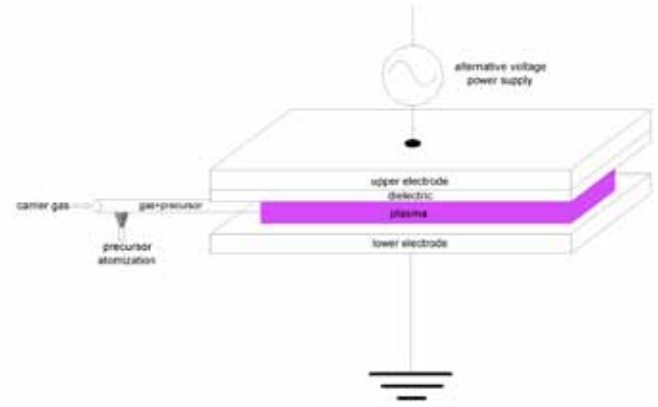



# RESEARCH HIGHLIGHT

## A FOLLOW-UP OF TRASU

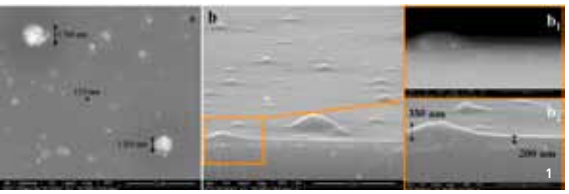
### DEVELOPMENT OF INNOVATIVE SURFACES BY MEANS OF OPTIMIZED PLASMA TECHNIQUES AND TECHNOLOGY TRANSFER TO INDUSTRIES

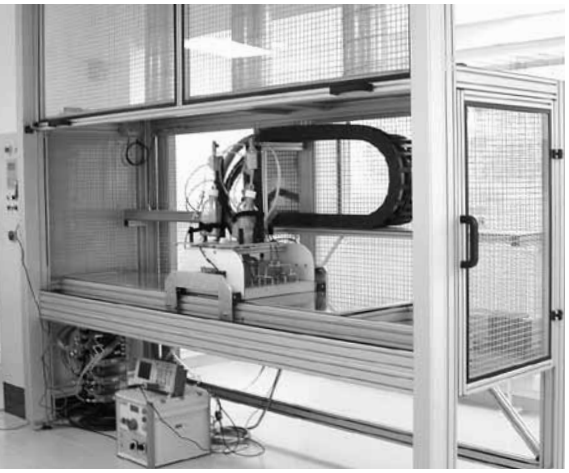
About seven years ago, a panel of industrials and scientists discussed the possible benefits of a technology little known in the Grand Duchy back then. Out of this meeting arose a new FNR project, Development of Innovative Surfaces by Means of Optimized Plasma Techniques and Technology Transfer to Industries – TRASU, which ran from May 2005 to October 2009. Plasma is the so-called fourth state of matter in physics: "A gas with electrically charged particles, which enables us, among others, to activate chemical reactions on a surface", explains Julien Bardon, the project coordinator from the CRP Henri Tudor. "The applications of plasma technology are manifold. During the TRASU project, we have worked mainly on corrosion protection, surface enhancement for adhesion and methods for surface cleaning, as well as thin film deposition", adds Dr Patrick Choquet, his counterpart from the CRP Gabriel Lippmann. Both agree that there remain many more avenues to be explored.

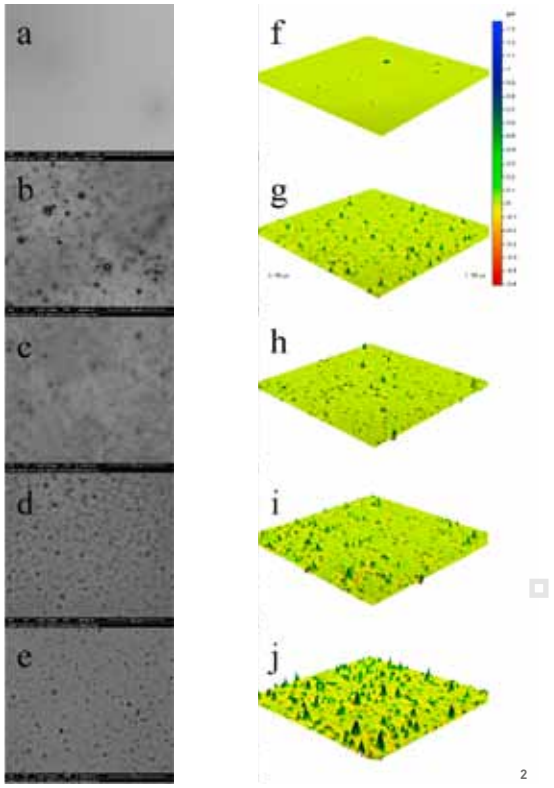
One particular idea the two CRPs would like to pursue in a future common research project stems from the already investigated anti-corrosion surface treatments and involves fire protection of polymer parts. "Polymers, for instance cable coating, have a natural tendency to burn in contact with fire. Until now, this burning hazard has been counteracted by adding fire-suppressing particles such as bromine or chlorine into the polymer", explains Bardon. However, this treatment alters other properties of the material as well. "By using plasma technology to change only the surface of the polymer parts, we hope to retain its original properties while rendering the material fire-proof at the same time."

