Colloids and Surfaces A: Physicochem. Eng. Aspects 412 (2012) 38–46

Contents lists available at SciVerse ScienceDirect

Colloids and Surfaces A: Physicochemical and Engineering Aspects

journal homepage: www.elsevier.com/locate/colsurfa

Fabrication of meso and nanotextured silica surfaces for tunable densities of functionalized molecules

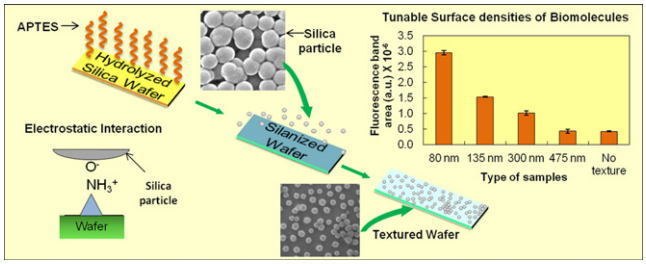
Subham Dastidar, Ravi Chahar, Vivekananda Bal, Satyendra Kumar, Siddhartha Panda*

Department of Chemical Engineering, Indian Institute of Technology Kanpur, Kanpur, UP 208 016, India

HIGHLIGHTS

- We report a method to obtain tunable meso and nanotextured silica surfaces.
- The time of introduction had a strong effect on the surface particle densities.
- Surface densities were also governed by the process used for the particle synthesis.
- The texturization phenomena were studied and possible mechanisms are proposed.
- The textured surfaces were functionalized with antibodies; the effects of texture were studied.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 31 May 2012
Accepted 11 July 2012
Available online 20 July 2012

Keywords:
Tunable
Texturization
Silica
Nanoparticle
Antibody
Sensor

ABSTRACT

Textured surfaces have applications in different fields including sensing. We report a method to obtain tunable textured surfaces utilizing electrostatic coupling by introducing silanized silica wafer surfaces into a sol of growing silica meso and nano particles at appropriate times specific to the process. An important finding here is that the time of introduction of the wafers into the sol had a strong effect on the surface particle densities and there exists an optimum time window of introduction for a given process to obtain the maximum surface density. The surface densities were also governed by the process used for the particle synthesis, with processes for smaller sized particles yielding higher surface particle densities. Thus by controlling the particle size and the time of introduction, the surface texture can be tuned for specific applications. This may be a cheaper alternative in specific cases to expensive (though more controlled) techniques. The texturization phenomena were studied and possible mechanisms are proposed for the observed experimental results. These textured surfaces were subsequently functionalized with biomolecules (antibodies) and the effects of the texture on the surface density of the immobilized antibodies were studied.

1. Introduction

Textured surfaces are utilized for enhanced photon absorption in photovoltaics [1,2], effective anti-reflective coatings for light trapping [1], higher data storage [3], improved adhesion and friction for tribology [4,5], obtaining superhydrophobic surfaces with appropriate chemical treatment [6,7], and higher sensitivity in chemical sensing applications [8,9]. Texturing of surfaces by silica micro and nano particles have been demonstrated by spin-coating [1,4], dip coating [10] and Langmuir–Blodgett techniques [6,11] using commercially available silica powders by both the subtractive routes and the additive routes. The subtractive routes typically involve the spin coated silica particles on the surface which act as "natural lithography" sacrificial masks for subsequent

* Corresponding author. Tel.: +91 512 259 6146; fax: +91 512 259 0104.
E-mail address: spanda@iitk.ac.in (S. Panda).

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http://dx.doi.org/10.1016/j.colsurfa.2012.07.012