SnO$_2$ based ceramics with high density and low electrical resistivity

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Here we present single-phase ceramics, based on SnO$_2$ with relative density of up to 91.9\% and electrical resistivity of up to 0.38$\ \Omega\cdot$cm at room temperature, thus characterized a ceramic with potential for the production of no-consumable anode the reduction of alumina due to high chemical resistance of SnO$_2$ phase.

This work was motivated by the fact that Brazil is the sixth largest producer of primary aluminum in the world. Aluminum is conventionally produced in Hall-Herout cells by the electrolysis of alumina in molten cryolite bath, employing carbon anode. The problems due to this process are the release of carbon dioxide, high power consumption, high consumption of the anode and the formation of impurities due to reaction with graphite. Clark, Alder and Hansey patented non-consumable anode based on SnO$_2$ doped CuO and Sb$_2$O$_3$ obtained resistivity of 0.0025 $\Omega\cdot$cm to 975\degree C, however these electrodes had high concentration of CuO and Sb$_2$O$_3$ that led to the formation of segregated and / or precipitates at grain boundary, decreasing it’s chemical resistance to cryolite. Thus, this work proposed to obtain a dense-phase ceramic of low resistivity and chemical resistance to the electrolyte. For this, the SnO$_2$ on based ceramic was modified with ZnO densifying agent and promoters of electrical conductivity Nb$_2$O$_5$ and Sb$_2$O$_3$. The synthesis of the powder was made by mixed oxide and the compacts were sintered in a microwave oven with a temperature of 1050\degree C and heating rate of 10$^\circ$C/min. After sintering, density tests were performed Archimedes, scanning electron microscopy, current x voltage electrical characterization at room temperature.  

Keywords: tin oxide, non-consumable electrode, microwave sintering, electrical conductivity.


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