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Multifunctional Low Density Polyethylene packaging films obtained by fluorination combined or not with plasma treatment

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Low Density Polyethylene (LDPE) films were treated by fluorination either at different conditions, i.e. static and dynamic ones with F₂ gas, or controlled process with atomic fluorine. Modification of the treated films chemical composition was studied by spectroscopic methods (solid state NMR, XPS and IRTF). Surface morphology was investigated by SEM and AFM. Also surface energy measurements and electron paramagnetic resonance (EPR) were carried out. Direct fluorination resulted in a formation of outmost fluorinated layer mainly consisted of specific fluorinated groups like CF₂ and CHF. Some oxygenated polar groups have been also detected mainly during the transfer to air after the fluorination. Multifunctional films were obtained using fluorination with F₂ gas. If the fluorination rate is sufficiently high, in other terms if the thickness of the fluorinated layer is high enough, the following commercial properties of LDPE can be improved: printability, barrier properties towards O₂ (due to presence of CHF and CF₂ groups even in low amounts), low friction coefficient. Improved tribological properties, close to that of the reference PTFE, allow the film to be proceeded at the industrial plant. Nevertheless, those lubricating properties are not achieved if the thickness of the fluorinated layer is not enough. The present work is a contribution to explain the improvement of various properties. Moreover, some C-H and C-C bonds could be broken during the fluorination processes, forming dangling bonds (radicals), which could react mainly with the oxygen and moisture from air or, in a few extend, with O₂ admixtures in F₂ or O₂ and H₂O absorbed on the polymer surface and in the bulk. This results in changes of the surface properties during the exposure to air after the fluorination. In order to avoid such side reactions, a plasma treatment was applied prior to fluorination. It activated the surface and changed the relative content of fluorinated groups CHF and CF₂. The resulting properties of LDPE after combined plasma and fluorination will be discussed.

Keywords

Plasma
Fluorination
polymer