ITFPC17 8TH INTERNATIONAL CONFERENCE ON INNOVATIONS IN THIN FILM PROCESSING AND CHARACTERIZATION
23-27 October 2017 NANCY, FRANCE

www.itfpc.com

SUBSURFACE EFFECTS IN PLASMA COATINGS BY MEANS OF VERTICAL CHEMICAL GRADIENTS

Dirk Hegemann

Empa, Swiss Federal Laboratories for Materials Science and Technology, St.Gallen, Switzerland

The common definition of "surface" includes surface atoms and molecules, practically extending at the most three layers – typically up to one nanometer. This definition is justified by the fact that many surface properties such as chemistry, wettability or charge density are determined by the top most surface layer. Far less explored are effects due to interactions with deeper subsurface layers, i.e. the region extending over several nanometers underneath the "surface". This subsurface region, however, might significantly contribute to migration and diffusion processes as well as molecular adsorption at the surface via long-range (i.e. few nm) interaction forces.

To make use of such subsurface effects, different plasma polymer films (PPFs) were deposited comprising a vertical chemical gradient structure. At first, the stabilization of oxygen- or nitrogen-functional PPFs was investigated [1]. A cross-linked, less functional base layer was deposited terminated by a highly functional top coating extending over a few nanometers. Thus, restructuring and migration processes can be hindered which strongly contribute to aging processes typically observed for PPFs. Functionality and stability can thus be enhanced for a-C:H:O and a-C:H:N coatings.

Second, hydrophobic-to-hydrophilic vertical gradients were generated by depositing nm-thick layers of plasma-polymerized HMDSO on a hydrophilic, nanoporous base layer of SiOx (with O_2/HMDSO in the plasma) [2]. Diffusion of water through the hydrophobic terminal layer is thus enabled yielding hydration of the PPF. The hydrated structures were found to affect protein adsorption at the surface thanks to long-range interactions promoted by water molecules. Thereby, additional control over adsorption processes relevant, e.g., for tissue engineering can be gained.

References

[1] P. Rupper, M. Vandenbossche, L. Bernard, D. Hegemann, M. Heuberger, Langmuir 33, 2017, 2340-2352.

[2] D. Hegemann, N.E. Blanchard, M. Heuberger, Plasma Process. Polym. 13, 2016, 494-498.

SHORT BIO

Dirk Hegemann is working for Empa, St.Gallen, Switzerland as the head of the Plasma & Coating group. His work involves plasma polymer deposition, etching and sputtering processes as well as their transfer to industry. He received his PhD in materials science from the Technical University in Darmstadt, Germany, in 1999.