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*Extended Abstract*

# Transdermal Microneedle Array-Based Biosensor for Real Time Simultaneous Lactate and Glucose Monitoring †

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Microneedle arrays for minimally invasive continuous sensing in the dermal interstitial fluid (ISF) have been demonstrated in both amperometric [1,2] and potentiometric [3] modes, however there are no publication where microneedle arrays have been shown to function as second generation biosensors [4].

Here we report the first mediated pain free microneedle-based biosensor array for the continuous and simultaneous monitoring of lactate and glucose in artificial interstitial fluid (ISF). The gold surface of the microneedles has been modified by electrodeposition of Au-multiwalled carbon nanotubes (MWCNTs) and successively by electropolymerization of the redox mediator, methylene blue (MB). Functionalization of the Au-MWCNTs/polyMB platform with the lactate oxidase (LOX) enzyme (working electrode 1) and with the FAD-Glucose dehydrogenase (FADGDH) enzyme (working electrode 2) enabled the continuous monitoring of lactate and glucose in the artificial ISF. The lactate biosensor exhibited a high sensitivity (797.4 ± 38.1 μA $cm^{-2}$ $mM^{-1}$), a good linear range (10-100 μM) with a detection limit of 3 μM. The performances of the glucose biosensor were also good with a sensitivity of 405.2 ± 24.1 μA $cm^{-2}$ $mM^{-1}$, a linear range between 0.05 and 5 mM and a detection limit of 7 μM. The biosensor array was tested to detect the amount of lactate generated after 100 minutes of cycling exercise (12 mM) and of glucose after a normal meal for a healthy patient (10 mM).

The results reveal that the new microneedles-based biosensor array holds interesting promise for the development of wearable real-time monitoring devices to be used in sport medicine and clinical care.

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