Photochemical nanomodification of polymer surfaces

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Polymers are, nowadays, one of the most interesting materials because of their huge variety of usages. A large number of investigations are treating with those materials with the objective of giving new properties and usages to polymers.

Polypropylene is becoming one of the most used polymers, because of its good initial characteristics, productivity and cost. For the automotive sector it is also an interesting material for their applications; however it is very difficult to paint, for its neutral chemical surface and its chemical composition, so the objective it's been improve the dyeability of this polymer. All this study is performed inside a project named nAUTO (now in the second stage, named $nAUTO^2$) which purpose was to involve nanotechnology capabilities with the automotive needs.

It is studied the effect of high intensity UV light + O_3 on the surface of a polymer (Polypropylene (PP) and Polycarbonate (PC)) with the objective of changing its surface roughness characteristics to increase the dyeability and decrease the reflexivity [1] [2]. This change must be achieved in micro - nano scale, and thus maintaining the same initial appearance at first glance.

If the interaction between the UV/O_3 and the surface is understood and the result is the desired, changes in the roughness at nano or micro level and the surface activation, could become a solution for improving the dyeability characteristics and end up with a paintable polypropylene [3].

The exposition is performed with a high intensity UV lamp, so intense that its rays are able to break the O-O bonds in the air and promote the creation of O_3. During the exposition it was controlled the time and varied the distance between the source and the sample. For the surface analysis, when measuring the surface roughness average before and after the UV treatment, it was used an interferometric microscope and the reflexivity study is done with an UV-Vis-NIR spectrometer.

With the results obtained (figure 1), the change in the surface roughness from 0.77 nm to 1.81 nm in the PP and from 0.094 nm to 0.110 nm in the PC and the enhanced surface activation, it could be said that the proposed UV treatments (figure 2) gives to this PP and PC polymer the necessary modification to increase the surface roughness and the surface activation in such a manner that improves the dyeability tests. This corresponds to an improvement of the coating characteristics of the PP, a polymer very difficult to attach any kind of particle, either chemically or mechanically.

Acknowledgements: nAUTO: Centro Técnico SEAT, Plastal Spain S.A., ASCAMM, FICOSA, PEGUFORM and UPC.

$nAUTO^2$: Centro Técnico SEAT, LEITAT, FICOSA, PEGUFORM, RAVAGO, IQAP and UPC.

References

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Figures

Sample	Mode	Distance (cm)	Time (s)	Ra (um)
PP + 0.0046 nanofluor	PSI 0.8	---------------	---------	2.17
PP CNT MB 5%	PSI 0.2	---------------	---------	2.65
PP	VSI 20.40.7	---------------	---------	0.77
PP	PSI 0.8	9	5	-----
PP	PSI 0.8	17	5	1.81
PP	PSI 0.8	17	10	2.63
PP	PSI 0.8	17	20	-----
PC/PBT	VSI 20.40.7	---------------	---------	0.094
PC/PBT	VSI 20.40.7	17	5	0.110
PC/PBT	VSI 20.40.7	17	10	0.132

Fig.1Summary Table

Sample	Time (s)	Ra (um)	Dose (J/cm^2)
PP	---------	0.77	--------
PP	5	1.81	240
PP	10	2.63	480
PP	20	-----	960
PC/PBT	---------	0.094	--------
PC/PBT	5	0.11	240
PC/PBT	10	0.13	480

Fig. 2 Energetic dose

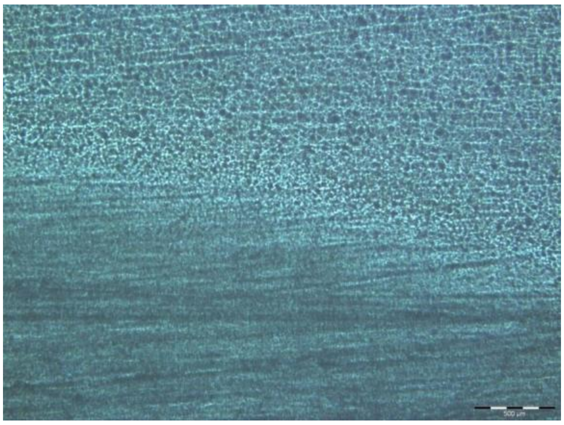

Fig.3 Treated PP part (porous) non treated PP (striped)