Organic Electrochemical Transistor Incorporating an Ionogel as a Solid State Electrolyte for Lactate Sensing

Vincenzo F. Curto\textsuperscript{a}, Dion Khodagholy\textsuperscript{b}, Kevin J. Fraser\textsuperscript{a}, Moshe Gurfinkel\textsuperscript{b}, Dermot Diamond\textsuperscript{a}, George G. Malliaras\textsuperscript{b}, Róisín M. Owens\textsuperscript{b}, Fernando Benito-Lopez\textsuperscript{a}

\textsuperscript{a} CLARITY: Centre for Sensor Web Technologies, National Centre for Sensor Research, Dublin City University, Dublin 9, Ireland

\textsuperscript{b} Centre Microélectronique de Provence, Ecole Nationale Supérieure des Mines de Saint Etienne, 880, route de Mimet, 13541 Gardanne, France.

Introduction:

Room temperature Ionic liquids (RTILs) have evolved as a new type of solvent for biocatalysis, mainly due to their unique and tunable physical properties.[1] In addition, within the family of organic semiconductor-based sensors, organic electrochemical transistors (OECTs) have attracted particular interest.[2]

Here, we present a simple and robust biosensor, based on a OECT, capable of measuring lactic acid using a gel-like polymeric materials that endow RTIL (ionogel)[3] as solid-state electrolyte both to immobilise the enzyme and to serve as a supporting electrolyte.[4] This represents the first step towards the achievement of a fast, flexible, miniaturised and cheap way of measuring lactate concentration in sweat.

Experimental:

1-Ethyl-3-methylimidazolium ethyl-sulfate ionic liquid, \([\text{C}_2\text{mIm}\][\text{EtSO}_4]\), was chosen because of its miscibility with water and bio-compatibility.

The OECT is fabricated by standard lithography and it is made of 200 nm thick PEDOT:PSS film.

The hydrated RTIL mixture containing the lactate oxidase enzyme (LOx) was photo-polymerised using a UV irradiation source (\(\lambda = 365\) nm) for 1 minute.

Conclusions:

We demonstrate the detection of lactate in a relevant physiological range using an OECT sensor with an ionogel solid-state electrolyte. The significance of this work for sensing applications lies in the configuration of the sensor; we show for the first time a solid state electrolyte on a flexible transistor-based biosensor.

References