Tailoring Wettability with Inclined Microscale Features Using Femtosecond Laser Surface Texturing

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Abstract

Tailoring the wettability of a surface by introducing surface textures can be of great interest in various fields where superhydrophobic surfaces play a significant role, leading to benefits such as corrosion reduction, oil/water separation, anti-icing properties, and heat transfer enhancement.

Laser surface texturing (LST) is an emerging and efficient technique to modify surfaces in order to meet specific functional requirements. This technology has gained significant attention for its ability to produce structures from nano to micro-scale and its capability to process non-planar surfaces. Furthermore, it is an environment friendly process since no chemicals or toxic waste are added to the environment during processing, and it can process nearly all types of materials. Surfaces processed with laser source of ultrashort (femtosecond, fs) pulse durations show minimal heat damage or burr formation, making them suitable for precision manufacturing Femtosecond laser surface texturing (fs-LST) provides high precision for generating surface functionalities based on the mechanical, chemical and optical properties of a material. Recently, surface topographies with non-symmetrical structures, like inclined microscale features, have attracted attention in the field of surface engineering due to their promising wetting characteristics for different applications. However, there is limited literature on tailoring surface wettability through inclined microscale features fabricated by fs-LST.

This work aims to study the effect of fs laser-treated inclined surface textures on the wettability of SS304L. The influence of process parameters, such as laser fluence and beam incidence angle, on the generation of surface textures has been investigated. Microscale textures were fabricated by irradiating the surface with a 250 fs IR (1030 nm) laser source. The tilting angle of the sample with reference to the optical axis of the scanner head was varied from 0 to 60° to study the effect of beam incident angle on the fabricated feature geometry. The surface topography of the fabricated textures was characterized using confocal microscopy, scanning electron microscopy, and optical microscopy. A contact angle goniometer was used to measure the water contact angle, following the sessile drop

method, to evaluate the impact of surface morphology on the wetting behaviour of both laser textured and plain surfaces.

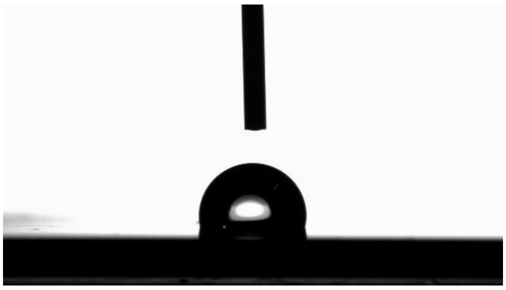

Figure 1: Static contact angle measurment