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**Development of Biomimetic and Functionally Responsive Surfaces**[1]

SPIROS H. ANASTASIADIS[2], Foundation for Research and Technology - Hellas and University of Crete

Controlling the surface morphology of solids and manufacturing of functional surfaces with special responsive properties has been the subject of intense research. We report a methodology for creating multifunctionally responsive surfaces by irradiating silicon wafers with femtosecond laser pulses and subsequently coating them with different types of functional conformal coatings. Such surfaces exhibit controlled dual-scale roughness at the micro- and the nano-scale, which mimics the hierarchical morphology of water repellent natural surfaces. When a simple alkylsilane coating is utilized, highly water repellent surfaces are produced that quantitatively compare to those of the Lotus leaf. When a polymer brush is "grafted from" these surfaces based on a pH-sensitive polymer, the surfaces can alter their behavior from super-hydrophilic (after immersion in a low pH buffer) to super-hydrophobic and water-repellent (following immersion to a high pH buffer). We quantify the water repellency of such responsive systems by drop elasticity measurements whereas we demonstrate that the water repellent state of such surface requires appropriate hydrophobicity of the functionalizing polymer. When a photo-responsive azobenzene-type polymer is deposited, a dynamic optical control of the wetting properties is obtained and the surface can be switched from super-hydrophilic (following UV irradiation) to hydrophobic (following green irradiation). In all the above cases we show that the principal effect of roughness is to cause amplification of the response to the different external stimuli.

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[2]In collaboration with E. Stratakis, M. Barberoglou, V. Zorba, A. Mateescu, D. S. Achilleos, M. Vamvakaki, C. Fotakis