Chapter 10
Development of Silica Thin Film as a Self-Cleaning Surface on Various Materials

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ABSTRACT

Materials with superhydrophobic surfaces have received great attention fom scientists recently. One of the materials that have this property is silica thin film. Silica thin film has been widely studied due to its high hydrophobicity and ability to be applied in various materials. Superhydrophobic silica thin film has a water contact angle of more than 150; consequently, it is suitable for applications as an anti-fogging, anti-reflective and self-cleaning material which is in great demand by the industry to develop. The development of superhydrophobic materials with self-cleaning capabilities has several advantages, such as reducing maintenance costs, increasing durability, preventing snow or ice adhesion, and protecting materials from the effects of environmental pollution. Superhydrophobic silica thin films have been developed in various materials that are on glass surfaces, wood surfaces, stainless-steel, and cotton fabric coatings. This chapter focuses on discussing the latest developments of superhydrophobic thin film silica applied on various materials.

DOI: 10.4018/978-1-6684-5629-3.ch010

INTRODUCTION

Materials with superhydrophobic surfaces have received much interest from scientists in the past few decades. The design of these materials is biologically inspired by natural adaptations or derivatives that have been observed on heterogenous types of surfaces, such as butterfly wings, lotus leaves, rice leaves, mosquito eyes, red rose petals, cricket wings, spider silk, fish scales, and considerably more. The surface exhibits superhydrophobic properties by nature which is water-resistant. Accordingly, its presence provides new insights into the artificial surface fabrication of superhydrophobic materials.

A superhydrophobic surface is a material surface once dropped with water, forms a relatively perfect globule, and will lightly flow in only a few-tilt. This surface can be obtained by coating the material with a silica-thin film.

Recent reviews of the design and fabrication of surfaces with particular limitations such as superhydrophobicity are available (Feng and Jiang, 2006). Surface roughness should be minimized to reduce light scattering so that light transparency can be achieved. Therefore, the long-scale formation of the surface micro/nanostructure and the appropriate chemical composition becomes very important in the preparation of silica thin films that exhibit superhydrophobic properties (Lin et al., 2011). Based on this, various coating methods have been proposed and studied to improve the surface preparation of superhydrophobic silica thin films through the construction of suitable surface geometric structures.

Recently, there have been numerous studies on silica thin film (Chang et al., 2015; Wu et al., 2014; Gurav et al., 2015; Purnomo et al., 2018) due to its high hydrophobicity as well as its versatile applicability. Superhydrophobic silica thin film has a water contact angle greater than 150^{o} (Sethi and Manik, 2018) and a low shear angle. Furthermore, superhydrophobic silica thin film has anti-fogging, anti-reflective, and self-cleaning capabilities that are in growing demand in the industrial sector to be advanced. Self-Cleaning is a prominent feature of several superhydrophobic surface applications and functions. The development of superhydrophobic materials due to their self-cleaning has plenty of advantages when implemented, such as minimizing maintenance costs, expanding durability, preventing snow or ice adhesion, and protecting the environment from pollution.

Superhydrophobic silica thin film has been utilized for material coatings in various scopes, such as glass to forestall condensation (Eshaghi & Mojab, 2014), wood to prevent rotting (Wang et al., 2011), mild steel to prevent corrosion (Zhang et al., 2020), for self-cleaning shoes and water-resistant cotton fabric (Latthe et al., 2019).

This article emphasizes the study of the latest progression regarding the manufacture of superhydrophobic silica thin film layers and the application of silica thin films on various materials such as coatings.