EFFECT OF INITIAL PARTICLE SIZE OF THE HEMATITE ON MICROWAVE SINTERING KINETICS AT 30 GHz

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Microwave-assisted sintering kinetics studies of ceramic materials are scarce in the literature, both on nanometric and submicrometric scales ceramic powders. Few studies reported in the literature on microwave sintering kinetics in the millimeter-wave range reveal enhancement in the sintering kinetics compared with the conventional heating[1-3]. However, up to the present, an in-depth understanding about the effect of the initial particle size on the sintering kinetics of ceramic materials heated by microwave in high frequency was not found. Therefore, in the present work, the sintering kinetics of hematite powders (α-Fe_2O_3) synthesized by sol-gel with different initial particle sizes (30, 80, 200, 460 and 1500 nm) were analysed by millimetre-wave in microwave-assisted dilatometry to evaluate the effect of initial particle sizes of the powders. Regarding this, a dilatometer (Linseis, GmbH) was used in combination with a 30 GHz gyrotron system. Constant heating rates of 5, 10, 15 and 20 ºC/min up to 1200 ºC were applied and a subsequent dwell time of 1 minute. The results were analyzed adopting non-isothermal methods by Woolfrey and Bannister in the initial stage and by Wang and Raj in the intermediate stage of sintering. The results showed that with increasing particle size of the starting powder, there was an increase in green densities and during sintering, the densification rate of finer powders was higher resulting in higher apparent densities after sintering by millimter-wave assisted dilatometry at high frequencies. The initial particle size of the powders did not significantly affect the densification kinetics of the initial stage, although it affected the densification kinetics of the intermediate stage. Higher values of activation energy (in the range of 26 - 104 kJ/mol) were observed with the increase in particle size for the intermediate stage, indicating that more energy is necessary for the densification process in this stage, corroborating with the smaller final apparent densities with the increase in initial particle size.

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