Superhydrophobic, Hydrophilic and Liquid-Infused Micropatterns for Biological Applications

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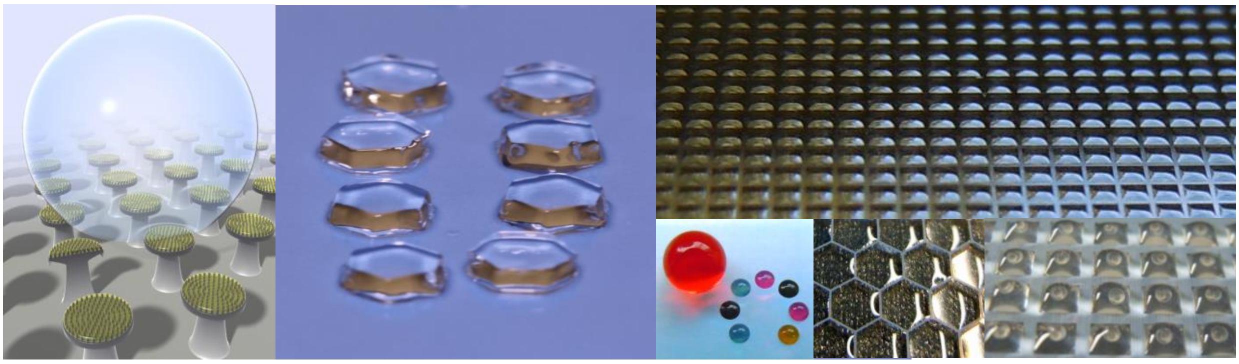
Patterns of different surface properties are ubiquitous in nature and serve various important purposes. Desert beetles exploit hydrophilic spots on their superhydrophobic back to collect water from the morning mist in the desert. Hydrophilic spots on a superhydrophobic surface of lichen plants allow them to uptake water, but also prevent the formation of undesired water layer on the plant surface. Bioinspired superhydrophobic, omniphobic and superoleophobic or their counterparts such as superhydrophilic, oleophilic and omniphilic surfaces possess unique properties including self-cleaning, extreme liquid repellency or cell repellency. An interesting question is what happens if we combine completely opposite often incompatible or different functionalities, for example superhydrophilic and superhydrophobic, liquid- and air-infused, in the same surface in precise micropatterns. In this presentation, I will talk about methods to produce interfaces and micropatterns with combinations of special wettabilities. Such seemingly incompatible combinations of properties lead to new functionalities non-existent in the original homogeneous interfaces. For example, superhydrophobic-superhydrophilic patterned surfaces can be used to create patterns of cells, arrays of microdroplets suitable for ultra high-throughput cell screenings, formation of arrays of hydrogel micropads or free-standing hydrogel particles with defined shapes for 3D cell culture. Patterned liquid-infused surfaces can lead to cell microarrays and arrays of isolated biofilm colonies for biofilm screenings. Combining the doubly re-entrant microtopography, required for superoleophobicity, with slippery liquid-infused porous surfaces (SLIPS) was used to design novel slippery superoleophobic surface.

Thus, micropatterns of superhydrophobic, omniphobic or other surface properties can lead to novel advanced functional interfaces and can find important applications in biotechnology, microfabrication, cell biology, sensing and diagnostics.



Priv.-Doz. Dr. Pavel Levkin is head of the Biofunctional Materials Systems research group at Karlsruhe Institute of Technology (KIT), Germany. He graduated from the Institute of Fine Chemical Technology, Moscow and obtained his Ph.D. in Organic Chemistry from the University of Tübingen in Germany, followed by a postdoctoral work at the University of California, Berkeley. Pavel Levkin is a recipient of the Heinz Maier-Leibnitz Prize, Ewald-Wicke Prize, an ERC Starting Grant, and a cofounder of ScreenFect GmbH and Aquarray GmbH. His research focuses on the development of functional and responsive materials, and surfaces for biomedical and biotechnological applications.