Holographic vectorial morphing of azomaterial surfaces

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The light-induced structuring of amorphous azobenzene-containing material films (azomaterials) offers a novel method for fabricating structured surfaces at micro- and nanoscale. Key features of this approach arise from the direct, non-destructive, and reprogrammable morphing of the film surface, which is initiated by the light-induced material transport following the cyclic trans-cis isomerization of azobenzene molecules [1]. The azomaterial transport is highly directional, with the polarization state of the illuminating light and its intensity pattern playing cooperative roles in defining the final surface geometry. Holography, with its ability to engineer the light field in multiple degrees of freedom, is a powerful optical tool to exploit the azomaterial photo-response.
Holographic morphing of azomaterial surfaces has can be achieved by Computer Generated Holography (CGH), implemented using a liquid crystal Spatial Light Modulator (SLM) [2]. With this technique, all-optical reprogrammable surface reliefs can be achieved by sequentially inscribing and erasing the surface patterns with spatio-temporally evolving intensity holograms [3,4]. However, an SLM operated as a computer-controlled polarization rotator can also allow the time-dependent evolution of polarization patterns to directionally drive the azomaterial surface deformations [5].
In this work, we use computer computer-generated holography and spatially-resolved computer-controlled polarization patterns to produce high-aspect-ratio surface reliefs and microscale polarization-driven anisotropic structures capable to capturing the vectorial nature of the irradiated holographic field. Reprogrammable diffractive optical elements, including gratings, optical Fourier surfaces, lenses, and holographic projectors are realized with this method. Our results open to a new photo-lithographic approach, where the degrees of freedom of the fully structured light directly control the shape of functional surfaces.

Acknowledgements: This work is supported by ERC grant (HyperMaSH, 101164874), funded by the European Union.

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