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Photoswitchable porous substrates for on demand wetting patterns creation

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Fabrication of smart surfaces with photoswitchable wetting properties is of great interest for applications such as coatings with various wetting patterns[1], sensors[2] or photo-controlled liquid imbibition[3]. Spiropyran stands out among the photoswitchable molecules due to the significant dipole moment change from 4.7 D (SP) to 17.7 D (merocyanine (MC)) featuring a remarkable color change upon UV exposure. However, SP-functionalized surfaces have some drawbacks: any damage or defect to the surface top layer would affect their homogeneous photoswitchable properties, and most fabrication methods such as graft to and graft from are not fully efficient and straightforward.

In this work, synthesized SP monomer was incorporated into the polymeric bulk material, so that the fabricated bulk photoswitchable substrates is still functional after abrasion. A micro/nano-scale roughness was introduced to the surface to amplify the static contact angle (SCA) change by introducing the porosity to the material structure. Polymers with different roughness, i.e. pore size were achieved by varying the porogen content and ratio, and SCA was measured on all the samples before and after UV exposure. In addition, the crosslinker content was found to have an important role to affect the porous structure (roughness) as it implies shrinkage in the pores. According to our results, not only the SP content, but also the pore size, i.e. roughness value is a crucial parameter to tune the photoswitchable wetting properties of the surface. Samples with larger pores, and hence, less SP in contact with the droplet showed insignificant SCA change, while samples with smaller pores could provide SCA changes up to 16.7l°. Photo-switched patterns were created on fabricated thin films using a photomask, and on-demand wetting patterns were exhibited. To prove the photoswitchable properties also in the bulk material, thicker samples were cut in half and the SCA change was shown on the cross-section upon UV exposure as well.

References

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Primary authors: NEKOONAM, Niloofar; Dr HELMER, Dorothea (Freiburg University, Department of Microsystems Engineering (IMTEK))

Presenter: NEKOONAM, Niloofar

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