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FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

Materials Science Department

Interfacing technology with the brain

CENIMAT/I3N
-Microelectronics and Optoelectronics Materials Group

CENIMAT i3N

Champalimaud Foundation

Intelligent Systems Lab

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2011- Started her PhD in Nanotechnology and Nanoscience in collaboration with Champalimaud Centre for the Unknown.

2009- Received her MSc degree in Biomedical Engineering from FCT-UNL.

Objectives

Brain recording with *neural electrodes* is the principle technique for determining how networks of neurons make sense of the world, generate ideas, and create adaptive behaviors in changing environments.
The present work proposes the integration of approaches from nanotechnology and nanomaterials (Figure1) to overcome the current limitations of the neural electrode technology. This collaborative project involves the design of new electrodes and their evaluation *in vivo* for improved neural recording performance and stability.

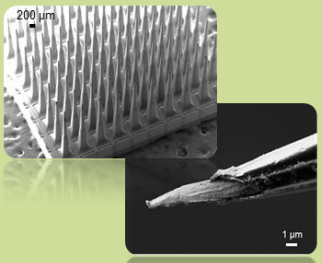

Figure1. Scanning electron microscope (SEM) images from two different neural electrodes: silicon-based array and insulated tungsten wire with exposed tip.

Methodology

- Design of novel neural interfaces:

This task will be achieved by the incorporation of nanoscale features using focused ion-beam (FIB) or coating metals with nanomaterials, such as gold nanoparticles (Figure2). Morphological and electrochemical characterization will be performed.

- Evaluation of the neural recording performance:

Design and construction of an *in vivo* neural recording platform. Acute, simultaneous extracellular and juxtacellular recordings from motor and somatosensory cortex in the mammalian brain will be acquired (Figure3).

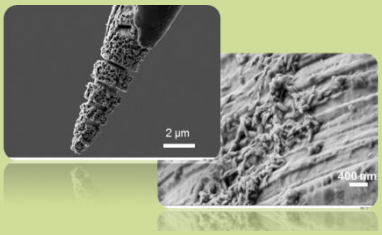

Figure2. SEM images of tungsten tip after FIB modifications and coated with nanoparticles.

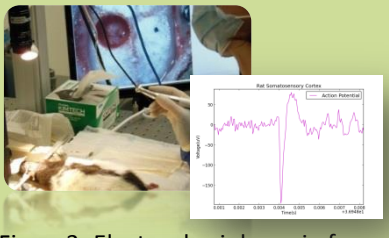

Figure3. Electrophysiology rig for acute recordings, and an action potential recorded from rat somatosensory cortex.

Expected Results

Improvement of electrical characteristics (signal-to-noise ratio and ability to isolate the electrical impulses of individual neurons) and stability of the interface between neurons and electrodes is a prerequisite for breakthroughs in brain research and central nervous system therapies. Nanostructured coatings will reduce the interface impedance and nanoscale features have been shown to increase neural adhesion, thus making the neuron-device coupling more reliable. The most promising neural electrode interface designs will be tested for chronic performance, i.e. devices will be permanently implanted (Figure4).

Figure4. Rat with implantable electrode during behavior task.

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