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Thermal management of metallic surfaces: evaporation of liquid sessile droplets on polished and plasma patterned metal surfaces

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Surface patterning, also known as surface texturation or surface structuration, is part of the surface engineering that consists in the production of a "patterned" surface with some regular array of surface height features on the size scale of micrometers to some nanometers. Patterned surfaces of metals have many potential applications and particularly in the thermal management for heat exchangers for instance. Robust and efficient surface patterning manufacturing methods are existing but alternative cheap and flexible technologies are needed to satisfy the vast demand for emerging applications. Plasma technologies such as nitriding and etchning by ion bombardment are well adapted technologies for that purpose.
This communication will focus on the evaporation od sessile water droplets on differentstates of metallic surfaces modified by plasma treatments. We will present the time evolution of the contact angle and of the droplet diameter as a function of time for different temperatures ranging from ambiant to 120 °C. Different surface states of austenitic stainless steel AISI 316L were investigated: mirror polished, nitrided with a resulting honeycom-like structure and patterned by ion sputtering using masks. Two different regimes for the evaporation were observed at low temperature : a constant diameter regime and a quasi-constant contact angle regime. The data are well described by theoretical models for evaporation on conventional surfaces. This is not the case for patterned surfaces, for which many small transition regimes, corresponding to local jump of the triple line, were observed.

Keywords
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