

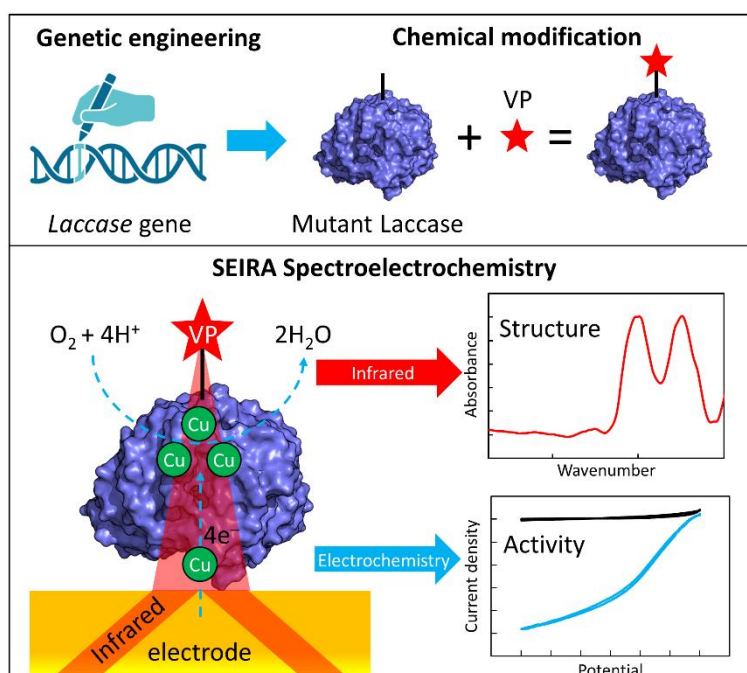
PhD position – Chemical Sciences (ED 250)

PhD subject: Vibrational Probes for Redox Enzymes Exploration.

- **Background:** Redox enzymes are extremely efficient biocatalysts with a wide range of potential applications including bioenergy, biofuel cells, biosensors, waste valuation, fine chemicals and biomedical applications. The maturation of these technologies requires the removal of two well-identified barriers: (1) the development of methods for perennial immobilisation and orientation on a conductive support and (2) a detailed understanding of their catalytic mechanism.

- **Objective:** This PhD project aims to develop an innovative methodology to characterise redox enzymes under native conditions (*in situ*) and during catalysis (*in operando*).

- **Methodology:** This new approach stands on two pillars: (1) the introduction of site-specific Vibrational Probes (VP) into a redox enzyme by genetic engineering and post-translational chemical modification and (2) SEIRA (Surface Enhanced InfraRed Absorption) spectroelectrochemistry, which allows the simultaneous monitoring of electrochemical activity and structural details of the redox enzyme (see figure). This methodology will be applied to a model redox enzyme: Laccase. This multi-copper centre oxidase couples the single-electron oxidation of small organic molecules to the four-electron reduction of oxygen to water. Appropriately positioned on the surface or inside the Laccase, the vibrational probes will allow a detailed and unprecedented characterisation of its functioning at a molecular level.



Profile: The candidate must have a solid background in electrochemistry and/or spectroscopy. Competence in biochemistry and/or chemistry will be a definite plus. A taste for research and experimentation is necessary as well as a good command of English (written and oral). The candidate must be serious, rigorous, dynamic and motivated to carry out this interdisciplinary project. The candidate should be able to work in a team and to communicate his/her results in group seminars.

Scientific Fields: Spectroelectrochemistry; Redox enzymes; Catalysis; Orientation.

Application: Send a detailed CV with a letter of motivation as well as a letter of recommendation from previous supervisors and copies of academic transcripts and degrees (M1 & M2) to alexandre.ciaccafava@cnrs.fr et thierry.tron@univ-amu.fr.

General information: This thesis will be carried out under the supervision of Alexandre CIACCAFAVA (CNRS Researcher) and Thierry TRON (CNRS Research Director) within the Biosciences team of the Institute of Molecular Sciences of Marseille (iSm²) on the Saint Jérôme campus. The thesis is scheduled to start on 1st of October 2022 for a duration of 36 months. It will be funded by the ANR VIPER (ANR-22-CE29-0012).