

## Open PhD position

The National Polytechnic Institute of Toulouse offers a full employment at the earliest opportunity for a PhD fixed position for three years in the topic:

### CVD processed silicon oxynitrides and oxycarbides coatings for aqueous corrosion barriers

Context:

Numerous industrial sectors require the implementation of innovative barrier coatings. Examples are pharmacy to store aggressive liquid drugs into resistant vials or aerospace and automotive industries to protect either polymer-based pieces against corrosive, e.g. hydraulic liquids, or against water ( housings of sensors), or light metallic alloys operating at moderate temperature against oxidation and/or corrosion.

Chemical Vapor Deposition (CVD) is an efficient process to coat complex-in-shape substrates by uniform thin films which can act as corrosion barrier. CIRIMAT and LGC are working on CVD processes since more than twenty years. Numerous experimental and process simulation studies have been performed by these two groups on silica, SiO<sub>2</sub> CVD. They reveal that these films demonstrate efficient barrier properties nevertheless, under certain conditions, they release silicon in corrosive liquid solutions and they can even delaminate.

The PhD thesis project aims to analyze and develop a thermal CVD process able to deposit two families of promising and innovative SiO<sub>2</sub>-based films i.e. oxynitrides SiO<sub>x</sub>N<sub>y</sub> and oxycarbides SiO<sub>x</sub>C<sub>y</sub>, using TEOS Si(OCH<sub>2</sub>CH<sub>3</sub>)<sub>4</sub> and ozone O<sub>3</sub> as main precursors. The work will be conducted by combining experimental investigations and numerical simulation of the CVD process, in order to efficiently optimize the deposition conditions so as to obtain the required film properties. Correlations will be established among process conditions, films structure, morphology and composition, revealed by SEM, TEM, Infra-Red spectroscopy, SIMS, RBS, SSNMR, XPS... and films functional properties in terms of mechanical durability, optical transparency, corrosion resistance etc.

The PhD work will be conducted in the frame of a national collaborative project including four laboratories and one industrial company. The five partners will work in a complementary mode, including films properties determination.

Candidates should demonstrate high degree of motivation and willingness for teamwork, good communication skills in English (both written and spoken) as well as a structured and targeted way of work including preparation of reports and presentations in regular meetings. Selection will occur according to suitability, qualification and professional performance applied to the following criteria :

- Engineer or Master in Materials Science or Process Engineering applied to materials
- Serious and autonomous student, with a high capacity to team work
- Ability to work in parallel to experimental (deposition and characterization of thin films) and numerical process simulation tasks
- Excellent ability to write scientific reports
- Good communication skills in English
- Good knowledge of CFD codes (Comsol) and of classical materials characterization techniques

**Advisors:** Pr. Brigitte CAUSSAT, Chemical Engineering Laboratory (LGC, [www.lgc.cnrs.fr](http://www.lgc.cnrs.fr))  
Dr. Constantin VAHLAS, Interuniversity Materials Research and Engineering Center  
(CIRIMAT, [www.cirimat.cnrs.fr](http://www.cirimat.cnrs.fr))

**Duration :** 36 months (01/03/2018 – 28/02/2021)

**Location :** LGC and CIRIMAT / ENSIACET - Toulouse - France

**Contact :** Send CV + cover letter to [brigitte.caussat@ensiacet.fr](mailto:brigitte.caussat@ensiacet.fr) or [constantin.vahlas@ensiacet.fr](mailto:constantin.vahlas@ensiacet.fr)