8th International Conference on Fog, Fog Collection and Dew
Taipei, Taiwan, 14–19 July 2019
IFDA2019-33-5

Rough surfaces increase dew drop collection

Daniel Beysens (1), Joachim Trosseille (2), Anne Mongruel (2), Laurent Royon (3), and Marie Gabrielle Medici (4)

(1) Physique et Mecanique des Milieux Heterogenes, CNRS, ESPCI Paris Tech, PSL Research University, Sorbonne Universite, Univ. Paris Diderot, Paris, France; OPUR, Paris, France (daniel.beysens@espci.fr), (2) Physique et Mecanique des Milieux Heterogenes, CNRS, ESPCI Paris Tech, PSL Research University, Sorbonne Universite, Univ. Paris Diderot, Paris, France, (3) Univ. Paris Diderot, CNRS, Sorbonne Paris Cite, Laboratoire Interdisciplinaire des Energies de Demain, Paris, France, (4) Universite de Nice, LPMC-CNRS-UMR 7336, Nice, France

Gravity collection of droplets is the main phenomenon limiting dew water collection for its use as an alternative source of water. The amount of collected water remains often limited by the drops runoff, the latter remaining attached on the substrate by pinning forces and evaporating in the morning. To reduce this limitation one can act on the condensation surface texture in order to enhance drops mobility under gravity, the latter being passively collected. Micropatterning such as micro grooving can improve collection efficiency. However, micropatterning is in general difficult to implement on large surfaces. A simple and inexpensive technique, sand blasting, is studied to obtain microstructured surfaces in order to promote efficient drop collection. The advantages of this technique are (i) the possibility of creating a random roughness and (ii) the simplicity of the method to treat large surfaces.
Experimental investigation.of water vapor condensation on substrates developed with sand blasting is thus presented. The study was performed in a temperature and humidity-controlled environmental chamber at ambient pressure. Duralumin plates, 173 mm x 173 mm x 2 mm dimensions, were sand blasted with 25 μm silica beads projected with a pressure of 2 bars pressure. It results a mean roughness Ra = 2 μm, to be compared with the natural roughness of plates Ra = 0.46 μm. Plates are set vertical; they are cooled below the dew point thanks to a Peltier element. Condensation is continuously measured (i) visually by an image treatment of the drops and (ii) by weighing a tissue set within 0.1 mm from the bottom of the plate. Condensation is simultaneously performed for sake of comparison with the same, smooth, plate placed aside the rough plate.
Results show that sand blasting, by increasing the number of nucleation sites, leads to a better collection rate than the same, smooth substrate, provided that sandblasting does not increase too much the surface roughness. Edges of the substrate, where drops grow faster, also improve water collection, early shedding of edge drops making such drops acting as natural wipers. Sand blasting and edge effects thus increase significantly the rate of collection of dropwise condensation; gains with respect to the same smooth surface of about 30% can be commonly obtained. This study shows in addition that coalescence events during condensation lower the drop pinning forces and have an important positive impact on drop sliding.