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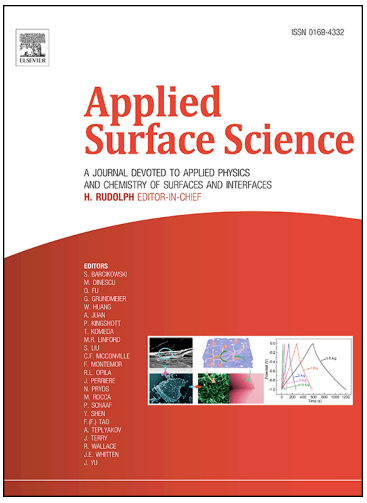

Full Length Article

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Hemant Kumar Raut, Anupama Sargur Ranganath, Avinash Baji, Kristin L. Wood

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Bio-Inspired Hierarchical Topography for Texture Driven Fog Harvesting

Hemant Kumar Raut,[1,2**] Anupama Sargur Ranganath,[1] Avinash Baji,[1,2*] Kristin L. Wood[1]

[1]*Division of Engineering Product Development, Singapore University of Technology and Design, 8 Somapah Rd, Singapore 487372, Republic of Singapore*

[2]*Department of Engineering, School of Engineering and Mathematical Sciences, La Trobe University, Bundoora, VIC 3086, Australia*

ABSTRACT

Fog harvesting is recognized as one of the most sustainable means of freshwater collection. Synthetic fog harvesting surfaces have been predominantly inspired from the desert beetle's exoskeleton which exhibits a bumpy topography. This topography underlies an alternating hydrophilic-hydrophobic pattern which has been the basis of several bio-inspired fog harvesting surfaces. However, replication of such hydrophilic-hydrophobic patterns involves multiple processing steps and tedious incorporation of functional/chemical groups at precise locations. On the other hand, surface topography or texture has proven to be insufficient in realizing an efficient fog harvesting surface. This is because micro- or nano-scale textures alone fail to simultaneously maximize the rate of droplet condensation and disposal, which are the two key aspects of efficient fog harvesting. Herein, we report that a hierarchically-textured surface, consisting of micro-lenses arrays covered with high aspect-ratio nanoscale fibrils, can fulfil these two key requirements for maximizing fog harvesting efficiency. While the micro-lenses enable faster droplet condensation, the cluster of nanoscale fibrils impart superhydrophobicity that aids in intermittent droplet disposal. Together, the topography achieves a fog collection efficiency ~ 5-6 times higher than that of the planar counterpart. Moreover, this hierarchical texture is fabricated by a simple one-step nanoimprinting approach which is scalable to arbitrarily large-area flexible substrates.

Keywords: Bio-Inspired, Fog-Harvesting, Condensation, Hierarchical arrays, Nanoimprinting.

* Corresponding authors' email addresses: a.baji@latrobe.edu.au, hkraut@mit.edu