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Honeycomb structures obtained with breath figures self-assembly allow water/oil separation

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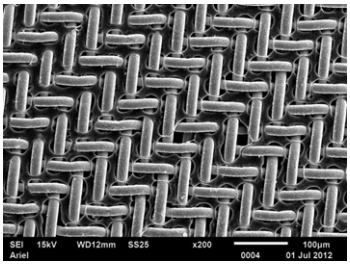
HIGHLIGHTS

- Breath-figures self-assembly with metallic gauzes as supports is reported.
- Micro-scaled porous hydrophobic/oleophilic polymer surfaces were prepared.
- The surfaces are permeable for oils and impermeable for water.
- The surfaces are suitable for water/oil separation.
- The 94% efficiency of water/oil separation is reported.

GRAPHICAL ABSTRACT

Hybrid metallic-polymer meshes obtained with the breath-figures self-assembly.



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ABSTRACT

We report the development of a method of the breath figures self-assembly, allowing manufacturing of micro-scaled porous hydrophobic/oleophilic polymer surfaces. The stainless steel gauzes were used as carrying frameworks for polymer honeycomb reliefs resulting from the breath figures self-assembly. Two very different kinds of polymer reliefs arose from non-woven large aperture and micro-scaled woven gauzes. Both of them are hydrophobic and oleophilic, permeable for oils and impermeable for water. The micro-scaled woven gauzes promoted formation of reliefs manifesting the "rose petal effect", i.e. high apparent contact angles accompanied with the high contact angle hysteresis. This kind of reliefs turned out to be extremely efficient for water/oil separation.

1. Introduction

Since the formation of micrometrically scaled polymer honeycomb structures by water-assisted self-organization (so-called "breath figures self-assembly") was first reported by Widawski, Rawiso and Francois [1,2], the theoretical and experimental activities in the field have been extended over the past decade [3–28]. Despite the fact that the physical mechanism of the patterning phenomenon is not clear to a full extent [26], the water-assisted self-assembly technique has already been successfully applied for manufacturing strictly ordered closely packed micro- and nanoscale 2D structures. Generally, "breath figures self-assembly" is related to the condensation of micro-scaled water droplets on the cooled surface of the evaporated polymer solution. The droplets then sink into the solution, eventually forming the honeycomb pattern [1–28].

Recent investigations in the field have focused on the manufacture of honeycomb patterns via curing or polymerization [8,9],

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