Other follow-up projects of TRASU are already ongoing, funded both by the FNR and by industry partners. Now that the potential of the plasma surface treatment has been aptly demonstrated, several of the original industry partners of the project have re-initiated more research in collaboration with the CRP Gabriel Lippmann. "Besides the work with our former partners, we have also set up projects with six new companies, based in Luxembourg and the Greater Region", says Choquet. The exact details being under the seal of confidentiality, he can only reveal a little: "The new partners are part of the aeronautical and automobile sectors, aerospace engineering and the steel industry. Some of the follow-up projects are directly in line with the techniques developed within TRASU, but some will also explore novel avenues." Another important aspect of the follow-up projects is the transfer of the technologies from the laboratory to industry.

Meanwhile, the team members from the CRP Henri Tudor have not been sitting by idly; several new research projects involving plasma technology have been launched, two PhD theses among them. "The doctoral works are a great way to investigate new directions of research. Both of our current projects are very innovative and very promising", says Bardon. The first one aims to incorporate arrays of shield-formed nanoparticles into a coating to create barrier layers. The biggest issue here is the ideal distribution pattern that must be achieved: the plates need to sit tight enough to prevent oxygen or other gas molecules from travelling through the layer. This work is included into a wider FNR project (FlexProtect) dealing with gas barrier layers. The second thesis deals with molecularly imprinted polymers; the goal is to create layers with a kind of key-and-lock system. After the initial layer is created, the key molecules are removed. As soon as the layer is brought back into contact with key molecules, a natural recombination will ensue. This technology could potentially serve as a detection method for biological molecules, such as insulin.








In fact, there is a host of possible applications for layers that can react to external stimuli. Following a recent call for proposals by the FNR, the CRP Gabriel Lippmann has introduced a project aiming to produce intelligent organic layers that change their colour upon detection of specific gases. Integrated into food packaging, these materials could indicate the freshness (or lack thereof) of the food. Similar materials, worked into clothing, could act as permanently active detectors of deadly gases, such as carbon monoxide, and offer a clever alternative to the current devices, which tend to be rather bulky and limited to punctual measurements. But it does not need to stop there: the researchers of both CRPs seem to be teeming with ideas to put the plasma technology to practice.

The TRASU project was clearly a great opportunity put to best use. "Starting out with next to no experience in plasma technology, the project has enabled us to become an internationally recognized and stable actor in the field within a couple of years", says Bardon. Within the material research and development team of the CRP Henri Tudor, two researchers were hired specifically for the project and have remained under contract at its closure. Within the CRP Lippmann, TRASU has even led to the creation of an entirely new research unit within SAM (Département Science et Analyse des Matériaux). The contacts with renowned scientific partners such as the Fraunhofer Institute for Surface Engineering and Thin Films in Braunschweig, the Flemish Institute for Technological Research (VITO) or the Jean Lamour Institute in Nancy that allowed such a quick rise in competency have not been abandoned either: many of the new PhD students join the CRPs from the partner organisations. With the Jean Lamour Institute, there are even plans to form an associated European laboratory with the CRP Gabriel Lippmann, where the two partners will share their experience to build a globally recognized expertise in the scientific field of plasma-surface interactions. "With the hope to extend this venture to the Greater Region one day…", adds Choquet.

**1.+2.** From "Self-Healing Properties of new Surface Treatment" (EFC-Wiley 58), Ed. L. Fredrizzi (in press)