

MASTER 2 INTERNSHIP / FINAL-YEAR ENGINEERING PROJECT

In situ Raman Spectroelectrochemistry of Furfural

Level: Master 2 or final-year engineering student	Host laboratory: Laboratoire de Réactivité de Surface (LRS) CNRS Sorbonne Université	Project: ANR PRISME
Duration: 5-6 months, depending on the academic calendar	Field: Electrocatalysis / spectroelectrochemistry	PhD continuation: CNRS-funded PhD position planned

CONTEXT AND OBJECTIVES

The ANR PRISME project aims to identify the elementary processes occurring at electrified interfaces that control electrocatalytic reaction pathways and selectivity. Furfural, a biomass-derived platform molecule, is used as a model system because its electroreduction involves competing pathways that depend strongly on the electrode material and interfacial conditions. This internship will provide the preliminary experimental work required for the doctoral project, with a primary focus on coupling electrochemistry with in situ Raman spectroscopy to probe molecular species directly at the electrode/electrolyte interface.

PROPOSED WORK

- Establish the electrochemical response of furfural on three model metals - Pt, Cu and Ni - under controlled and reproducible conditions, and define the potential domains relevant to furfural electroreduction.
- Develop and validate an in situ Raman spectroelectrochemical configuration: electrochemical cell design, optical and electrode geometry, electrode preparation and conditioning, potential control, signal stability and measurement reproducibility.
- Record potential-dependent Raman spectra and identify the spectral signatures of furfural and of interfacial or adsorbed species formed during electroreduction. These spectroscopic observables will be correlated with the electrochemical response on Pt, Cu and Ni.
- Prepare the transition toward a dynamic operando approach. After validation of steady-state and potential-step measurements, small-amplitude sinusoidal potential perturbations will be applied around selected operating potentials while monitoring specific Raman bands. The objective is to assess whether a frequency-dependent spectroscopic response can be extracted, define preliminary spectroscopic transfer functions, and compare their characteristic times with those obtained by electrochemical impedance spectroscopy. This work will establish the basis for the subsequent extension of the methodology to infrared spectroelectrochemistry.

Techniques: cyclic voltammetry, chronoamperometry, electrochemical impedance spectroscopy, in situ Raman spectroscopy, electrode preparation and conditioning, electrochemical cell development, and combined analysis of electrochemical and spectroscopic data.

CANDIDATE PROFILE

Master 2 student or final-year engineering student in physical chemistry, electrochemistry, spectroscopy, materials science or a related field. A strong background in physical chemistry is expected, together with knowledge of or a marked interest in spectroscopy and/or electrochemistry. The project has a strong experimental and instrumental component and requires rigour, autonomy, the ability to work effectively in a team, and the ability to analyse complex datasets. A good command of scientific English, both written and spoken, is required.

SUPERVISION AND PHD CONTINUATION

Supervision at LRS: Vincent Vivier, Mireille Turmine, Thomas Onfroy and Vincent Losinho. This internship corresponds to the preliminary experimental work of the PRISME doctoral project.

A CNRS-funded PhD continuation is planned, with the objective of extending the approach toward operando spectroelectrochemistry and dynamic analysis by electrochemical impedance spectroscopy, including a medium-term extension to infrared spectroscopy.

CONTACT

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