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Research progress in superhydrophobic surfaces fabricated by laser

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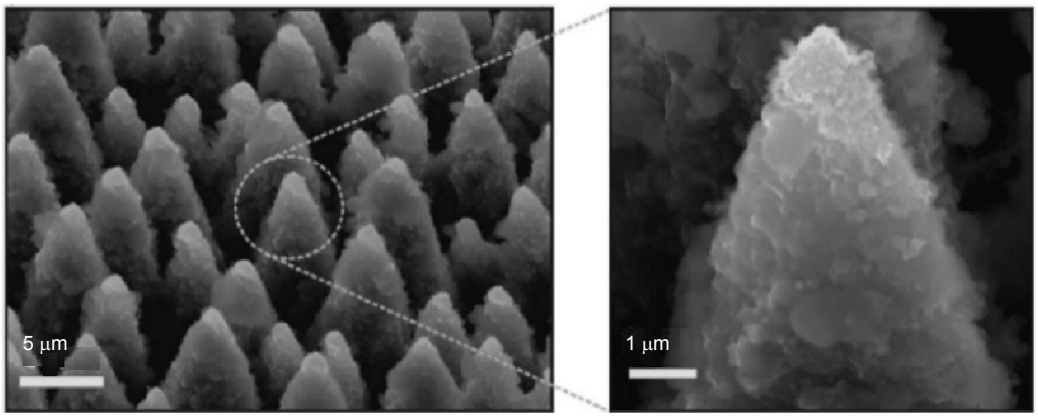

Micro-nano structure superhydrophobic surface fabricated on silicon by femtosecond laser.

Abstract: Superhydrophobic surfaces, which are defined by the water contact angle higher than 150° and the slide angle lower than 10°, have recently attracted more and more attention due to their important applications in anti-corrosion, oil-water separation, friction reduction, and liquid transportation. Over the past few decades, many methods have been developed to fabricate superhydrophobic surfaces which can usually be achieved by creating a rough surface structure on a hydrophobic material or depositing a layer of chemical molecules with low surface energy onto a rough surface, so surface morphology is a key factor to determine the wettability of a solid surface, and patterning is one of the effective ways to change the surface morphology and to improve the wetting properties. Laser patterning using a pulse laser source is a unique technique that can modify the surface morphology with very limited distortion of the bulk material. Moreover, it is a noncontact method, and complex patterns can be created. The basic wettability theory of solid surface was introduced, such as Young equation, Wenzel model, Cassie-Baxter model, wetting courses and conditions. As the surperhydrophobicity depends on the surface microstructure of materials, and the pulse width is one of the key factors affecting the processing accuracy and quality of laser fabricated microstructure, the research progress in the superhydrophobic surfaces fabricated by laser was classified based on the laser pulse width (nanosecond, picosecond and femtosecond). Several typical approaches of laser fabricated superhydrophobic surfaces were summarized, including the laser texturing and subsequent surface modified technologies, meanwhile the surface morphologies and wetting properties of the surperhydrophobic surfaces fabricated with different laser pulse width were compared, and the relevant applications were also presented. The cost of nanosecond laser is relatively low, but the processing accuracy is restricted by the diffraction theory, and the nanosecond laser is not suitable for fabricating superhydrophobic surface on hard-brittle transparent materials, so as on low-melting materials. The nonlinear absorption effect of femtosecond laser could obtain the processing accuracy which is much smaller than the focal spot, meanwhile depending on this effect, microstructure superhydrophobic surfaces could be fabricated on almost all the solid materials. Although the research in the field of superhydrophobic surfaces has been conducted for over ten years, the fabricating cost and durability still could not meet the requirements of industrial application.

Keywords: superhydrophobic surface; laser processing; contact angle; sliding angle

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