The optical TiO_2 layers deposited on polymer substrates

R. Chodun[a], L. Skowronski[b], S. Okrasa [a], B. Wicher [a], K. Nowakowska – Langier [c], K. Zdunek [a]

[a] Faculty of Materials Science and Engineering, Warsaw University of Technology, Woloska 141, 02 – 507, Warsaw, Poland
[b] Institute of Mathematics and Physics, UTP University of Science and Technology, Kaliskiego 7, 85-796 Bydgoszcz, Poland
[c] National Centre for Nuclear Research, Andrzeja Soltana 7, 05-400, Otwock-Swierk, Poland

Plasma Surface Engineering methods meet the limitation of efficient synthesis of layers on the thermally unstable substrates, i. e.: HSS, electronic materials, polymers, etc. During the process of synthesis, an exchange of energy between the plasma and the substrate surface occurs. Overheating the substrate material leads to its decomposition, phase transition, structural changes, etc. Polymers are materials characterizing by relatively low melting temperature, so the process of layer deposition is very challenging. Overheated polymers degrade easily by breaking bonds in chain, so among the PSE methods only a few are predestinated to use.

Couple of years ago, we introduced a novel approach to control the plasma pulses in the magnetron sputtering method – Gas Injection Magnetron Sputtering (GIMS) [1]. In this technique the plasma is generated by pressure oscillations controlled by pulse gas valve. Our previous study showed that, using the GIMS technique, the synthesis of TiO_2 rutile phase is possible [2]. Taking into account the pulsed distribution of energy during the process of synthesis by GIMS, we predicted that the efficient deposition of coatings on polymer substrates is possible, thanks to favorable conditions of the energy dissipation on the substrate between each of the plasma pulse.

In this work, we present the optical TiO_2, TiO_2/Al, TiO_2/Cu layers deposited on PMMA substrates. Metallic and TiO_2 layers were synthesized by GIMS technique, operating with 1Hz frequency of gas injection for 7 min (metallic sub – layer) and 1,5 – 5 min (TiO_2).

The prepared samples were investigated by means of spectroscopic ellipsometry and spectrophotometry. To extract optical constants of TiO_2 layers and their thicknesses the multiple sample analysis approach was applied. Optical constants of metallic films were determined in a separate experiment.

Keywords: Magnetron Sputtering, TiO_2 layers, polymer substrates, optical properties

References

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