



Post-doctoral fellowship ANR EmbryoElecSense

Investigation domain

MicroElectrochemical sensors – *In vitro* diagnostic – Microfluidics

Microdevices for the analysis of the embryo development

Context of the project:

Oxidative stress reflects an imbalance between the intracellular production of reactive oxygen (ROS) such as hydrogen peroxide (H₂O₂) and nitrogen (RNS) species such as nitric oxide (NO) and a biological system's ability to eliminate these reactive intermediates. These short-lived species have beneficial or deleterious effects, notably depending on their *in vivo* levels. **In the context of embryo development** and the use of assisted reproductive technologies, **oxidative stress appears to be one of the major factors affecting the success rate of embryonic biotechnologies**. It impacts the long-term phenotype of individuals born from these biotechnologies. The monitoring of ROS and RNS is thus of outmost importance to find better embryo development conditions. The measurement of the production of ROS/RNS faces major difficulties: these species are involved in several cellular mechanisms, they are unstable and their level is generally low.

Objectives of the project

In this context, we propose **the conception of microdevices with incorporated electrochemical sensors with and without microfluidics**, for the real-time extra-cellular measurement of ROS and RNS releases to closely monitor the embryo activity. The evaluation of ROS and RNS will be achieved by designing **miniaturized sensors** implemented inside microdevices to selectively detect the **targeted analytes (ROS and RNS) *in vitro*** for several days (pre-implantation period of embryo).

Post-doctoral position

The post-doctoral position will be granted by the ANR (France).

The candidate will be involved in a multi-disciplinary project that will be conducted in a consortium of three laboratories described below, localized in the center of Paris and at Jouy en Josas. The candidate will develop microdevices with the incorporation of microelectrodes with different designs devoted to the simultaneous detection of ROS and RNS, during *in vitro* embryo development. The challenge will be to perform the simultaneous selective detection of several reactive species, that will be present at trace level: H₂O₂, NO and O₂, with particular attention to sensitivity and selectivity for their detection in embryo culture media. The development of biocompatible devices/materials is also essential since the embryos will be cultured within the devices for a few days. The electrochemical sensors will be integrated into small wells or microstructures and/or inside microchannels of microfluidic devices and will be used underflow to mimic *in vivo* conditions of embryo development. The candidate will strongly interact with the UMR1198 for the application of the devices to the analysis of redox stress markers at the level of several embryos and then at the level of a unique embryo. It should be noted that the UMR1198

will develop in parallel measurements of intracellular ROS/RNS using fluorescent probes and evaluate oxidative stress-related genes expression.

The preparation of selective electrochemical sensors for ROS and RNS analysis will be performed at iCLeHS (Chimie ParisTech), while the microelectrode preparation and microfluidic devices assembly will be designed at UMR PASTEUR (Ecole Normale Supérieure). The devices are devoted to the analysis of embryos culture media so that the post-doctorate will strongly interact with UMR 1198 (INRAE), specialized in embryo biology research.

Profile of the candidate:

The candidate should have a PhD in analytical chemistry or electrochemistry, with research expertises in electroanalysis, electrode surface modification, an attraction for chemistry/biology interdisciplinary project, and also experimental basic knowledge in micro-fabrication technologies.

Practical Informations :

Beginning schedule: October 2020

Duration: 18 months

Involved laboratories:

- Chimie ParisTech (ENSCP), Institute of Chemistry for Health and Life Sciences CNRS 2027 (iCLeHS), Paris.
- École Normale Supérieure (ENS), Laboratoire PASTEUR, UMR CNRS 8640, Paris.
- INRAE, Biologie du Développement et Reproduction, UMR1198 Jouy-en-Josas.

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