Nanocoatings based in transparent titanium dioxide nanocomposites deposited on PET and PLA foils for food packaging applications

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Abstract

Traditional packaging systems, besides merely market tools used to communicate with consumers, protect products against deterioration effects (e.g. heat, light, oxygen, pressure, microorganisms, insects, dirt and dust particles) caused by environmental factors and give mechanical support. Nevertheless, traditional food packaging characteristics are no more suitable for the current market landscape since supply chains changed dramatically towards internationalization. Consumers are no longer used to daily shop of perishable foods leading to higher consumption of pre-prepared and packaged products, which require longer product's shelf life. The increased distribution distances, the longer storage times with different requirements in terms of temperature has been pushing food-packaging concepts to higher limits. Furthermore, the present awareness of environmental preservation and the occurrence of foodborne diseases lead to the presentation of more compelling value propositions so that market needs can be fully satisfied.

In this sense, new bio-based polymers have been developed to extend both the shelf life and the food quality of packed food products while reducing packaging waste. However, the industrial application of biocompatible polymers has been reduced since there some issues related with their performance (brittleness, poor gas and moisture barrier) and production costs. Poly(lactic acid) (PLA) has been attracting considerable attention for food packaging industry since it is a thermoplastic material that is produced from renewable resources, it is biodegradable and compostable. Moreover PLA presents the same behavior in mechanical, thermal and barrier properties comparable to the most used synthetic materials like Poly(ethylene terephthalate) (PET).

This research work was mainly engaged with the production of titanium dioxide (TiO2) nanocoatings by Pulsed DC Magnetron Sputtering technique on 10x10 cm on flexible PLA and PET substrates. The correlation between process parameters and attained properties was possible by using Scanning Electron Microscopy (SEM), X-Ray Diffraction (XRD), Atomic Force Microscopy (AFM), Contact Angle measurements, UV – visible Spectroscopy techniques, Fourier Transform Infrared Spectroscopy (FTIR). The photocatalytic activity of the samples was studied by measuring the Methylene Blue (MB) degradation over time as a result of the catalyst exposure to ultraviolet (UV) radiation. The obtained results allowed the study of the advantages and limitations, as well as to study possible was to improve the thin films characteristics for large scale food packaging applications.