Zirconia-titania porous ceramic as soil moisture sensor element in controlled environments

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Abstract The last years long, ceramic materials, specifically metal oxides, have shown promising properties as moisture sensoring mainly as porous sintered bodies. This work is an attempt to improve the microstructural control of the ZrO_2-TiO_2 porous ceramics, in temperature and relative humidity controlled environments, to be applied as sensor elements for soil water content to monitor hazard areas of landslides. The preliminary results have shown that the environmental sensors confectioned from ZrO_2-TiO_2 solid solution presented potential for this application.

The current market requirements for the automation and control of processes in the monitoring of environmental parameters have motivated the characterization and the development of sensors and sensor systems for relative humidity and soil moisture [1]. For this proposal, this work is in search of new measurements techniques and processing of signals associated with microstructural control of ZrO_2–TiO_2 porous ceramic. The significant importance of the soil moisture ceramic sensors is to warn for the imminent hazard of slope instability and landslide susceptibility that may occur mainly in the rainy periods, what makes the water the most important primer agent of these movements. The first reports about this kind of occurrence date back 2.000 years ago, formerly in China and Japan. Thousands of casualties and loss of billions dollars per year, have been attributed to landslide all over world [2]. The ZrO_2–TiO_2 ceramic sensing elements were confectioned from the adequate choice of commercial powders, which were mixed mechanically, compacted uniaxially with a pressure of 100 MPa and sinterized at 1100 ^oC. The porous ceramics were characterized by using scanning electron microscopy and X-ray diffraction techniques. The apparent density of the compacted and sinterized bodies was determined by the Archimedes principle. The electric properties of the sensing elements were evaluated through the variation of capacitance and of impedance in different types of ground, with different contents of humidity, in temperature and relative humidity controlled environment. This is a subject of great originality in world-wide terms, mainly concerning to the influence of the pores form and their size distribution on the capacity of chemical and physical interactions of water molecules with the surface of the sensor material.

References

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