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Dilatometer Investigations of Reactive Sintering of Zinc Titanate Ceramics

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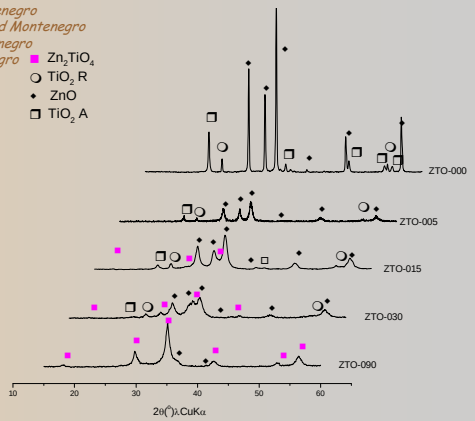
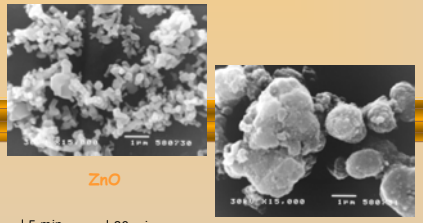
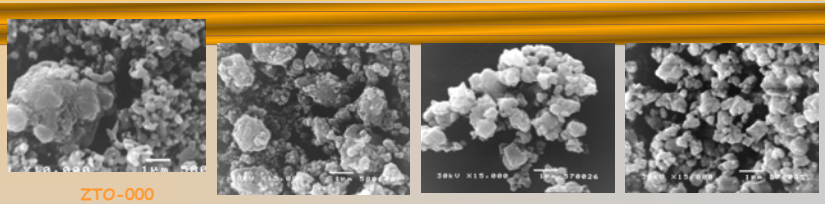
Abstract

Starting powder mixtures of ZnO and TiO_2, in the molar ratio that is in accordance with stoichiometry of zinc titanate Zn_2TiO_4, were mechanically activated using planetary ball mill during different time intervals from 0 to 90 minutes. X-ray diffraction analysis, scanning electron microscopy and non-isothermal dilatometric measurements were performed in order to investigate zinc titanates formation. Processes that occur during mechanical activation lead to the formation of a specific structure of obtained powders that promoted and accelerated solid-state reactions and densification during reaction sintering.



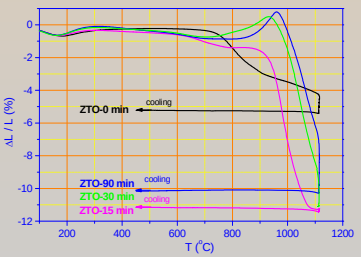
X-ray diffraction patterns of unmilled and milled ZnO and TiO_2 powder mixtures



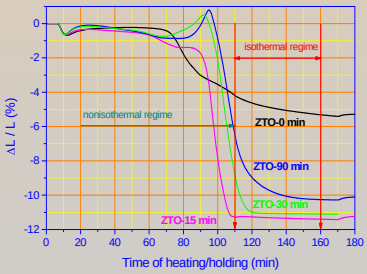


Scanning electron micrographs of starting ZnO, TiO_2, non-activated and the various activated powders

The dependence of SSA vs. time of milling



Relative shrinkage of the non-activated and various activated samples as a function of temperature during heating to 1100°C with heating rate of 10°C/min and 2 hours holding



Relative shrinkage of the non-activated and various activated samples as a function of time during heating to 1100°C with heating rate of 10°C/min and 2 hours holding

Conclusions

The influences of mechanical activation on solid-state reaction and sintering in a mixture $2ZnO$-TiO_2 were investigated. From the results of the present research it is possible to conclude that mechanical activation enables better compaction of activated powders without binders, but first of all that Zn_2TiO_4 ceramics could be obtained by mechanical activation after certain time with appropriate thermal treatment, i.e. heating rate and sintering time, at temperature lower then in case where no activated mixtures were used.

The main conclusion based on dilatometry and XRD analysis is that activation of only 15 minutes very successfully promotes solid-state reactions and sintering processes and establishes an optimal thermal treatment of sintering at a significantly lower temperature than in the case of non-activated mixture.

Acknowledgement

This research was performed within the project No. 1832 entitled "Synthesis of functional materials from the 'synthesis-structure-properties-application' relationship", financed by the Ministry for Science and Environmental Protection of the Republic of Serbia. Authors would like to express their gratitude to Prof. S. Djuric for X-ray measurements.