“Molecular Understanding and Interface Engineering“

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Surfaces of engineering materials such as Fe, Zn, Al, Ti or Mg-alloys are often in contact with aqueous electrolytes or polymers. Consequently, such engineering alloys form surface films in contact with the environment based on oxidation and hydroxylation reactions and thereby exhibit a composition and morphology, which is strongly different from the bulk composition of the alloy. However, an even more complex situation is characterized by a simultaneous interaction of macromolecules and aqueous electrolytes with such inorganic solid interfaces. Examples are organically coated or adhesively bonded metals in corrosive environments, metallic biomaterials in contact with body fluid, metal coatings on polymer substrates or inorganic coatings on tool steels used for processing of polymers.

The understanding and engineering of such interface dominated materials and composites profit from the analysis and understanding of the interfacial chemical and electrochemical properties and the interfacial molecular forces. Therefore, in-situ analytical studies are of increasing interest for the characterization of the molecular mechanisms of adsorption, adhesion and de-adhesion under ambient conditions. Studies by means of in-situ techniques, such as FTIR-spectroscopy, Chemical Force Microscopy, Single-Molecule-Force Spectroscopy will be highlighted in the presentation as examples, together with complementary investigations by means of the Scanning Kelvin Probe as an electrochemical method with the capability of providing information on interfacial stability. Based on a molecular understanding of the interface we aim at the development of surface technologies which allow for a correlation between the macroscopic performance and the interface structure.

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