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Laser texturing to control the wettability of materials

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- Invited Paper –

Abstract

Many applications of different materials are related to the properties of their surface. Wettability is a key property affecting applications in all fields: adhesives, lubricants, detergents, all types of coatings, implant integration, heat transmission, corrosion, etc. Laser texturing has been demonstrated to be an excellent technique to modify surface wettability of many different materials: polymers, metals, ceramics, or even natural stones. The relative simplicity and robustness of the results, together with the widespread availability of affordable industrial laser sources made laser texturing a very promising tool for modifying the surface of parts in manufacturing plants. In this paper we introduce the basics of the technique and show some examples of applications. On one hand, treating the surface of different polymers for biomedical applications. And on the other hand, the production of surfaces with extreme wettability properties is shown: superhydrophilic, superhydrophobic and omniphobic surfaces were obtained by laser texturing.

Keywords: laser; surface texturing; wettability; superhydrophilic; superhydrophobic

1. Introduction

Wettability is the ability of one fluid to spread on, or to adhere to a given surface. This property is relevant in many physical, chemical or biological processes (such as in tribology, pipe flow, adhesion of dust to surfaces, cell or bacteria-surface interactions, etc.) [1]. Hence, the control of this property on the surface of different materials is relevant in science and industry and can find many applications, such as the production of surfaces with self-cleaning properties, reduced viscous drag, improved lubrication properties, or better osseointegration [2].

Wettability is mainly controlled by the surface topography and chemistry of materials [1,3]. Surface topography refers to both the profile shape and the surface roughness (including the waviness and the asperity or the finish).

In order to tailor the topography or chemistry of surfaces, many techniques have been explored (for example, application of paints and coatings [4], chemical etching [5], electrochemical machining [6,7], lithographic techniques [8–10], sandblasting [11], etc. However, these techniques have some limitations, some of them only can modify either the topography or the chemistry, others are limited to small areas, in others the modification is not local or not valid to treat large surfaces, etc. Recently, laser texturing has become one of the most popular techniques to modify the surface topography or chemistry to modify the surface wettability [12,13]. This technique is able to create a wide variety of surface topographies, both at the micro and nanoscales in many materials, with large repeatability, with excellent control of the surface features shape and size, and with a minimum

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