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Wettability study of smart surfaces with tunable geometry

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Various 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 (MEW) 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 the capability of stimuli-induced restoration of shape after deformation [4, 5].

In this work, we report the fabrication of surfaces with tunable geometry and mechanical properties with high aspect ratio surface features (50:1) and the investigation of their wetting properties. For the fabrication of the topographical surface, we melt-electrowrite lamellas structure with a thermoplastic polyurethane with shape memory behavior (Polybutylene adipate based TPU). Our smart surfaces were programmed by the use of extra small forces driven by the surface tension of water. The actuation and switching of surface topography occurs in few minutes (below 5 min). This investigation can open the door for further research in the application of micro/millifluidic devices, creating smart locks to allow the passage of fluids by changing the temperature of the set.

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