PhD in Chemistry & Neurosciences

INSULIGHT: Development and Functional Validation of a Novel Fluorescent Nano-biosensor for Imaging Insulin Distribution and Action in the Brain

This interdisciplinary PhD project, at the interface of nanosciences, photonics, diagnostics, and neurobiology, will be conducted jointly at the LCPO (Laboratoire de Chimie des Polymères Organiques) and the Neurocentre Magendie Institute in Bordeaux. The PhD objective is to develop a next-generation of insulin biosensor capable of monitoring the spatiotemporal dynamics of insulin action in the brain.

Insulin is a key regulator of glucose homeostasis and is centrally involved in major global health challenges, including diabetes, obesity, and neurodegenerative diseases. Although the mechanisms governing insulin transport from the systemic circulation into the brain are relatively well understood, how the hormone traverses the extracellular space (ECS) and extracellular matrix (ECM) to reach its cellular targets within the brain parenchyma remains poorly defined. Addressing this knowledge gap is critical, as growing evidence links metabolic and neurodegenerative disorders to alterations in brain ECM composition and ECS diffusivity. The primary objective of the project is to develop a new generation of insulin biosensors. The biosensor will be composed of a fluorescent nanoparticle functionalized with fluorescent aptamers that recognize insulin. Depending on the presence or absence of insulin, the nanoparticle and the aptamer can undergo FRET (Förster resonance energy transfer). The resulting change in fluorescence when the analyte is present constitutes the biosensor's optical readout.

Following characterization of its spectroscopic properties, the biosensor will be validated in vivo at the single-cell level to quantify insulin bioavailability in brain neurons and to assess its relationship with local changes in extracellular matrix (ECM) and extracellular space (ECS) properties. This work will build on the NeuroCentre Magendie's expertise in neuroendocrinology and brain ECM/ECS organization. The biosensor will then be applied to elucidate the molecular and cellular mechanisms regulating insulin biodistribution and signaling in murine models of metabolic and/or neurodegenerative disorders.

Ultimately, this work will establish a platform for a new generation of nanosensors capable of making reversible, quantitative, spatially resolved measurements of insulin in living systems. This will offer unprecedented insight into how insulin acts in the brain, which could lead to a better understanding of the neurobiology of metabolic and neurodegenerative disorders.

Starting date: Oct. 2026, *Deadline*: April 2026

Candidates profile: We are looking for a candidate with a strong interest for the **interface between chemistry and neurosciences**.

Application: Interested applicants should send a motivation letter, a complete CV and contact information of two references to Chloé Grazon (chloe.grazon@u-bordeaux.fr) and Carmelo Quarta (carmelo.quarta@inserm.fr).