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Facile fabrication of recoverable and stable superhydrophobic polyaniline films

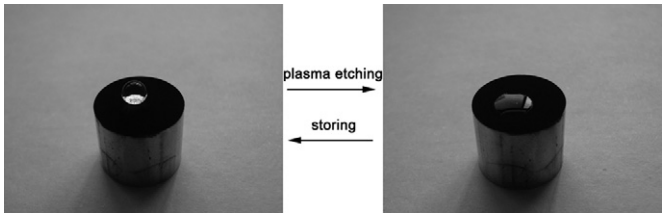
Xiaoyan Zhou[a,b], Zhaozhu Zhang[a,*], Xianghui Xu[a], Jin Yang[a,b], Xuehu Men[a,*], Xiaotao Zhu[a,b]

[a] State Key Laboratory of Solid Lubrication, Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, Tianshui Road 18th, Lanzhou 730000, PR China
[b] Graduate School, Chinese Academy of Sciences, Beijing 100039, PR China

HIGHLIGHTS

- We fabricated the recoverable and stable superhydrophobic polyaniline films.
- The recoverable function was certified by the air plasma treatment.
- The damaged film can restore its superhydrophobicity in 48 h at room temperature.

GRAPHICAL ABSTRACT



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ABSTRACT

A superhydrophobic polyaniline (PANI) film was fabricated by using a facile one-step spraying method. The sprayed film showed stable superhydrophobic behavior at ambient environment for more than a month. However, after plasma treatment, the surface turned superhydrophilic and such wettability transition may be attributed to the change of surface composition since its rough surface microstructure remained the same as the pristine film without any treatment. The damaged film possessed a recoverable characteristic of superhydrophobicity when it was simply left in normal ambient conditions. After storage for 48 h, the low-energy-materials gradually transferred to the top surface and the superhydrophobicity of the damaged surface was healed. This recovery time can be shortened to only 10 min when the etched PANI film was wetted by deionized water.

1. Introduction

Surfaces with extreme wettability such as superhydrophobicity and superoleophobicity have attracted great attention because of their potential use in fundamental researches and industrial applications [1–5]. In nature, there are many natural superhydrophobic species such as lotus leaves, rose petals, butterfly's wing and water strider's legs [6–8]. The investigations on the natural superhydrophobic samples indicate that the combination of suitable micro- and nano-structures and low-surface-energy materials is crucial to obtain a superhydrophobic surface [9–11]. Large amounts of superhydrophobic surfaces have been theoretically studied and artificially prepared by roughening the surface and minimizing the surface free energy [12–15]. However, both microstructures and low-surface-energy materials can be easily damaged by the sunlight, atrocious weather, physical rubbing and other conditions in an outdoor environment, leading to destruction of the surface superhydrophobicity [16,17]. This will seriously influence the lifetime use of the surfaces and hinder their practical application.

Nature can rebuild the surface microstructures and refresh the surface chemistry after damage to recover the surface property. For example, the superhydrophobicity of plants can be recovered after damage by regenerating the epicuticular wax layer, which serves as the low-surface-energy material [18,19]. If this valuable characteristic can be applied to artificial superhydrophobic surfaces, their durability will be greatly enhanced. In order to get the recoverable superhydrophobic surfaces, researches have been operated. Zhou et al. obtained the superhydrophobic and superoleophobic surface by filling perfluorooctyl acid into the

* Corresponding authors. Fax: +86 931 4968098.
E-mail addresses: zzzhang@licp.cas.cn (Z. Zhang), xhmen@licp.cas.cn (X. Men).

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