

Implantable Sensors: Materials and Tissue-Sensor Interface

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Whatever the sophistication of current chemical and biosensors, their reliable operation in biological matrix is critically dependent upon a stable maintained analyte recognition capability. In effect, the sensing surface requires to be 'biocompatible' and thereby subject to minimal surface fouling or contamination. For most devices, a superimposed colloid layer, formed during use constitutes the final common pathway to failure.

In our work on enzyme-based electrochemical sensors, we have predominantly relied on polymeric barrier membranes as a tried and tested means of stabilizing the vulnerable sensing interface. Furthermore such membranes have allowed for manipulation of analytical range, independence from external cofactor requirements and an ability to operate under variable flow conditions.

We have specifically worked with enzymic metabolite (glucose, lactate) sensors with electrochemical transduction (1). With microporous membranes such as those based on polycarbonate, aperture can be controlled at well formed cylindrical pores, and substrate transport reduced to substrate, while allowing for say higher O₂ transport which can occur both through the pores and through the membrane material itself. In an alternative strategy, the interchain spacing of polymer chains has been increased through incorporation of inert spacer-plasticiser. The plasticiser properties now can determine the molecular scale aperture in what would otherwise appear to be a homogeneous membrane structure (2). Thus by varying the surfactant content of solvent cast cellulose acetate membranes it has been possible to change relative permeability to target molecules and interferent compounds on the basis of molecular weight differences. With charged surfactant, there is the possibility to reject or retain compounds on the basis of charge repulsion as demonstrated for the enzymic pyruvate electrode where cationic cofactor loading and retention at the sensor permits reagentless measurements.

The surfactant type also influences biocompatibility. One general effect may be for the lysis and disaggregation of deposited cells, but superimposed on this are more subtle stabilisation effects as shown by differences in signal drift in contact with biofluids. Such studies have been possible with model films of electropolymerised phenols used to entrap high molecular weight surfactants.

In a further development, we have exploited conducting polymer films (poly(pyrrole)) to register charge effects associated with binding of target analyte (Figure 1). These offer a possible reagentless route to affinity monitoring and may eventually allow for integration with biomaterials.

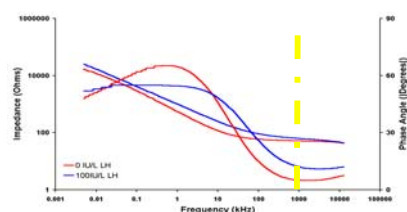


Figure 1. Antibody/poly(pyrrole) impedimetric response to Lutenising hormone

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