HIGH CONDUCTIVITY OF SI-DOPED Β-(ALXGA1-X)2O3 THIN FILMS VIA MIST CVD

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Recently, gallium oxide (Ga_2O_3) has gained attentions for power switching applications owing to its high breakdown field [1]. β-$(Al_xGa_{1-x})_2O_3$, an alloy of β-Ga_2O_3 and θ-Al_2O_3, is essential for Ga_2O_3-based heterojunction device applications [2]. For β-Ga_2O_3, Si is utilized as the most effective n-type dopant [3]. Our group has reported high-conductivity Si-doped β-Ga_2O_3 thin films via mist CVD, which can be performed cost-friendly [4]. Therefore, we demonstrated Si-doped β-$(Al_xGa_{1-x})_2O_3$ thin films via mist CVD to enhance the Ga_2O_3-based device applications.

We utilized $Ga(acac)_3$, $Al(acac)_3$, and $C_6H_{12}ClNSi$ as mist CVD precursors. Si-doped β-$(Al_xGa_{1-x})_2O_3$ thin films were grown on Fe-doped β-Ga_2O_3(010) substrates by mist CVD.

Figure 1 shows (a) X-ray diffraction (XRD) 2θ-ω scan profiles, (b) reciprocal space mapping (RSM), and (c) the relationship between the Hall mobility and carrier concentration of the Si-doped β-$(Al_xGa_{1-x})_2O_3$ thin films for Al compositions below 10% and above 10%. As shown in Fig. 1(a), the peak of the highly crystalline β-$(Al_xGa_{1-x})_2O_3$ 020 with Laue oscillation was observed. RSM revealed that the thin film was coherently grown on the substrate. The Al composition was calculated from the peak of XRD 2θ-ω following the report by Oshima et al. [5] The mobility decreases as the Al composition exceeds 10%. This result is consistent the findings of Anhar Uddin Bhuiyan et al. [6] In addition, highly conductive β-$(Al_{0.14}Ga_{0.86})_2O_3$ thin films which exhibits 593 S/cm were achieved through Si doping by mist CVD.

These results are expected to expand possibility of Ga_2O_3-based device applications.