Optical Oxygen Nano-sensor

Anna Świderska-Środa[1], Krzysztof Gałązka[1], Witold Łojkowski[1], Tadeusz Chudoba[1], Agnieszka Opalińska[1], Krisjanis Smits[2], Larisa Grigorjeva[2], Donats Millers[2], Cristina Leonelli[3]

[1] Institute of High Pressure Physics, Polish Academy of Sciences, Poland

[2] Institute of Solid State Physics, University of Latvia

[3]Universita' degli Studi di Modena e Reggio Emilia, Italy

e-mail: annas@unipress.waw.pl

Detection of oxygen content in gases is important for health protection and engines operation. Commonly used oxygen sensors exploit the dependence of electric resistance of ZrO_2 ceramics on oxygen content in the analyzed gas. The ceramic needs to be heated up to about 700^{o}C. There are optical sensors where changes of luminescence of organic materials are exploited. For them direct contact with a hot gas has to be avoided. We developed nano-zirconia particles whose photoluminescence strongly depends on oxygen content in nitrogen/oxygen gas mixtures. The nano ZrO_2:Eu^{3+} particles are produced in a microwave hydrothermal synthesis process. They are doped uniformly with Eu^{3+} ions, and the optimum content is 8%. Their grain size distribution is narrow and for 8 at.% Eu the average size is 19 nm. The material temperature can range from room temperature to 300^{o}C, but the optimal conditions are 100^{o}C. We designed a prototype of the sensor of a very simple construction. An example of the influence of oxygen partial pressure on the luminescence intensity is presented in Fig 1.

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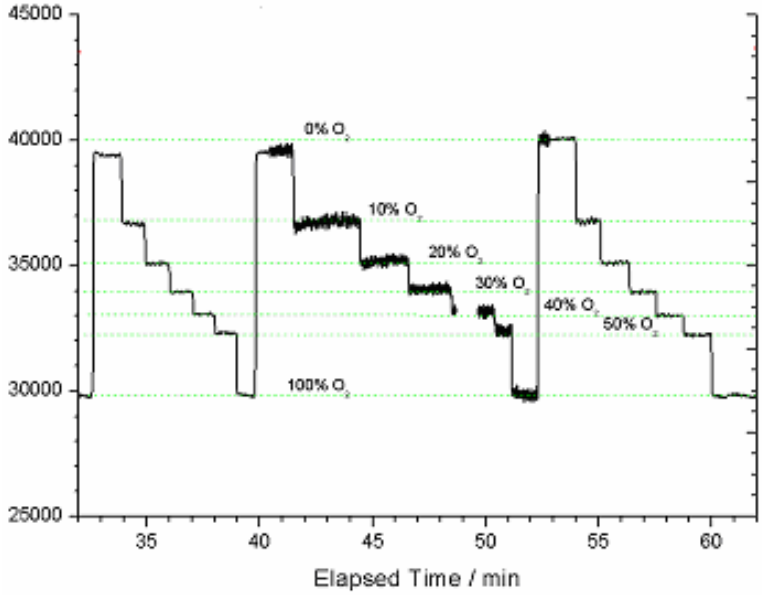

Fig.1 The influence of O_2 partial pressure on the luminescence intensity of ZrO_2-8 at.% Eu nano-sensor. The plot shows the time dependence of the integral of luminescence in the range 600 – 640 nm excited by a 402 nm LED. Temperature is 100^{o}C.