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Smart surfaces with wetting-programmed topography

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Living organisms have structured surfaces with specific wettability that allows their efficient adaptation to the environment and improves their survival rate. For example, the rice leaves have micro- and nanoscale structures on their surface that form a superhydrophobic surface for self-cleaning and water repellence [1]. Bioinspiration of these natural surfaces in science can be beneficial for applications in biotechnology, microfluidics, textiles, fabrication of sensors, etc [2]. Addressing these challenging goals requires the development of both materials with tailored properties and methods for the fabrication of structured surfaces. In comparison to previously reported surface patterning techniques, melt-electrowriting is a novel and solvent-free technique that is based on 3D printing and electrospinning which allows programmed deposition of polymeric microfibers [3]. Shape memory polymers offer a very interesting combination of properties such as switching of mechanical properties and capability of stimuli-induced restoration of shape after deformation [4, 5].

This paper reports on fabrication and investigation of wetting properties of structures surfaces with high aspect ratio features (height / width ratio up to 75:1) made using polymers with tunable mechanical properties and shape-memory behavior. It was found that wetting properties of such structured surfaces depend on temperature –surfaces are wetted easier at elevated temperature when polymer is soft because of deformability of lamellae. The deformed morphology can be temporary fixed at low temperature, and it restores to original one by heating above actuation temperature of shape memory polymer. Thus, the high aspect ratio allows tuning of geometry not only manually, as it is done in most works reported previously, but can also be done by placed liquid and is controlled by temperature - a liquid in combination with temperature program topography and wetting properties. This opens new opportunities for design of smart elements of microfluidic devices such as, for example, smart valves.
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Sitzung Einordnung: Short talks