently an Assistant Professor in the department of electrical & computer engineering at SUNY Binghamton. He earned his Ph.D. in Electrical Engineering at Arizona State University in 2011. He has published over 40 journal and conference articles, two book chapters, one book, and holds one U.S. patents. His areas of interest are MEMS-based biosensors, and biofuel cells.

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