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# The Influence of α- and γ-$Al_2O_3$ Phases on the Thermoelectric Properties of Al-doped ZnO

Li Han, [a 1] Ngo Van Nong, [a] Le Thanh Hung, [a] Tim Holgate,[a] Nini Pryds, [a] Michitaka Ohtaki[b] and Søren Linderoth[a]

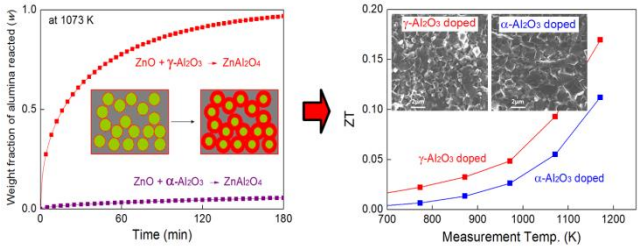
[a] *Department of Energy Conversion and Storage, Technical University of Denmark, DTU Risø Campus, Frederiksborgvej 399, 4000 Roskilde, Denmark.*

[b] *Department of Molecular and Materials Sciences, Interdisciplinary Graduate School of Engineering Sciences, Kyushu University, 6-1 Kasugakoen, Kasuga, Fukuoka 816-8580, Japan*

## Abstract:

A systematic investigation on the microstructure and thermoelectric properties of Al-doped ZnO using α- and γ-$Al_2O_3$ as dopants was conducted in order to understand the doping effect and its mechanism. The samples were prepared by the spark plasma sintering technique from precursors calcined at various temperatures. Clear differences in microstructure and thermoelectric properties were observed between the samples doped with α- and γ-$Al_2O_3$. At any given calcination temperature, γ-$Al_2O_3$ resulted in the formation of a larger amount of the $ZnAl_2O_4$ phase in the Al-doped ZnO samples. The average grain size was found to be smaller for the γ-$Al_2O_3$-doped samples than that for the α-$Al_2O_3$-doped ones under the same sintering condition. It is proposed that the $ZnAl_2O_4$ phase is the reason for the observed suppression of grain growth and also for the slightly reduced lattice thermal conductivity exhibited by these samples. The γ-$Al_2O_3$ promoted the substitution for donor impurities in ZnO, thus resulting in shrinkage of the unit cell volume and an increase in the electrical conductivity compared with the α-$Al_2O_3$-doped ZnO. At a calcination temperature of 1173K, the γ-$Al_2O_3$-doped sample showed a ZT value of 0.17 at 1173K, which is 27% higher than that of the α-$Al_2O_3$-doped sample.

*Key words: thermoelectric oxide, Al-doped ZnO, α- and γ-$Al_2O_3$, $ZnAl_2O_4$ formation kinetics.*




[1] Corresponding author at: DTU Energy Conversion, DTU Risø Campus, Frederiksborgvej 399, 4000 Roskilde, Denmark

E-mail address: ihan@dtu.dk