Wrocław, 21.09.2021 r.

Rozprawa doktorska pod tytułem „Wykorzystanie metody zol–żel do otrzymywania funkcjonalnych warstw hybrydowych na podłożu elastycznym o obniżonej przepuszczalności dla tlenu „

Autor - Kamila Startek

Rozprawa doktorska wykonana pod kierunkiem dr hab. inż. Anny Łukowiak

Doctor's dissertation entitled "The use of the sol-gel method to obtain functional hybrid layers on a flexible substrate with reduced oxygen permeability"

Author - Kamila Startek

Doctoral dissertation conducted under the supervision of D. Sc. Anna Łukowiak

Abstrakt

The sol-gel process enables the production of bulk materials (monoliths or aerogels), layers, fibers or nanoparticles, thanks to which it is used in many inorganic materials. It also allows obtaining hybrid or multifunctional materials by combining their properties in one system. Therefore, this method of layers fabrication was chosen and applied in this work. By changing the conditions of the process and the choice of substrates and additives, the properties of the manufactured materials are designed.

As part of the doctoral dissertation, hybrid organic-inorganic layers on a flexible substrate made of polyethylene terephthalate (PET) film were obtained. Their chemical composition was intentionally changed using silicon precursors with different alkyl groups and the influence of the obtained structures on their functional properties such as roughness, wettability, thermal stability as well as optical, mechanical and barrier properties were investigated. The oxygen barrier was assumed as the main functional property of the obtained layer/substrate structure. Due to the complexity of the gas permeation mechanism through the polymer material, an attempt was made to broadly characterize the properties of the obtained materials to better understand the influence of both the chemical structure of the layer and its surface properties on the efficiency of oxygen permeability through the produced system.

The hybrid sol-gel coatings presented in this paper on polyethylene terephthalate film showed, among others: low roughness, high transmittance, good adhesion to the substrate, good thermal resistance, reduced oxygen permeability values compared to the properties of the substrate itself.

In addition to the improved barrier properties, the obtained materials showed promising topographic and optical properties, thanks to which they can also be used as protective layers in optically active systems.

Furthermore, a positive feature is the hydrophobic nature of the materials produced and the reduced surface energy, thanks to which these materials also protect against the degradation of products under the influence of water.

Selected results from the analyzed properties of the obtained materials in the form of layers on PET film have been described in three scientific articles (D1, D2, D3), which were used to prepare the doctoral dissertation (included in Chapter 9).