Development of Functional Materials Surfaces

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Superhydrophobic surfaces have attracted significant scientific interest due to their importance in both fundamental research and practical applications [1, 2]. In this work, the development of a superhydrophobic and in certain cases water repellent surface is reported utilizing a simple, fast and economical way [3]. The material used was a smooth Ti6Al4V metal alloy that is widely utilized in several applications however its surface is considered hydrophilic. The surface of the material was initially irradiated by a femtosecond (fs) laser, without following a specific pattern, in order to acquire the necessary roughness. Following the irradiation, the effect of different parameters like temperature, pressure as well as residence time under heating or vacuum on the surface properties was investigated and the results were compared to the respective ones of a smooth surface. Contact angle and contact angle hysteresis measurements were performed to evaluate the wetting properties. The surface morphology was imaged by Scanning Electron Microscopy (SEM) whereas the surface chemical composition was evaluated by Energy Dispersive X-Ray spectroscopy (EDS). A just-irradiated surface exhibits superhydrophillic behavior, nevertheless its residence in an oven at different temperatures results in an alteration of its surface characteristics and in the manifestation of a hydrophobic behavior especially for temperatures higher than 120°C. A similar effect was observed in the case that an irradiated surface was placed in a vacuum chamber (pressure 10^{-2} mbar); after a minimum of 3 hours the surface was converted to a superhydrophobic one, which additionally possessed water repellent properties, exhibiting very high contact angle and very low contact angle hysteresis. The observed behavior can be understood if one considers the change in the surface morphology and surface chemical composition.

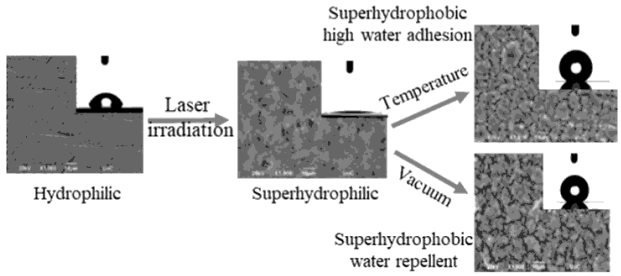

Figure 1: Schematic representation of the surface modification procedure.

References:

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