Fabrication of a superhydrophobic Ti alloy surface by femtosecond- low vacuum hybrid processing

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Superhydrophobic surfaces got attention among industries and researchers due to their plethora of applications across several key industries, such as biomedical (orthopedic dressings), aerospace (anti-icing), energy (solar cell), food (foils for packaging), etc. [1]. The lotus effect inspired many researchers to generate water-repellent surface structures by different processing techniques. The lotus effect is primarily governed by developing composite boundary lines with solid–air–liquid. The wetting property of the metallic surface has been transformed by manipulating the surface structures and surface chemistry. Titanium alloys are widely applied in bio-medical industries as implant materials for orthopedic and dental prostheses. The techniques adopted to fabricate the superhydrophobic surface either take several days to months (aging technique) or require chemical coatings. The widespread application of superhydrophobic surfaces across different industries requires a production technology without any chemical coating or long duration for the wetting property transformation.

Herein, a femtosecond laser source has been used to generate dimple structures on Ti-6Al-4V surface at different area ratios. The textured surface exhibited hydrophilic behavior immediately after laser treatments due to the presence of metal oxides [2-3], which have high surface free energy. Therefore, a novel low vacuum process has been adopted for the accelerated adsorption of hydrocarbons on the laser-textured dimple structures. The wetting property transformation was evaluated by the sessile drop technique and found to be superhydrophobic with a static contact angle of 158° after the low vacuum processing. The laser micro-machined structures were analyzed with respect to area ratios, and static contact angle measurements were performed before and after low vacuum process. The surface geometries and micro-nano surface structures were analysed with confocal microscope and scanning electron microscope respectively.

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