

ORGANOSILICON THIN FILM PHOTOPROTECTING POLYPROPYLENE AS A POLYMERIC DEVICE SUPPORTING PHOTOCATALYST TiO_2

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Abstract

Device with organosilicon thin films on PP was successfully developed to photoprotection against UVC irradiation.

Introduction

Catalytic photodegradation with UV light exposition to TiO_2 is a remediation technique for pollutants, gaseous or soluble in an aqueous environment¹. Exposure to UV light in the presence of water generates hydroxyl radicals which mineralize organic compounds. Usually, the substrate of this catalyst is glass, but the need for greater flexibility and complex designs to improve the interface between the pollutant and the catalyst led to the study of polymers as a substrate. However, it is also necessary to protect the polymer against hydroxyl radicals, which leads to the proposal of this work: to deposit, by plasma, organosilicon thin films on polypropylene in order to build an interface that protects the PP from TiO_2 contact.

Results and Discussion

The organosilicon films were deposited by plasma in the presence of hexamethyldisiloxane (HMDSO) for 30, 45 and 60 minutes. The deposition of the TiO_2 film was made by dip-coating from titanium isopropoxide solution. TiO_2 /organosilicon/PP devices were characterized by FTIR-ATR and UV-Vis spectroscopies and scanning electron microscopy, and were aged under UVC radiation (more energy intensive) and UVA (which best activates the catalytic capability of TiO_2). The amount of carbonyl formed was used as a criterion for the evaluation of photodegradation.

It can be observed in the graph of carbonyl area as a function of photodegradation time (Figure 1A) that the photoprotection was directly proportional to plasma deposition time. Figure 1B puts the result of Figure 1A in a new perspective: the percentage variation in relation to the formation of carbonyl for each photodegradation time, with TiO_2 /PP values as a standard for 100%. It can be seen that the organosilicon film deposited for 30 minutes hardly protected PP against photodegradation, with variation around 0% of photoprotection. The system with the organosilicon film deposited for 60 minutes showed the photoprotection of approximately 80% in almost all the extent of photodegradation.

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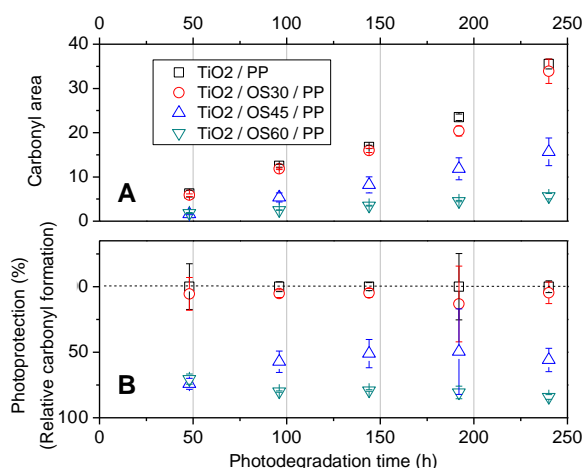


Figure 1. A) Carbonyl area formed due to the photodegradation time for TiO_2 /PP and for the systems with organosilicon film deposited by plasma at different times. B) Photoprotection in relation to carbonyls formed in TiO_2 /PP as 100%.

UV-Vis spectroscopy showed that the organosilicon films absorb in the UV region and micrographs showed that the films deposited by plasma have a more continuous coating and greater adherence only at higher deposition times. The greater continuity and adhesion of the film ensures reduced oxygen permeation into the polymer bulk and the UV absorption by organosilicon prevents its arrival to the surface of PP.

The aging under UV light showed the opposite result, probably by the best activation of the catalytic ability of TiO_2 and consequent degradation of organosilicon film, avoiding the photoprotective effect of organosilicon film.

Conclusions

The developed device provides protection in the UVC range, more energy intensive, but does not work in the UVA range which would be interesting for photocatalytic degradation applications.

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¹ Sánchez B, Coronado JM, Candal R, Portela R, Tejedor I, Anderson MA, Tompkins D, Lee T. *Appl Catal B Environ* **2006**, 66, 295.