IAP Seminar

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Tuesday, 26th March 2019, 16:00 s.t.
TU Wien, Institut für Angewandte Physik, E134
1040 Wien, Wiedner Hauptstraße 8-10
Yellow Tower „B“, 5th floor, SEM.R. DB gelb 05 B

Interface analysis of plasma deposited functional layers

The deposition of thin films by plasma techniques is widely spread for applications within the fields of microelectronics, energy, medicine and packaging, among others. In spite of its ubiquity, the process is still poorly understood at a molecular level, so that the development of coatings with specific functionalities is still mostly based in trial and error approaches. The nucleation and development of internal structure within a plasma-deposited film is a complex process in which the plasma produced species intermix with the surface species in an often synergistic interplay between deposition, surface etching, and surface modification by additional energy-bringing species such as metastables, UV radiation, electron and ions. The overall goal within the collaborative Research Center “Pulsed High Power Plasmas for the Synthesis of Nanostructural Functional Layers” (TRR 87) is to explore and quantify the relationships between materials properties and plasma parameters.
Two families of coatings as deposited by pulsed high-power plasmas are of interest within the TRR 87: on the one hand, ternary or quaternary ceramic layer systems with outstanding tribological properties (e.g. TiAlN, TiAl(O)N) deposited on metal substrates [1-3]; on the other hand, silicon- or carbon-based layers (e.g. SiOx, SiOCH) with tailored barrier properties deposited on plastic substrates [4, 5]. As part of the cooperative research approach, our group is focused on the identification of the relevant aspects of interface chemistry that determine the initial stages of film growth and the resulting functional properties of the coating. Spectroscopic, microscopic and electrochemical methods are combined for the comprehensive understanding of structure-property relationships.
The presentation illustrates how fundamental studies at materials interfaces can promote the design of thin functional films as deposited by complex gas phase processes. E.g. combination of in-vacuo XPS and AFM analysis allowed for the correlation of surface passive film formation and adhesive properties of hard coatings as a function of their composition, while in-situ FTIR spectroscopy of water adsorption could be correlated to the state of crosslinking in thin SiOx-films. Electrochemical methods can provide information on the structure of passive films on electron conducting hard coatings as well as on the nanoporosity in ultra-thin dielectric barrier films.

Selected references

[1] C. Kunze et al. Applied Surface Science (2014), 290, 504-508. [2] M. Wiesing et al. in Physical Chemistry Chemical Physics (2018), 20, 180-190. [3] M. Wiesing et al. in Electrochimica Acta (2016), 208, 120–128 [4] B. Oezkaya in Plasma Processes and Polymers 2015, 12, 392-397 [5] C. Hoppe et al. in Journal of Physics D: Applied Physics (2017), 50, 204002

All interested colleagues are welcome to this seminar lecture (45 min. presentation followed by discussion).

Friedrich Aumayr
(LVA-Leiter)

Markus Valtiner
(Seminar Chair)