USING NANO-ADDITIVES TO INCREASE THE OXYGEN BARRIER OF POLYMERS

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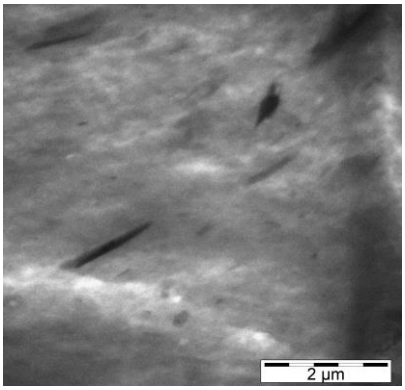
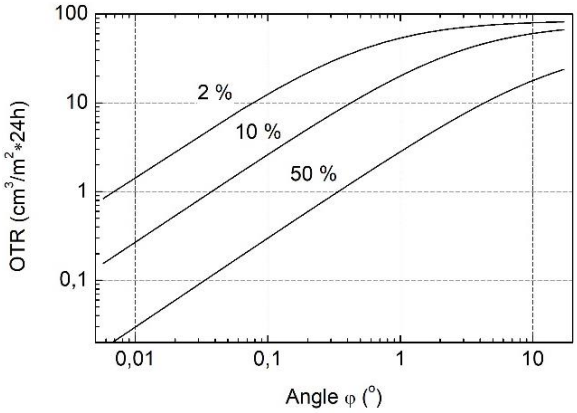
The aim of this work is to increase the gas barrier of packaging polymers by using nano-scale additives. Barrier improvements by an order of magnitude have been reported by Cerisuelo *et al*. by using nanoclay. [1] The effect of nano-additives is expressed by a tortuous path for the permeant molecules, thus increasing the diffusion length. [2] First tests have revealed the impact of nanoparticles on the mechanical and barrier properties of polyamide. A modest increase of the oxygen barrier was observed. Further investigation was carried out using TEM and XRD measurements to assess the extent of dispersion, exfoliation and the orientation of the nanoclay particles. The orientation of the platelets is crucial to achieve an effective gas barrier.



Polyamide-nanoclay composite film



Simulated OTR dependence on filler particle angle at different filler content ratios in polymer.

It was found that on average, the filler particles behaved as if their axis was at an angle of 9.5° to the film surface plane, which is in turn at an 90° angle to the diffusion normal direction. The results are a good starting point for comparing the twin-screw mixing technology with other promising methods, such as layer-by-layer coating with other polymers [3], for future large-scale testing and possible industrial use.

References

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2. *Kim, Seong Woo, and Sang-Ho Cha. "Thermal, Mechanical, and Gas Barrier Properties of Ethylene-Vinyl Alcohol Copolymer-Based Nanocomposites for Food Packaging Films: Effects of Nanoclay Loading." Journal of Applied Polymer Science 131, no. 11 (June 5, 2014)*
3. *Carmen Fernández Ayuso, Alejandro Arribas Agüero, Jose A. Plaza Hernández, Antonio Bódalo Santoyo and Elisa Gómez. "High Oxygen Barrier Polyethylene Films" Polymers & Polymer Composites, Vol. 25, No. 8, 2017*

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