Controlled super-hydrophobicity on metallic substrates: Lessons from nature

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Inspiration from nature, micro/nano scale structures and surface chemistry are the most effective parameters in making superhydrophobic surfaces. Irradiation of metallic surfaces using ultra-short pulse laser results in dual scale structure and changes the surface chemistry. According to Kietzig et al. [Langmuir, 2009], metallic surfaces become hydrophobic after micromachining by femtosecond laser. One of the most important problems in designing the superhydrophobic surfaces is creating a surface which Cassie-Baxter is the stable state on the surface. In this work, regular patterned structures are created in order to control the surface morphology and henceforth the level of superhydrophobicity. Various patterns are manufactured depending on the laser parameters such as scanning speed and laser fluence. Using the Gibbs free energy analysis of surface the equilibrium contact angle and hysteresis are calculated. The optimum surface parameters for a specified type of geometry can be determined by minimizing the Gibbs free energy. Alternatively, the effects of the geometrical details on maximizing the superhydrophobicity of the nanopatterned surface are also discussed in an attempt to design surfaces with desired wetting properties.

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