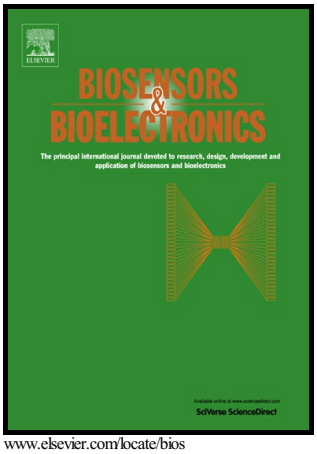

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PII: S0956-5663(17)30129-X
DOI: http://dx.doi.org/10.1016/j.bios.2017.02.042
Reference: BIOS9576

To appear in: *Biosensors and Bioelectronic*

Received date: 1 December 2016
Revised date: 28 January 2017
Accepted date: 23 February 2017

Cite this article as: Igor Schmidt, Alaaeldin Gad, Gregor Scholz, Heidi Boht Michael Martens, Meinhard Schilling, Hutomo Suryo Wasisto, Andreas Waag and Uwe Schröder, Gold-modified indium tin oxide as a transparent window i optoelectronic diagnostics of electrochemically active biofilms, *Biosensors an Bioelectronic,* http://dx.doi.org/10.1016/j.bios.2017.02.042

Gold-modified indium tin oxide as a transparent window in optoelectronic diagnostics of electrochemically active biofilms

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Abstract:

Microbial electrochemical technologies (METs) are one of the emerging green bioenergy domains that are utilizing microorganisms for wastewater treatment or electrosynthesis. Real-time monitoring of bioprocess during operation is a prerequisite for understanding and further improving bioenergy harvesting. Optical methods are powerful tools for this, but require transparent, highly conductive and biocompatible electrodes. Whereas indium tin oxide (ITO) is a well-known transparent conductive oxide, it is a non-ideal platform for biofilm growth. Here, a straightforward approach of surface modification of ITO anodes with gold (Au) is demonstrated, to enhance direct microbial biofilm cultivation on their surface and to improve the produced current densities. The trade-off between the electrode transmittance (critical for the underlying integrated sensors) and the enhanced growth of biofilms (crucial for direct monitoring) is studied. Au-modified ITO electrodes show a faster and reproducible biofilm growth with three times higher maximum current densities and about 6.9 times thicker biofilms compared to their unmodified ITO counterparts. The electrochemical analysis confirms the enhanced