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Microstructure and crystalline phases characterization of multilayered ZrO_2-TiO_2 ceramic for applications as air humidity sensor

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Abstract – This present investigation is described the processing and characterization of a multilayered ZrO_2-TiO_2 ceramic. The ceramic was sintered by microwave heating. The sintered ceramics presented high densities. Their response and recovery time to environmental humidity as function of temperature was discussed. The results were compared to ZrO_2-TiO_2 solid solution bulk sensors.

The measurement and control of humidity in air are very important in many areas such as industrial and agricultural processes, food production, meteorology, and domestic environment. Ceramic humidity sensors have improved thermal, chemical, and mechanical stability when compared to the polymeric ones [1]. ZrO_2-TiO_2 solid solution bulk ceramics are widely studied for humidity sensors [1-3]. Both titania and zirconia were been studied for gas as well as air humidity sensing [1,4,5]. However, there is not any report in the literature about the ZrO_2-TiO_2 humidity multilayered sensors formed by ZrO_2 and TiO_2 microlayers and their response and recovery time to environmental humidity.

The ZrO_2 and TiO_2 powders composed by sub-micrometric particle size were mixed with 40 % vol. of water and organic surfactant. The adequate content of surfactant in this solid suspension was determined using rheological measurements. The films were deposited on alumina substrates using deep coating technique. The samples were dried and sintered at different temperatures in microwave furnace. The microstructure and crystalline phases characterization were been carried out using SEM and X-ray diffraction, respectively. The thicknesses of the films were measured by cross-sectional SEM, before and after the sintering step to determine the retraction values of the ceramics. The ZrO_2-TiO_2 ceramic films characterization as air humidity sensor element was accomplished through impedance and capacitance measurements using a RLC bridge in a climatic chamber.

The ceramic microstructure analyses showed few pores. X-ray diffraction analyses indicated monoclinic zirconia and rutile The results showed that there is a combined effect related to zirconia and titania in the behaviour of the water adsorption and desorption processes in a wide temperature range. However, this humidity multilayered sensor presented a different response and recovery time to environmental humidity, when compared to ZrO_2-TiO_2 solid solution bulk ceramics.

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