Post-doctoral Position:

**Electrochemical contribution in the understanding of MoDTC degradation under tribological stresses**

The decrease of sliding coefficient is a key target to contribute to the potential energy saving and exhaust emission limitation. This aspect is more and more taken into account by scientific community especially by tribologists.

One of current solutions used to internal combustion engine consists in to lubricate contact working under sever hydrodynamic conditions. As graphite, MoS₂ is widely used as a solid lubricant because of its low friction properties and chemical stability. Disulfide Molybdenum can be obtained from molybdenum dithiocarbamate. However, it has been observed that the robustness and sustainability of the lubricating performances decrease with time. Previous studies have demonstrated an aging effect of the lubricant in service due to temperature, pressure, oxidation… Consequently, the understanding of this evolution is required to improve the efficiency of the MoDTC in dynamic systems.

MoST project funded by Engineering@Lyon institute and headed by LTDS Laboratory aims to understand the MoDTC decomposition under several coupled or uncoupled parameters. Included in this project, an original approach consists in electrochemical methodology to identify physicochemical pathway of decomposition of the molecule.

This study will be held under guidance of a corrosion group of MATEIS lab, involving in the MoST project. Research activities of this group concern surfaces and interfaces reactivity of multifunctional systems.

**Outline of the Post-Doc project :**

Experimental works and ab initio simulating performed at LTDS have highlighted that MODTC decomposition follows several steps, especially a Mo reduction step involving in the molecule. This step has been identified as the understanding key.

The proposed project aims to identify the MODTC electroactivity in non aqueous media without tribological loading. To this goal, a labmade electrochemical cell will be developed in terms of geometry, electrodes configuration, electrolyte… From this three electrodes device the electrochemical methodology will be proposed to identify and to quantify electrochemical reactions resulting from MoDTC evolutions. The challenge but also the originality of this research is to perform experiments in non aqueous solutions as mentioned before but considering also the low conductivity of electrolyte. Theses constraints are due to the MODTC solubility.

Electrochemical study is mainly based on voltametrics measurements. Performed under different potential scan rates, they could characterize potentials and kinetic of oxido-reduction reactions. Chronopotentiostatic measurements will be carried out and associated to fine surface analysis (IR, Raman). XPS will be performed in collaboration with LTDS to know the chemical nature of MODTC transformations. The combination of techniques has to inform about the relationship between electrochemical reactions, the lubricant or the media/electrode interface modifications. Equivalent methodology could be considered under tribological loading. Effectively, previous methodology finds its originality in the media choosen to perform electrochemical measurement, this second steps is a real breakthrough in the tribological point of you since it will combine superficial mechanical aspect of damage with electrochemical interfacial reactions. This approach is called tribocorrosion. Triboborrosion
measurement will be performed for applied potentials. Transients of current densities will be analysed and related to previous measurements and analyses to achieve knowledge of molecules transformations under contact.

Skills required:
Candidate should be familiar with electrochemical measurements and analysis. An experience in electrochemical measurement in non-conductive media will be appreciated. The profile could be extended at all candidate who could attest of electrochemical skills in organic media. This knowledge should be completed by experience in physicochemical analysis of material. Tribological skills will be developed during the project.

Financement : I@L
Salaire :
Durée : 10 monthes
Lieu de travail : MATEIS, INSA de Lyon
Spécialité : Electrochemistry - Chemistry – Chemical Engineering – Material Engineering
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Laboratoire :

MATEIS is a laboratory which develops research in Material Science and Engineering. The lab exhibits a pluridisciplinary culture which allows to combine physics, chemistry, and mechanics to develop and optimize innovative materials. All material families are studied in MATEIS Lab (metal, ceramics and polymers) and of course the mix of them constituting composites. The characterizations of the volume and surface materials properties are the specificities of MATEIS Lab to establish relationship between microstructure and performances. In this laboratory, the CorrIS group dedicates it research on corrosion science and surface engineering. Surface reactivity and multifunctional surface properties are the heart of scientific activity of the group. Methodology are developed to propose material solutions in terms of surface treatments, coatings, conversion layers, inhibitors... This project will take place in this group.