Abstract

Micron, submicron and nano sized Zinc Oxide powder was prepared during this work. The preparation method used was the sol-gel combustion utilizing Zinc Nitrate, and Ammonia as a precursor in addition to the Citric Acid as the combustion agent. The optimum preparation conditions for gel formation were at PH of 6.5 at 80°C.

The combustion of the Citric acid during the preparation helps in reducing the final powder particle size. While the addition of alcohol as a dispersion agent prevents the formation of hard agglomeration of powder particles.

The problem of creation of particles agglomerates during the drying and calcination step was thoroughly examined. Drying at 80°C for 24 hrs and calcination at 400°C for one hour followed by rapid increase to 500°C with holding for 15 min; assisted in avoiding agglomeration.

The amount of alcohol, as a dispersion agent, in the starting solution controls the final particle size of the prepared Zinc Oxide powder. The obtained particle size of the prepared powder batches were of average particle size of 52 nanometer, 601 nanometer and 5.342 micrometer. That depends on the amount of alcohol in the starting solution.

X-ray diffraction pattern for the resultant powder shows neat and well crystallized Zinc oxide powder.

The produced powder batches were compacted and sintered at different temperatures up to 1400°C for three dwell times; 30, 60 and 90 minutes. The mechanical and physical properties for the sintered compacts were then measured.

It was found that the final density increased with higher sintering temperature, higher dwell time and lower particle size. The sintered compacts with nano sized starting particle size has much better density values compared with the sintered compacts with submicron and micron sized starting particle size. Porosities of all the samples were also measured.

Measurements of the linear shrinkage were performed up to 1350°C with three different heating rates; 2°C/min, 5°C/min and 10°C/min. The linear shrinkage data and the density values extracted from that data show that lower heating rates and smaller particle sizes give higher density. Once more, a better density results were obtained with compacts of nano sized starting particle size.

The microhardness and splitting strength results for the sintered compacts at 1400°C and different dwell times are coherent with the densification behavior. In other words, better densification gives better mechanical properties. This conclusion is supported by the SEM test of the sintered compacts. The SEM micrographs show that better microstructure (reduction of the pore phase and continuous solid phase) can be achieved at higher sintering temperatures, higher dwell time and smaller starting particle sizes especially with the sintered compacts of nano starting particle sizes.