Functionalization of Teflon Surfaces

H. Gao, D. Caminada

The OptoDex® platform is a surface engineering technology developed by CSEM that integrates technologies from material science, surface chemistry, and biochemistry, and includes novel materials, controllable and well characterized surface chemistries for biomolecule attachment and surface passivation. The proprietary linker polymer technology brings unique properties to bioanalytics and generates valuable new material surfaces.

In a feasibility study we have shown that Teflon substrates can be functionalized using the OptoDex surface functionalization technology. Polytetrafluoroethylene (Teflon) has inherently low surface energy and poor polarizability due to its chemical structure. This means the surface cannot provide enough energy to bond with adherents such as adhesives and inks. Gas plasma surface treatment solves this problem by increasing the surface energy of polytetrafluoroethylene. This is achieved with the addition or substitution of polar chemical groups onto the surface.

The OptoDex® technology relies on the unique properties of photolinker polymers which immobilize probe molecules on material surfaces. Light activation of photolinker polymers leads to the generation of highly reactive intermediates, in particular photogenerated carbenes, which form covalent bonds with probe molecules on nearly any type of material.

In this study, the functionalization of Teflon surfaces was attained by combining a plasma treatment and the OptoDex® technology. Two coating processes were applied, adsorptive dip coating and dry-down coating, using fluorescence labelled OptoDex.

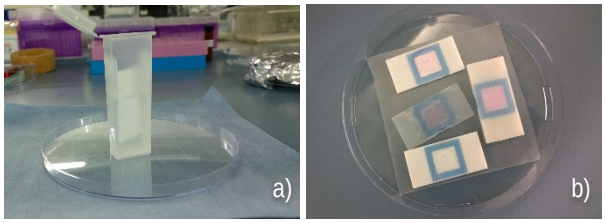

Figure 1: Coating processes. a) adsorptive dip coating, and b) dry-down coating.

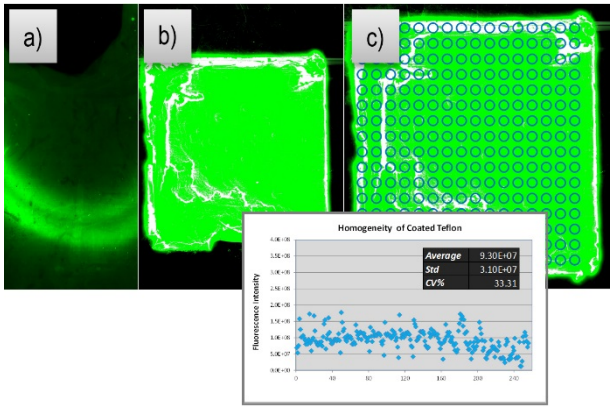

Figure 2: Image of fluorescence scanning. a) adsorptive dip coating; b) dry-down coating, and c) analysis of fluorescence image with GenePix quantification.

The fluorescence intensity was determined using GenePix Array Scanner (Excitation 535 nm and Emission 570 nm) and evaluated by localizing the grid onto the coating surface (16 col x 16 raw, ϕ= 600 µm).

The functionalized Teflon samples showed that the surface became hydrophilic after OptoDex coating. The hydrophilic properties of OptoDex coated Teflon surfaces were analyzed with water contact angle measurements using the commercially available Tropfenkonturanalyse-System DSA30 (KRÜSS). One data point per second was collected via video analysis. There was no delay from start of measurement and data collection. Data was collected for approximately 10 s. Table 1 lists the values of contact angle before and after OptoDex coating.

	Before coating	After coating
Contact angle	103 ± 2.5	64.5 ± 0.83

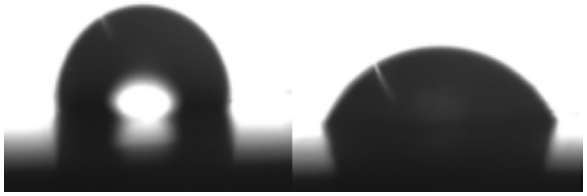

Figure 3: Image of contact angle measurement.

These tests proved that a modification of Teflon surfaces is feasible. Fluorescent images showed the homogeneity of the coating with Fluorescent-labelled OptoDex. The water adsorption properties (Figure 4) demonstrated the obtained hydrophilicity of the surface.

Figure 4: Photograph of hydrophilicity of OptoDex coated surface.

Pre-activation with plasma treatment is crucial to obtain good surface functionalization. In this feasibility study, the surface could be modified by pre-activation with air-plasma. In upcoming projects, the optimization of this pre-activation process will be explored, e.g. using oxygen plasma instead of air plasma. In order to obtain a more homogeneous coating of the surface, the coating processes will be optimized further.