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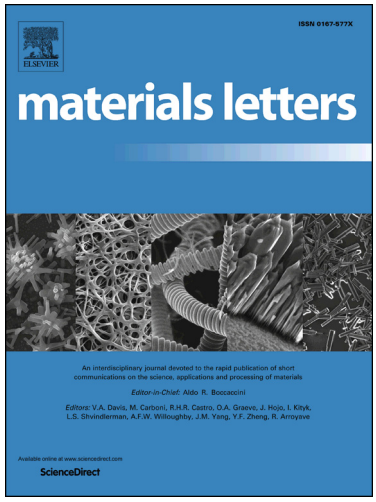

Surface Structure and Wettability Tuning of Porous Silicon Films by Capillary-driven Surface Texturing under Different Current Densities of Electrochemical Etching

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Surface Structure and Wettability Tuning of Porous Silicon Films by Capillary-driven Surface Texturing under Different Current Densities of Electrochemical Etching

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Abstract:

Silicon-based biomimetic surfaces with special wettabilities are difficult to be fabricated without lithographic techniques. In this report, superhydrophobic surfaces of porous silicon (PSi) with adjustable papillary microstructures have been prepared simply by electrochemical etching of n-type silicon, capillary-driven surface texturing (CDST) of PSi films and surface modification. According to the results of FE-SEM and Drop Shape Analyzer, surface morphologies (from 2D pore structures to 3D papillary microstructures) and corresponding wettabilities (Contact angles, CAs: 134.8^{o}-158.9^{o}; Sliding angles, SAs: 180^{o}-1^{o}) of PSi films can be adjusted efficiently by current density (<20 mA cm^{-2}). The sizes and distribution of inverted-pyramid structures (IPSs) at the interfaces and symbiotic macropores in their centers are essential for such an adjustment. Considering the excellent biocompatibility of PSi, Such surfaces will be beneficial to the silicon-based biosensors, microarrays and microfluidics.

Keywords: Porous materials; Biomimetic; Inverted-pyramid structures; Electrochemical etching; Capillary-driven Surface Texturing.

1. Introduction

Because of the existence of cross-talking problems in silicon-based microarray biochips and microfluidics [1, 2], surface wettability control of silicon has become an important issue to deal with. In general, the combination of multiscale structure construction with surface modification has become a basic strategy for superhydrophobic surface construction [3-5]. However, biomimetic structures [6] are difficult to be fabricated on silicon surfaces without the help of lithographic technology [7]. In our early report, porous silicon (PSi) surfaces with micropapillae and nanopores have been successfully prepared by the coupling of

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