High density nanocrystalline anatase TiO_2 ceramics. Part II: Electrical properties

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The electrical properties of nanocrystalline anatase TiO_2 are of great interest due to their potential applications, including dye-sensitized solar cells [1], photocatalytic decomposition of organic pollutants in waste water [2] and solid state gas sensors [3]. In order to study specifically the electrical behaviour of nanocrystalline anatase, we prepared high density pellets with a mean grain size between 30 and 100 nm, as determined by X-ray diffraction and electronic microscopy.
In this work, we present the electrical properties of these materials as function of oxygen partial pressure $P(O_2)$ [10^{-30}-1 bar] and temperature [450-650°C]. The $P(O_2)$ was modified and monitored by an electrochemical zirconia oxygen pump and oxygen sensor system. The grain size effect as well as the effect of alio- and isovalent dopant cations (Na^+, Zn^{2+}, Al^{3+}, Si^{4+}, Nb^{5+}) are also presented and analysed in the framework of point defect thermodynamics, dopant segregation, and space charge theory.

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