PERFORMANCE OF TiO_2:Sm^{3+} BASED OPTICAL SENSOR EMBEDDED IN CAVITATED POLYMER FILMS

Taavi Tikk[1](presenting author), Sven Lange[1], Tõnis Paara[1], Marko Eltermann[1], Andres Krumme[2]

1 Institute of Physics, University of Tartu, W.Ostwaldi 1, Tartu, Estonia

2 Tallinn University of Technology, Ehitajate tee 5, Tallinn, Estonia

taavitikk@gmail.com

The aim of the present work is to incorporate inorganic, low cost and remotely readable trace oxygen sensor into industrial polymer packaging material with the aim to help detect package inside atmosphere instabilities after package sealing. For the purpose photoluminescent Sm^{3+} ion doped TiO_2 nanoparticles are used. The intensity of Sm^{3+} photoluminescence spectra in TiO_2 has been shown to be greatly influenced by its surrounding ambient oxygen concentration [1,2]. By incorporatin the latter into polymer packaging film, it is expected to enable remote sensing of the local oxygen concentration in the film and consequently inside the package.

In previous research a good dispersion of the oxide particles synthesized via liquid phase extraction method by using colloidal solutions of Ti (IV) oxysulfate in water as a precursor was achieved. Trials were made to enhance the modulation of the optical signal by increasing the relative free surface area of the sensor particles via a cavitation technique that introduces voids into the polymer film (an industrial process). Retrieved results were controversial which were the cause of instability of the cavitation process.

In current work the main aim is to increase the relative free surface area of the sensor particles by increasing polymer porosity via using solution based mixing and adding cellulose microfibers. This approach yielded highly oxygen sensitive films that could easily be read at distance.

References

1. M. Eltermann, K. Utt, S. Lange, and R. Jaaniso, *"Sm3+ doped TiO2 as optical oxygen sensor material."* Optical Materials, Volume 51, January 2016, Pages 24–30
2. Taavi Tikk, Tõnis Paara, Marko Eltermann, Andres Krumme, Raivo Jaaniso, Valter Kiisk, Sven Lange, *„TiO2:Sm3+ based luminescent oxygen sensitive probes in LDPE packaging material"*, Proceedings of the Estonian Academy of Sciences, Volume 66 (4), November 2017, Pages 450–454

Euroopa Liit
Euroopa
Regionaalarengu Fond

Eesti
tuleviku heaks