Development of a Nanodiamond-Based Optical Potassium Sensor for Neural Interfaces

Institution	University of Technology Sydney ARC Centre of Excellence in Quantum Biotechnology (QUBIC) – UTS Node
Project details	Potassium ions (K^+) play a central role in neuronal communication. Changes in extracellular K^+ accompany neuronal depolarisation and can also indicate disruption of ionic homeostasis or neural tissue injury. Measuring these changes locally could complement conventional electrophysiological recordings and provide a more complete picture of neural activity. This four-week project will explore the development of an optical K^+ sensor based on fluorescent nanodiamonds containing nitrogen-vacancy (NV) centres. These nanodiamonds combine highly stable fluorescence with a surface that can be chemically engineered to recognise specific biological targets. The student will functionalise NV nanodiamonds with a potassium-selective ionophore and investigate whether K^+ binding produces a measurable change in their fluorescence spectrum. The sensor will be evaluated across a range of K^+ concentrations and tested in the presence of competing physiologically relevant ions, particularly Na^+. The project will involve: • Functionalising and characterising NV nanodiamonds with a potassium-selective ionophore. • Measuring their spectrally resolved fluorescence response to K^+. • Evaluating sensor selectivity, reproducibility and stability under extracellular-like ionic conditions. **Expected aims and outcomes** The project aims to determine whether ionophore-functionalised NV nanodiamonds to produce a selective optical response to K^+. Expected outcomes include an initial K^+ calibration, assessment of interference from competing ions and evaluation of the sensor's suitability for integration with neural interfaces. The student will gain experience in nanoparticle surface chemistry, fluorescence spectroscopy and nanosensor characterisation. The results will support future integration of potassium-responsive nanodiamonds with a interface for spatially resolved sensing around brain organoids.
Who can apply	Undergraduate students studying biomedical engineering, chemistry, materials science, nanotechnology, biotechnology, physics are encouraged to apply.
Contatct / Project supervisors	Dr. Franco Centurion Postdoctoral Research Associate