

Success Stories

Innovative surfaces

Development of innovative surfaces by means of optimised plasma techniques and technology transfer to industries

A research project entitled "Development of innovative surfaces by means of optimised plasma techniques and technology transfer to industries" is currently being carried out within the scope of the FNR TRASU programme. The aim of this project is to initiate innovative surface treatment activities in Luxembourg to support the industries. It is within this context that the researchers involved in the project applied to the TRASU programme call of the FNR. Three public research institutes are involved in this project: the CRP Gabriel Lippmann (Département Science et Analyse des Matériaux (SAM), Dr. Migeon), the CRP Henri Tudor (Laboratoire de Technologies Industrielles et Matériaux (LTI), Dr. Ruch) and the University of Luxembourg (Dr. Sanctuary).

The project aims at creating competences in Plasma Surface Treatment in Luxembourg covering the whole chain of innovative and concurrent research and engineering. This chain starts at the level of fundamental research on plasma science and ends at the creation of a semi work (pre-industrial) pilot prototype for surface treatment.

At the CRP Henri Tudor, the work undertaken deals with the development of anticorrosion coatings. Nonetheless, the TRASU opportunity is firstly used to create fundamental knowledge and know-how concerning atmospheric plasma treatment. The LTI's objectives are, in fact, fourfold. First, creating sufficient scientific and technological knowledge and competences. Second, applying acquired knowledge to solve an important economic and environmental issue. Third, creating a scientific and experimental site with a flexible prototype for investigating and experiencing on further industrial surface treatment problems. And, forth, extending the field of competence to a wider spectrum of applications with respect to the bulk and surface materials.

At the CRP Gabriel Lippmann, the fundamental part of the TRASU project is carried out with the participation of several University laboratories in Luxembourg, France and Belgium, and the collaboration with the Fraunhofer Institute of Braunschweig in Germany, one of the most experienced team in Europe in atmospheric plasma. The fundamental studies are made possible via PhD theses with the innovative techniques available at SAM in the field of plasma characterisation, plasma assisted deposition and surface analysis. The fundamental results support the studies on different innovative industrial plasma applications such as surface cleaning, adhesion promotion, corrosion protection and wear resistance with the participation of several companies present in Luxembourg. The two main strengths of the TRASU project at SAM are the comparison of different plasma technologies for the same application, especially in the atmospheric plasma field, and the association of different scientific fields as plasma characterisation, surface treatments, surface analysis, corrosion, adhesion and wear resistance which allows a complete understanding of the processes involved in the surface treatments. These two main strengths are possible because of the collaboration of several academic and industrial partners, because of the numerous high-performance techniques (Optical Emission Spectroscopy for plasma characterisation, plasmas at low- and atmospheric-pressure for surface treatments, SIMS, XPS, TEM and AFM for surface characterisation, electrochemical techniques for corrosion studies), and because of the complementarities and experience of the scientific staff involved in this work.

What results have been obtained thus far? It has been found that some silicon oxide-based plasma polymerised layers provide a significant passive corrosion protection. Significant improvement of the protection has been achieved by means of an increase of oxygen concentration in the gas mixture and the control of the chemical composition of the film. Moreover, deposition of conducting polymers has been achieved by means of atmospheric plasma treatments. The goal of this deposition development is providing active corrosion protection, nevertheless other applications such as antistatic layers can be targeted.



Part of the surface treatment platform

David Duday (CRP Gabriel Lippmann) further explains: "We already improved the resistance to corrosion and wear of different materials. The cleaning of surfaces by atmospheric plasma is working for some organic contaminants. These good results are obtained with low cost and environmentally friendly methods." The industrial challenge is currently to improve the layer properties while increasing the deposition rate to achieve industrial requirements for industrialisation.

On the one hand, scientific articles and oral presentations at conferences have been done in order to disseminate findings within the scientific community. Other than this, the project has also been of interest to an important number of industrial partners associated to the project.

"Many industrial developments are expected", explains David Ruch, "and industrial partners show high interest in utilising the pre-industrial prototype for future R&D projects". Many innovative plasma based developments are possible and the scope of potential applications is wide. David Duday explains: "Several new Luxembourgish industrial partners are ready to start surface treatments studies with us only two years after the beginning of the TRASU project". The TRASU project has "triggered a lot of new ideas to investigate for very exciting applications" David Ruch concludes.

for the FNR,
Morgan Meyer