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CHARACTERIZATION OF PA6.6 AND PET FABRICS AND FILMS COATED WITH THIN FILMS OF TiO_2 BY REACTIVE SPUTTERING

R. Bessada[1,2], G. Silva[2], A.V. Machado[1], M. C. Paiva[1], F. Vaz[3]

1 DEP - Department of Polymer Engineering, University of Minho, Campus de Azurém, 4800-058 Guimarães, Portugal
2 TRW – Vila Nova de Cerveira R&D, 4920-011, Vila Nova de Cerveira, Portugal
3 Department of Physics, University of Minho, Campus de Azurém, 4800-058 Guimarães, Portugal

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TiO_2 coating; magnetron sputtering; textile fabric

Abstract

Nanoscale titanium dioxide (TiO_2) films were deposited on the surface of PET and PA6.6 fabrics and films by using direct current reactive magnetron sputtering. The effect of time deposition on the surface structures and properties of the material was considered. The surface morphology was analysed by SEM and surface chemical composition by FTIR-ATR. Thermal properties were determined and compared.

Introduction

Airbags for car vehicle are normally made of silicon-coated or uncoated polyamide or polyester fabrics. These fabrics have to allow a specific adjustment of the air permeability and moreover, they have to be heat-resistant. Heat resistance of the airbag is improved by coating the inner side of the fabric with a heat absorbing material, such as, silicone or other polymeric resin like polyurethane. These materials dissipated the heat provoked by the hot gases that flow into the airbag, this way the airbag wall is not damaged. However, these protective materials increase thickness and weight, which is a significant disadvantage, since airbag fabric should fold well and have the lowest weight in order to be light and occupy the smallest space as possible in the vehicle. This specification could be achieved by deposition of a nanometric thickness film coating. Various techniques have been developed and employed to produce nanometric thickness film coatings, like TiO_2 coatings, such as the sol-gel method [1], liquid deposition method [2], vacuum evaporation, sputtering [3, 4] and so on. In comparison with the conventional wet processes, some advantages such as higher and easily controlled sputtering speed, high-quality and uniform films and conventional manipulation make the deposition processes like reactive magnetron sputtering are currently used to produce high purity oxide films for application in various advanced technologies. Magnetron sputtering has high deposition rate, good adhesion of the films and is an environmentally friendly process, making this a good technique for preparing nanoscale functional films. Sputtering can be used in large-area deposition and achieve high quality films even at low substrate temperatures, which can increase their practical use effectively in many areas. TiO_2 films deposited by magnetron sputtering, under ideal vacuum conditions can arouse a special interest in functional textiles [5].

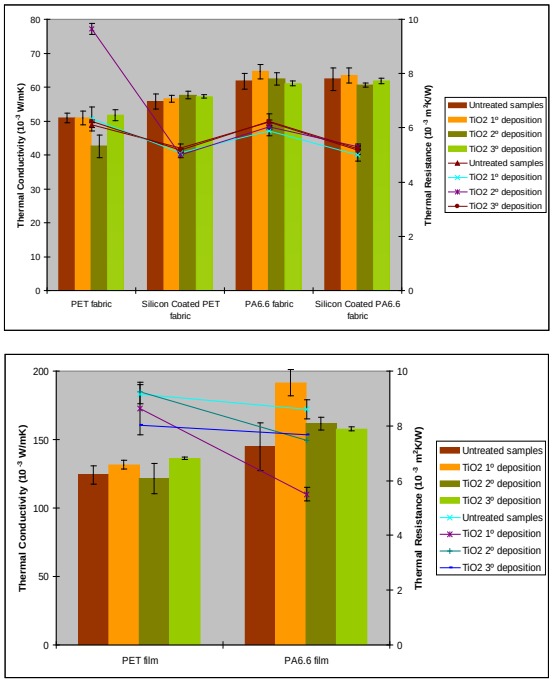

Figure 1: Thermal Conductivity for untreated samples and samples with TiO_2 deposition. a) fabrics, b) films.

In this study nanoscale TiO_2 films were deposited on the surface of PET and PA6.6 fabrics and films by using direct current (DC) reactive magnetron sputtering. The

aim is to develop a nanometric functional thin coating for airbag fabrics, with good thermal resistance. The fabrics were characterized by FTIR-ATR, SEM and thermal analysis techniques and their behavior compared with PA6.6 and PET films.

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References

[1] – J. Yu, X. Zhao, "Effect of substrate on the photocatalytic activity of nanometer TiO_2 thin films", Mater. Res. Ull. 35 (2000) 1293-1301.

[2] – X. P. Wang, Y. Yu, X.-F. Hu, L. Gao, „Hydrophilicity of TiO_2 films prepared by liquid phase deposition", Thin Solid Films, 371 (2000) 148-152.

[3] – Z. Qinnan, L. B. Baoshun, Z. Xiujian, et al, „Effect of ratio of Oxygen to argon and thermal treatment on the structure and hydrophilicity of TiO_2 thin films coated on glass by DC reactive magnetron sputtering", rare Met. Mater. Eng. 32 (5) (2003) 339-343

[4] – P. Zeman, S. Takabayashi, "Effect of total and oxygen partial pressures on structure of photocatalytic TiO_2fils sputtered on unheated substrates", Surf. Coat. Technol. 153 (2002) 93-99.

[5] – Y. Xu, H. Wang, Q. Wei, H. Liu, B. Deng, "Structures and properties of the polyester nonwovens coated with titanium dioxide by reactive sputtering", J. Coat. Technol. Res, 7 (5) (2010) 637-642.