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Modification of paper using polyhydroxybutyrate to obtain biomimetic superhydrophobic substrates

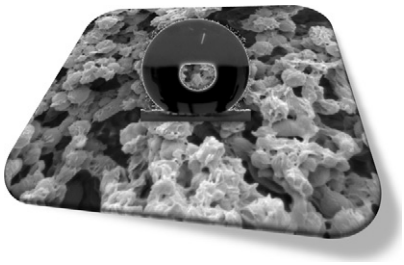
Constancio G. Obeso[a,b,1], Maria P. Sousa[a,b,1], Wenlong Song[a,b], Miguel Angel Rodriguez-Pérez[c], Bharat Bhushan[d], João F. Mano[a,b,*]

[a] 3B Research Group – Biomaterials, Biodegradables and Biomimetics, Headquarters of the European Institute of Excellence on Tissue Engineering and Regenerative Medicine, Department of Polymer Engineering, University of Minho, Guimarães, Portugal
[b] ICVS/3B's – PT Government Associate Laboratory, Braga/Guimarães, Portugal
[c] Cellular Materials Laboratory (CellMat), Condensed Matter Physics Department, University of Valladolid, 47011 Valladolid, Spain
[d] Nanoprobe Laboratory for Bio- & Nanotechnology and Biomimetics, The Ohio State University, Columbus, OH 43210-1142, United States

HIGHLIGHTS

- Superhydrophobic paper-based substrates were obtained by a simple surface modification.
- The final material kept the main handling/mechanical properties of the original paper.
- The wettability of the substrates can be controlled through argon plasma treatment.
- It is possible to pattern wettable regions in the superhydrophobic-based paper.

GRAPHICAL ABSTRACT



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ABSTRACT

Inspired in nature, the creation of synthetic superhydrophobic surfaces is nowadays a major object of study, with many potential applications in different fields. The fabrication of such substrates has been dominated by the use of non biodegradable and poorly flexible materials, using expensive and complex procedures. To overcome this issue, we propose a simple concept for fabricating low-cost, biodegradable, and flexible biomimetic superhydrophobic materials, using paper as substrate. The methodology includes the precipitation of poly(hydroxybutyrate) (PHB) on the surface of cellulose fibers of papers using a phase separation process. The obtained surfaces showed a rough texture, at both micro and nano length scales and an apparent water contact angle of $153.0 \pm 0.7^{\circ}$. Furthermore we showed that argon plasma treatment increases the surface wettability and it is possible to control the wettability in certain regions by using adequate hollowed masks. Such findings could be used for the production of cheap open-microfluidic or lab-on-chip devices, using materials from renewable resources.

1. Introduction

The development of new devices for microfluidics, electronics, biosensors, environmental and biomedical applications requires often substrates exhibiting low adhesion and non-wetting properties [1–4]. Many surfaces found in nature exhibit highly hydrophobic and self-cleaning properties, including the leaves of plants such as lotus, the wings of cicada and butterflies or the water strider's leg, which have inspired many researchers in

* Corresponding author at: 3B Research Group – Biomaterials, Biodegradables and Biomimetics, Headquarters of the European Institute of Excellence on Tissue Engineering and Regenerative Medicine, Department of Polymer Engineering, University of Minho, Guimarães, Portugal.
E-mail address: jmano@dep.uminho.pt (J.F. Mano).
[1] These authors contributed equally to this work.

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