

Functionalization of Carbon Coatings: Decoupling Bulk and Surface for Multifunctional Interfaces

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Surface engineering is a key technology for high-tech applications, enabling a targeted decoupling of bulk and surface properties and thereby creating multifunctional interfaces for demanding applications. Particularly promising opportunities arise when surface topography and material properties are considered in combination. Carbon plays a central role in this context, offering a broad spectrum of electrical, optical, and tribological properties. This talk summarizes methods and results on the structuring and modification of nanometer- to micrometer-thick carbon-based coatings, including scanning probe-based writing techniques, pulsed UV laser processing, and Direct Laser Interference Patterning (DLIP). Finite element simulations of transient temperature fields are used to elucidate mechanisms of pattern formation and localized phase transformations such as graphitization. Periodic nano- and microtextures (DLIP patterns, hierarchical roughness) are shown to influence friction and electrical conductivity, enabling applications ranging from surface-based information storage to tailored lubricant and wear-debris reservoirs in tribological systems. Finally, an outlook is given on the application of laser-based surface functionalization and the role of roughness in the context of electrochemical and electrically conductive surfaces.