SCIENCESPRINGDAY

FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

Materials Science Department

Bio-batteries

Ana Baptista

(PhD Student)

Research interests:
Bioelectronics & Biomaterials.

2011 Started a PhD. in Materials Science and Engineering (under the supervision of Prof. Dr. Isabel Ferreira and Prof. Dr. João Paulo Borges).

2009 MSc. in Biotechnology

2007 BSc. in Applied Chemistry
FCT-UNL

CENIMAT/I3N and **DCM- FCT/UNL**:
- *Microelectronic and Optoelectronic Materials Group*
- *Polymeric and Mesomorphic Materials Group*

FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

i3N
INSTITUTE FOR NANOSTRUCTURES, NANOMODELLING AND NANOFABRICATION
RESEARCH, INNOVATION AND ENGINEERING APPLICATIONS

Objectives

The present PhD thesis proposes the development of a flexible and lightweight electrochemical device (*bio-battery*) based on a biocompatible electrospun membrane - **Figure 1**. Considering that harvesting energy directly from the environment is probably the most effective and promising approach for powering long-term biomedical devices, the proposed electrochemical device should take advantage of the ionic content of the physiological fluids to generate electric energy to supply low power consumption biomedical systems, such as implantable devices and biosensors.

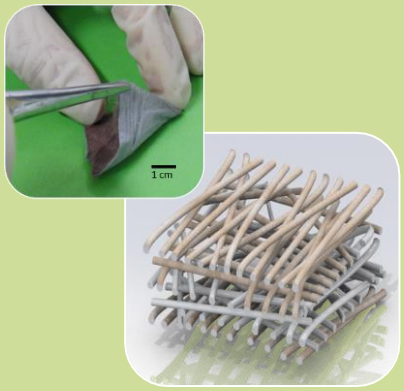

Figure 1

Structure of the proposed *bio-battery* based on an electrospun membrane. By depositing thin metal films electrodes onto both sides of the membrane, the original flexibility and surface area is preserved leading to a highly flexible and foldable electrochemical device.

Methodology

- *Development of biocompatible membranes composed by micro/nanofibers:*
  - Study and optimization of the electrospinning process;
  - Morphological characterization of the produced membranes;
  - Electrochemical studies under different physiologic conditions.
- *Electrodes development:*
  - Incorporation of NPs into the fibers;
  - Electrospinning of conductive polymers;
  - Thin film (metal and metal oxide) depositions.
- *Electrochemical device characterization.*
- *Bio-batteries implementation and validation.*

Expected Results

The concept was already demonstrated [1] – **Figure 2**. A cellulose-based structure has demonstrated the ability to generate electrical energy from physiological fluids showing a power density of 3 $\mu W.cm^{-2}$, which is a really promising achievement since a typical power required for a pacemaker operation is around 1µW.

Owing these results, it is necessary to develop and optimize the concept of *bio-battery* envisaging the supplying of low power consumption devices in the medical field and food industry.

Figure 2

Concept demonstrator using an electrospun cellulose acetate membrane covered with silver and aluminum as electrodes in contact with sweated skin.

[1] A.C. Baptista, J.I. Martins, E. Fortunato, R. Martins, J.P. Borges and I. Ferreira, Thin and flexible biobatteries made of electrospun cellulose-based membranes, Biosensors and Bioelectronics 26 (5), pp. 2742-2745 (2011).

Funding:

Doctoral grant given by FCT- MEC: *SFRH/BD/69306/2010*

FCT
Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR