Carbon nanotube/enzyme bioelectrodes for implantable glucose/O_2 biofuel cells

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Abstract

The design of biofuel cells involves the application of enzymes or microorganisms as catalyst for the targeted oxidation and reduction of specific fuel and oxidizer substrates to generate an electrical power output. Biofuels such as glucose can be found in physiological fluids, opening thus the way to energy harvesting from body fluids for supplying biomedical electronic devices.[1] We investigated the efficient wiring of enzymes in a carbon nanotube (CNT) conductive matrix for the fabrication of glucose biofuel cells (GBFC). CNTs combine many advantages for designing GBFCs: excellent conductivity, high specific surface, ease of functionalization and strong interactions with redox enzymes.[1] Direct and indirect electron transfer were both investigated for the wiring of laccase and glucose oxidase on CNT electrodes for the respective oxygen reduction and glucose oxidation.[2,3] GBFCs delivered, *in vitro*, a maximum power density up to 1.3mW cm^{-2} and an open circuit voltage of 0.95 V (50mM glucose, 25 °C, pH 7). Moreover, the GBFC was successfully implanted in rats by surgical insertion into the retroperitoneal space, enabling Glucose and O_2 from the Extracellular Fluid to flow into the GBFC.[4] The implanted GBFC delivered a maximum power density of 0.25mW cm^{-2}, 0.42mW mL^{-1} and an open circuit voltage of 0.85V and has proven to be able to supply small electronic devices.

References

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Figures