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Plasma deposition of hydrophobic coatings on structured surfaces for condensation and heat transfer applications

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The control of vapor condensation process by suitably prepared surfaces is a prominent research area with important applications in industry. For example it is well known that the efficiency of condensation heat exchangers can be significantly increased when the vapor condenses in the form of drops that do not wet the surface instead of a closed film. In the present work hydrophobic thin films are deposited by a plasma CVD process on metal surfaces and the condensation of water vapor on the surface is investigated. The dropwise condensation on the coated surfaces is analysed by optical microscopy and the effect on the heat transfer is measured by heat flux measurements.
To investigate the potential of the deposition process for industrial applications different metals and alloys used in commercial condensation heat exchangers are coated and the effect of the dropwise condensation on the heat transfer is investigated. As the static contact angle of water on hydrophobic surfaces depends strongly on surface topography the effect of surface roughness of metal samples on the dropwise condensation is presented.
Patterning of surfaces and controlling the surface energy can be used to further enhance condensation heat exchanger efficiency, e.g. by directing the drop movement after departure or by defining droplet growth sites on the surface. Laser interference patterning is presented as a tool for efficient structuring of heat exchanger surfaces. Surface geometries for enhanced droplet removal are presented and the effect on the dropwise condensation process is demonstrated.

Keywords
condensation
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