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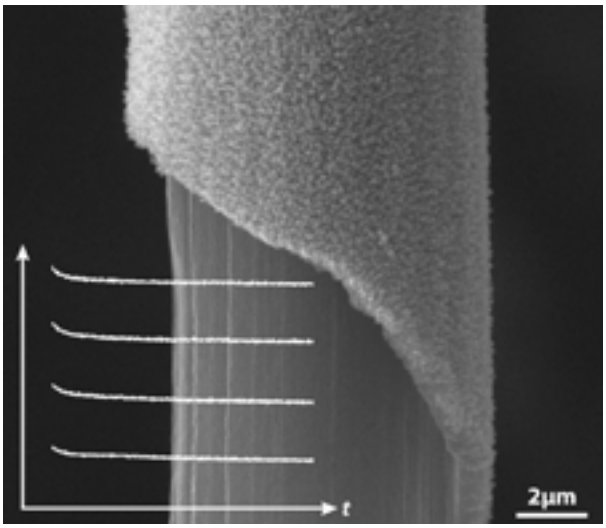
Palladium nanostructured single carbon fiber electrodes for detection of early-onset sepsis and oxidative stress

Aaron McConville
Ulster University, UK

Hydrogen peroxide (H_2O_2) is one of the several reactive oxygen species (ROS) generated as a by-product of many biological processes. While it occurs naturally in relatively low concentrations throughout the human body, deviation from the normal physiological range may be indicative of a number of conditions. As such, hydrogen peroxide may be viewed as a biomarker, allowing it's concentration to be monitored and thus used to augment diagnosis of critical ailments such as sepsis and oxidative stress. To this end, we have sought to investigate the development of a non-enzymatic sensor capable of quantifying peroxide. The core aim of the approach relates to the provision of a micro scale sensor that could be ultimately be used for in vivo measurements or transdermal sensing. The underpinning methodology pursued involves the design and development of a monofilament carbon fiber probe (10 micron diameter) onto which a nano layer of palladium is electrochemically deposited. Examination of the latter using scanning electron microscopy revealed a forest of Pd nano fibrils and a representative image highlighting the partial formation of the film is shown in Figure 1. These structures have been shown to exhibit exceptional catalytic activity towards the oxidation of peroxide at low operating potentials where there is very little interference from other matrix components. The high sensitivity and selectivity for peroxide can be further exploited through coupling of oxidase enzymes to expand the range of biomarkers that can be quantified. The subsequent modification of the Pd film and the extrapolation of the amperometric approach to the measurement of glucose and lactate (itself an important marker of sepsis) is considered and critically appraised.



Biography

Aaron McConville is in the 2nd year of his PhD at the Ulster University in Northern Ireland. He currently has published 3 papers in reputed journals, with several others at various stages of completion and in review. He has significant involvement in module co-ordination and delivery of material to engineering undergraduate students in the university in which he studies, as well as supervises Biomedical Engineering undergraduate students throughout their final year projects.

McConville-A4@email.ulster.ac.uk

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