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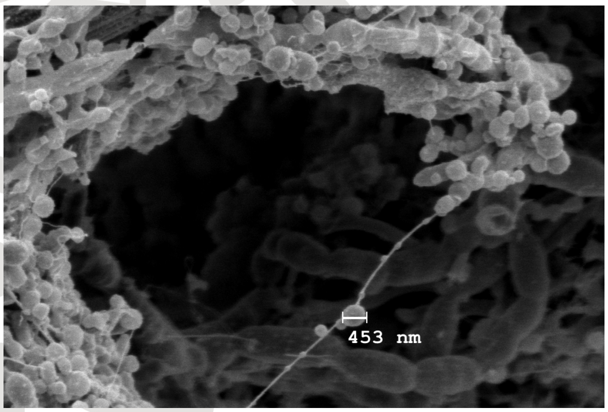

REVVING UP MICROBIAL FUEL CELLS

Hyung-Sool Lee, Seokheun Choi, Yongmo Yang, Prathap Parameswaran, César I. Torres, Bruce E. Rittmann, Junseok Chae

Imagine a fuel cell so small it's measured in millionths of a litre. That's the promise of microbial fuel cells (MFCs): electrochemical devices that use bacteria as catalysts to convert the chemical energy of organic material into electricity.

The problem? Performance suffers significantly when scientists try to shrink the technology. Power density drops as much as four orders of magnitude in micro-scale MFCs compared to their macro-scale, while Coulombic efficiencies are six times lower.

UW environmental engineering professor Hyung-Sool Lee and his colleagues set out to improve that picture by focusing on three key areas: electron sinks, the bacterial mix and internal resistance.

MFCs operate on the principle that certain bacteria can oxidize organic materials, creating electrons. These electrons are transferred outside the cell to the anode. Meanwhile, the electrons moving to the cathode are reduced to water, using oxygen molecules as the terminal electron acceptor.

However, if oxygen molecules grab electrons en route to the anode, efficiency drops substantially. By adding an oxygen scavenger into the system, Dr. Lee and his team were able to eliminate this problem.

Next, the researchers tweaked the bacterial mix. Although several species of bacteria can be used as so-called anode-respiring bacteria, they don't all perform equally. By using large quantities of Geobactersp., Lee and his colleagues were able to increase current density within the tiny fuel cells.

Finally, the researchers reduced the internal resistance within MFCs by designing fuel cells with a high surface-to-volume ratio and adjusting the distance between electrodes.

Thanks to these measures, they were able to boost current density by several orders of magnitude and increase Coulombic efficiency to 31 per cent — by far the highest value reported for miniaturized MFCs.

While micro-scale MFCs are still an emerging technology, numbers like these make the tiny fuel cells look more and more viable.