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**Unique interface layer to tailor the crystallographic orientation, surface morphology and carrier transport of highly n-type-doped ZnO polycrystalline films on glass substrates**

We have been developing a unique deposition method together with a growth process to achieve tailor-made properties, such as carrier concentration ( $N_c$ ) and Hall mobility ( $\mu H$ ), of degenerate n-type-doped wide-bandgap oxide films prepared on amorphous glass substrates. We, very recently, reported that 500 nm thick ZnO-based textured polycrystalline films consisting of 490-nm-thick Al-doped ZnO (AZO) polycrystalline films deposited on 10 nm thick Ga-doped ZnO (GZO) polycrystalline films exhibited a high  $\mu H$  of  $50.1 \text{ cm}^2/\text{Vs}$  with a  $N_c$  of  $2.55 \times 10^{20} \text{ cm}^{-3}$ . The film growth process was a substrate temperature as low as  $200^\circ\text{C}$  with no post heat annealing process. Firstly, the very thin GZO films were prepared on glass substrates by ion plating with dc arc discharge, which has been developed by our group and the AZO films were then deposited on the GZO films by Direct Current Magnetron Sputtering (DC-MS). The GZO interface layers with a preferential c-axis orientation play a critical role in producing AZO films with a well-defined (0001) orientation and a flat surface, whereas AZO films deposited by only DC-MS showed a mixture of the c-plane and the other plane orientation, resulting in very rough surfaces, to exhibit a low  $\mu H$  of  $38.7 \text{ cm}^2/\text{Vs}$  with a  $N_c$  of  $2.22 \times 10^{20} \text{ cm}^{-3}$ . The key point is to reduce a contribution of grain boundary scattering to the carrier transport due to the drastically improved crystallographic orientation and alignment between columns. Our results indicate that high  $\mu H$  polycrystalline oxide films possess rather unique equiaxed columnar grain structure, which enriches our current knowledge of ultimate carrier transport.

**Biography**

Tetsuya Yamamoto has obtained PhD degree in Theoretical Condensed Matter Physics from Osaka University in 1997 and has been a Professor of Kochi University of Technology since 2001. His area of expertise is in the film growth, the development of film growth apparatus, characterization, first-principles calculation and condensed matter physics theory of wideband-gap semiconductors such as GaN, ZnO and In<sub>2</sub>O<sub>3</sub>. He has been the Supervisor of many national projects in Japan. He has won the prize by the Ministry of Education, Culture, Sports, Science and Technology for his work on ZnO-based transparent conductive oxides films for optoelectronic devices in 2011.

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