Effect of Crystal Orientation and Polarity on ZnO Grain Boundary Barriers

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In order to get a more profound insight into the basics of ZnO varistors we produced ZnO bicrystals of well-defined crystallographic geometries by diffusion-bonding at high temperatures of 1450°C in air. The electrical conductivity of the grain boundary was found to depend on the crystallographic orientations of the boundary planes and especially on the polarity in the case of basal-plane inversion boundaries. A typical commercial ZnO varistor contain basal-plane inversion boundaries which bisect practially every grain. They have been known to be of a head-to-head polarity configuration [1-3]. The elongated grain growth along the inversion boundaries [4] has been also explained by the slow grain growth of O-surface [5] which constitutes the intergranular boundaries of ZnO grains in the varistor. Present study thus suggests that the barrier effects of ZnO varistors should be related to the crystallography of the boundary planes.

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