Deposition of thin composite films consisting of fluoropolymer and silver nanoparticles having surface plasmon resonance

Alexey I. Safonov, VeronicaS. Sulyaeva, Nikolay I. Timoshenko, Sergey V. Starinskiy

PII: S0040-6090(16)00128-0
DOI: doi: 10.1016/j.tsf.2016.02.030
Reference: TSF 35030

To appear in: *Thin Solid Films*

Received date: 11 August 2015
Revised date: 9 February 2016
Accepted date: 16 February 2016

Deposition of thin composite films consisting of fluoropolymer and silver nanoparticles having surface plasmon resonance

Alexey I. Safonov [a, *], Veronica S. Sulyaeva [b], Nikolay I. Timoshenko [a], Sergey V. Starinskiy [a]

[a] Kutateladze Institute of Thermophysics SB RAS, Lavrentyev Ave. 1, 630090, Novosibirsk, Russia.

[b] Nikolaev Institute of Inorganic Chemistry SB RAS, Lavrentyev Ave. 3, 630090, Novosibirsk, Russia.

* Corresponding author: Tel.: +007 383 3356245; fax: +007 383 3308018; E-mail address: safonov@itp.nsc.ru (A.I. Safonov).

Abstract

This paper describes the method of obtaining composite coatings consisting of silver nanoparticles covered by a fluoropolymer film. The morphology and optical properties of resulting coatings are given within. The presence of a surface plasmon resonance (SPR) minimum of silver nanoparticles deposited on glass and fused silica surfaces has been revealed. The paper describes a shift towards the infrared (IR) region when the average size of deposited silver nanoparticles is changed. However, coating the nanoparticles in a fluoropolymer film does not significantly shift their resonance.

1. Introduction

It has been shown that composition and structure of thin films determine their optical properties [1, 2]. Furthermore, the presence of nano-sized elements on the surface often cause effects that change the optical properties [3-5]. Recently great interest has been placed on nano-sized elements of noble metals due to their specific response to infrared (IR) and visible radiation which excite localized plasmons. This effect is the most noticeable in silver nanostructures [6]. The incorporation of these nanostructures within biosensors [7] for the visualization of cell structures [8, 9], targeted delivery of medicines [10, 11], photothermolysis of cancer cells [12], higher efficiency of solar elements [13-16] has triggered the development of new methods to obtain and study structures with plasmonic properties.

The usage of thin nanostructured silver films is hindered due to their quick surface contamination [17]. Oxidation, sulfidation and nanoparticle coalescence in the coatings are likely to cause its properties to change. It is possible to solve these problems by encapsulating metal nanoparticles inside a polymer matrix. Furthermore, the dielectric layer created by the polymer matrix provides the possibility of preserving of the plasmonic effects.

The given investigation presents the results of developing the method to obtain metal nanoparticles in a fluorine-polymer matrix and studies the properties of these films.