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Artificial gills for robots: MFC behaviour in water

Ioannis Ieropoulos[1,2], Chris Melhuish[1] and John Greenman[1,2]

[1]Bristol Robotics Laboratory, University of Bristol and University of the West of England, Bristol BS16 1QY, UK
[2] Faculty of Applied Sciences, University of the West of England, Bristol BS16 1QY, UK
E-mail: Ioannis.Ieropoulos@brl.ac.uk, Chris.Melhuish@brl.ac.uk and John.Greenman@uwe.ac.uk

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Abstract
This paper reports on the first stage in developing microbial fuel cells (MFCs) which can operate underwater by utilizing dissolved oxygen. In this context, the cathodic half-cell is likened to an artificial gill. Such an underwater power generator has obvious potential for autonomous underwater robots. The electrical power from these devices increased proportionately with water flow rate, temperature and salinity. The current output at ambient temperature (null condition) was 32 μA and this increased by 200% (~100 μA) as a result of a corresponding temperature increase (ΔT) of 52 $^{\circ}$C. Similarly, the effect of increasing the water flow rate resulted in an increase in the MFC output ranging from 135% to 150%. Furthermore, the same positive effect was recorded when artificial seawater was used instead, in which case the increase in the MFC current output was >100% (from 32 to 65 μA). There was a distinct difference in the MFC performance when operated under low turbulent as opposed to high turbulent flow rates. These findings can be advantageous in the design of underwater autonomous robots.