



PhD thesis proposal (Toyota Motor Europe / IMN) – October 2018

Title: Development of Organic Redox Mediators for Lithium-air batteries

Commercialized since 1991, lithium-ion batteries (LIBs) are becoming a flagship technology able to power from microchips to large-scale application markets such as electric vehicles. However, their storage capability, particularly volumetric, is too low for long distance vehicles, such as might be needed for an all-electric vehicle capable of achieving 500 km typically achieved by today's internal combustion engines between re-fuelling. **Li-O₂ battery**, in principle, could double the gravimetric energy density over the current Li-ion technology but serious side-reactions have plagued its development. **Redox mediators** were recently proposed as an efficient approach to modify the reaction pathway that leads to improved battery performance. Based on recent results obtained with **organic** redox mediators the aim of this PhD thesis is to:

- synthesize new redox-active organic compounds that possibly require multi-step synthesis;
- evaluate their electrochemical catalytic activity in Li-O₂ cells.

This work will be performed at IMN institute (University of Nantes-CNRS). Considering it is funded by Toyota Motor Europe, regular progress reports and phone meetings with this company will be done.

The first part of this PhD thesis will be dedicated to the **synthesis** of different organic redox mediators. The targeted materials will be ideally new and possibly patentable. They will be prepared and purified according using classical techniques known in synthetic organic chemistry and fully characterized (**liquid/solid-state NMR, IR, Thermal analysis, X-ray diffraction**, etc.)

The second part will be dedicated to the evaluation of their performance in **Li-O₂** and possibly in **Li-ion batteries**. The applicant will have to perform **electrode fabrication, battery assembly** and various **electrochemical tests** in order to evaluate the new materials as compared to benchmark organic redox mediators from the literature. Also, **in situ EPR techniques** will be developed in order to follow the formation/presence of radicals while cycling Li-O₂ cells with organic redox mediators.

Applicant profile: you have obtained a Master degree (M2 or equivalent) in Materials science, Organic/Synthetic Chemistry or equivalent. You have a good knowledge of synthesis in organic chemistry and/or electrochemistry. You have a strong interest in learning new techniques and the desire to participate in the development of new systems for the production of electricity.

Funding: Toyota Motor Europe *via* CNRS

Contact: CV + application letter + least 2 year marks to:

Philippe POIZOT
Université de Nantes
IMN, UMR CNRS 6502
2, rue de la Houssinière
44322 Nantes Cedex
Email: philippe.poizot@cnrs-imn.fr

