

Synthesis of Novel Lubricant Ionic Liquids and Their Characterization by Multidimensional Diffusion and Relaxation NMR

The NMR Research Unit of the University of Oulu (UO), Finland, in collaboration with Chemistry of Interfaces research group at Luleå University of Technology (LTU), Sweden, are looking for a PhD student within the research subjects Molecular and Materials Physics (UO) and Chemistry of Interfaces (LTU).

Project description

An interdisciplinary field of tribochemistry deals with the physico-chemical processes occurring at mechanical interfaces such as those found in various lubricated machine components: engines, gears, bearings, clutches, etc. These processes lead to formation of nanometer-thin tribofilms on the interacting metal surfaces. These films reduce wear and control friction. Fundamental understanding and knowledge of these interfacial processes is crucial for the design of high-performance machine components and lubricating fluids. Modern lubricants are designed for ferrous materials such as steel. A trend towards light-weight machinery calls for novel lubricating fluids capable to operate with non-ferrous materials. The most promising compounds for these applications are ionic liquids, which are low-temperature molten salts. Ionic liquids are composed entirely of ions. A number of combinations of cations and anions allows for a design of ionic liquid compounds for any task-specific application.

The goal of the current project is to design, synthesise and characterise novel halogen-free "green" ionic liquids and optimize their tribological performance for ferrous-nonferrous materials, diamond-like and graphenic coatings (in collaboration with other researchers and PhD students in the participating groups). A substantial body of work in the synthesis, wet chemistry and purification will be performed for obtaining task-specific ionic liquids at LTU. Spectroscopic characterisation of novel ionic liquids and tribofilms using a variety of NMR techniques, including *multidimensional diffusion and relaxation NMR*, and MR *microimaging*, as well as FT-IR, Raman, XRD and SEM/EDS. The characterization will be performed in the laboratories at UO and LTU, while the tribotests will be carried out at the tribolaboratories of our collaborators at KTH in Stockholm.

The student is expected to take part in teaching activities at the two institutions. The student will be awarded with both a Swedish and a Finnish doctoral degree.

Qualifications

The PhD student positions belong to I4Future doctoral programme, funded by the European Commission Marie Skłodowska-Curie COFUND action. Applicants must fulfil the eligibility criteria described in the programme call text (see <http://www.oulu.fi/i4future/node/34377>).

The candidate should have a MSc degree in (Organic or Inorganic) Chemistry, Physics or Materials Science. Previous experience with NMR spectroscopy, organic synthesis or ionic liquids is an advantage. The candidate should be able to productively communicate in English (both written and spoken).

Information

Academy Researcher Ville-Veikko Telkki (Ville-Veikko.Telkki@oulu.fi) and Professor Juha Vaara (juha.vaara@iki.fi), NMR Research Unit, University of Oulu, Finland
Professor Oleg N. Antzutkin (olan@ltu.se) and Dr Faiz Ullah Shah (faisha@ltu.se), Chemistry of Interfaces, Luleå University of Technology, Sweden

Application

Expressions of interest should be directed (in English) to: Academy Researcher Ville-Veikko Telkki (Ville-Veikko.Telkki@oulu.fi) and Professor Juha Vaara (juha.vaara@iki.fi), NMR Research Unit, University of Oulu, Finland, as soon as possible.

Deadline

Due date for the final application is July 31, 2016, interviewing process will be carried out during August 2016, and the project is planned to start in September 2016.