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Wetting properties of model interphases coated with defined organic functional groups

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Surface properties of soil particles are of particular interest regarding transport of water and sorption of solutes, especially hazardous xenobiotic species. Wetting properties (e.g. determined by contact angle, CA), governed by the functional groups exposed, are crucial to understand sorption processes in water repellent soils as well as for the geometry of water films sustaining microbial processes on the pore scale. Natural soil particle surfaces are characterized by a wide variety of mineralogical and chemical compounds. Their composition is almost impossible to identify in full. Hence, in order to get a better understanding about surface properties, an option is the usage of defined model surfaces, whereas the created surface should be comparable to natural soil interphases. We exposed smooth glass surfaces to different silane compounds, resulting in a coating covalently bound to the surface and exhibiting defined organic functional groups towards the pore space. The wetting properties as evaluated by CA and the surface free energy (SFE), calculated according to the Acid-Base Theory, were found to be a function of the specific functional group. Specifically, the treated surfaces showed a large variation of CA and SFE as function of chain length and polarity of the organic functional group. The study of wetting properties was accompanied by XPS analysis for selective detection of chemical compounds of the interphase. As the reaction mechanism of the coating process is known, the resulting interphase structure can be modeled based on energetic considerations. A next step is to use same coatings for the defined modification of the pore surfaces of porous media to study transport and sorption processes in complex three phase systems.