Effect of biaxial stretching of nanolayered poly(ethylene furanoate) (PEF) films on gas barrier properties

Food packaging films must be reinvented in order to meet the new ecological requirements and challenges. In particular, efforts have been directed to reduce the use of petrochemical polymers and to develop biobased and/or biodegradable polymers. Among those, Poly(ethylene furanoate) (PEF) is a new promising biopolymer with high gas barrier and good mechanical properties, but its high price limits currently its industrial applications. Its combination with another polymer is thus of great interest and film coextrusion could be a relevant processing method for PEF. Nanolayer coextrusion can create hundreds to thousands micro or nanolayers and has been shown to improve the gas barrier properties of some polymers due to various confinement effect [1,2].

In this study, a new grade of PEF, developed by AVA Biochem in the scope of the H2020 Mypack program, has been combined with PET using nanolayer coextrusion. Multilayered films with different PEF layer thicknesses (varying from the micrometer down to the nanometer scale) have been successfully processed. AFM observations have shown the continuity of the PEF layers with individual thicknesses as thin as 40 nm.

PEF was amorphous at the end of the coextrusion step and post-thermal annealing was necessary to get a crystallinity degree of 14%. Surprisingly, the gas barrier properties were not improved by the crystallization step.

While PEF alone is too brittle to withstand any deformation, it was possible to biaxially stretch amorphous PEF/PET multilayered films with draw ratio as high as 4,5 x 4,5. After a subsequent crystallization, an improvement of a factor 4, compared to the bulk PEF, has been obtained for the gas barrier properties.

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