Microstructure characterisation of magnesium-aluminum porous ceramics: a comparison between conventional mercury porosimetry and PALS study

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It is well known that magnesium-aluminum $MgAl_2O_4$ porous electroceramics possess suitable characteristics for use as active elements in humidity sensors. This paper focuses on the investigations of porous structure of these ceramics using different experimental probes.

The investigated sintered compacts were prepared by conventional ceramic processing route from the mixtures of starting powders $MgO:Al_2O_3$=1:1 with different values of surface area. The conventional method of mercury porosimetry (Pascal 140, CE INSTRUMENTS, and Porosimeter 4000, CARLO ERBA STRUMENTAZIONE) was used for determination of pore size distribution in studied objects. Positron annihilation lifetime spectroscopy (PALS) has been rarely applied to topologically-disordered solids because of high complications in the interpretation of the obtained experimental data. Nevertheless, this method was used for the first time, in order to characterize the vacancy-like defects in $MgAl_2O_4$-based ceramics with a spinel structure. Measurements of positron annihilation lifetimes were carried out with an ORTEC spectrometer and ^{22}Na source, placed between two identical ceramic samples.

The obtained porous structure characteristics of ceramics were analyzed and correlated with humidity-sensitive electrical properties of fabricated sensors.