Grain Growth Kinetics of Cobalt-doped SnO_2 by Varying Nb_2O_5 Content

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Abstract

The aliovalent ions of CoO and Nb_2O_5 were incorporated into SnO_2 and the grain growth behavior of SnO_2 was investigated. When CoO was solely doped, it was expected that the Co ions with the negative effective charge will be segregated at the grain boundaries of SnO_2, which was thought to affect the grain boundary mobility and thus directly determine the grain growth characteristics of the SnO_2. When the amount of CoO is fixed to 1.0 mol% and the amount of Nb_2O_5 increased, the grain growth exponent of the SnO_2 changed from 3 to 2. Further addition of Nb_2O_5 recovered the exponent from 2 to 3. In the case of the SnO_2 specimen with the $Nb_2O_5/CoO = 0.505$, of which the grain growth exponent has changed from 3 to 2, it is believed that there are no segregation at the grain boundaries since the respective space charges generated by Nb^{+5} and Co^{+3} might be compensated with each other and an iso-electric point is formed. The segregation induced grain growth behavior of SnO_2 out of the iso-electric point region, where the concentration of either Co or Nb ions is richer than the other one , was also examined

PB06-T-19

The Grain Growth Velocity of SnO_2 Ceramics by Varying Nb_2O_5/CoO Co-doping Ratios

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Abstract

It is known that the degree of grain boundary segregation and the diffusion coefficient at grain boundary are the factors affect the grain growth. When additives are doped both of the factors are dependent. In this study, aliovalent ions of Nb_2O_5 and CoO were co-doped in SnO_2 with different Nb_2O_5/CoO ratios and the grain growth velocity of SnO_2 was examined. On the basis of mass action law, the concentration of tin and oxygen vacancies is dependent on the Nb_2O_5/CoO ratios. Since different defects have different diffusion coefficients in an ionic crystal and the effective diffusion coefficient of the system is determined by a slow-moving ion, changes in diffusion velocity are expected when Nb_2O_5/CoO ratios are changed, which will resultantly affect the grain growth velocity. As a result, however, the maximum grain growth velocity was observed around $Nb_2O_5/CoO = 0.25$. This is not coincide with the $Nb_2O_5/CoO = 0.50$ where the respective space charges generated by Nb^{+5} and Co^{+3} are compensated with each other and an iso-electric point is formed without segregation at the grain boundaries. The grain growth velocity of SnO_2 was discussed from the viewpoint of the defect concentration.