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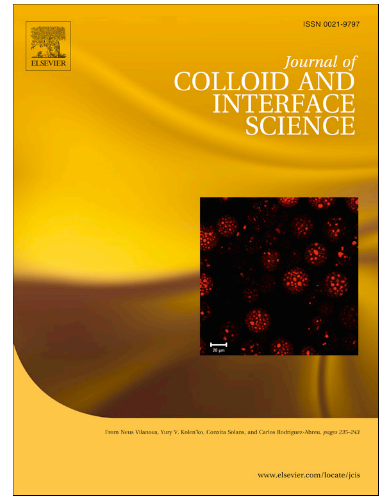

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Insights into the wettability transition of nanosecond laser ablated surface under ambient air exposure

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Abstract

Super-hydrophobic surfaces are attractive due to self-cleaning and anti-corrosive behaviors in harsh environments. Laser texturing offers a facile method to produce super-hydrophobic surfaces. However, the results indicated that the fresh laser ablated surface was generally super-hydrophilic and then gradually reached super-hydrophobic state when exposed to ambient air for certain time. Investigating wettability changing mechanism could contribute to reducing wettability transition period and improving industrial productivity. To solve this problem, we have studied the bare aluminum surface, fresh laser ablated super-hydrophilic surface, 15-day air exposed surface, and the aged super-hydrophobic surface by time-dependent water contact angle (WCA) and rolling angle (RA), scanning electron microscopy (SEM), 3D profile and X-ray photoelectron spectroscopy (XPS). The origins of super-hydrophilicity of the fresh laser ablated surface are identified as (1) the formation of hierarchical rough structures and (2) the surface chemical modifications (the decrease of nonpolar carbon, the formation of hydrophilic alumina and residual unsaturated atoms). The chemisorbed nonpolar airborne hydrocarbons from air moisture contributed to the gradual super-hydrophobic transition, which can be proved by the thermal annealing experiment. Particularly, to clearly explore the wettability transition mechanism, we extensively discussed why the laser-induced freshly outer layer was super-hydrophilic and how the airborne hydrocarbons were chemisorbed. This work not only provides useful insights into the formation mechanism of laser ablated super-hydrophobic surfaces, but also further guides industry to effectively modify surface chemistry to reduce wettability transition period and rapidly produce stable and