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Growth of nitride semiconductors on oxide templates by rf-magnetron sputtering

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AlN layers were deposited on ZnO templates by radio-frequency magnetron sputtering changing various deposition parameters, such as substrate temperature, working pressure, plasma power. Powder-sintered targets of AlN and ZnO were adopted and Ar and N2 were used for working gas. Base pressure was below mid-10^{-6} Torr and working pressure was 5 mTorr. Rapid thermal annealing (RTA) treatment was carried out for all samples to improve crystal quality of AlN. We measured x-ray diffraction (XRD) $\omega/2\Theta$ scan for AlN layers grown directly on c-plane sapphire at room temperature after RTA treatment at 500, 700, 900 ^{o}C. AlN (0002) peak around 35.8 ^{o} became stronger at higher RTA temperature which means improved (0002) orientation. But extra peaks at 37.5 and 45 ^{o} from Al metal were also observed at high temperature. No other peak was observed from as-grown AlN sample. We also observed cross-section images of as-grown AlN on ZnO template and AlN on ZnO template which was treated in typical growth ambient of MOCVD for GaN by scanning electron microscopy (SEM). AlN was well-deposited on ZnO template by rf-sputtering. But the interface of ZnO/AlN was clearly observed and AlN in other region shows the delamination from ZnO template. This region looks hole-shaped and these holes were uniformly observed at whole surface. And thickness of ZnO in this region was a little reduced which was caused by the reaction of ZnO and NH_3. This results means ZnO surface was not perfectly covered by AlN layer even though AlN was well-deposited as confirmed by SEM measurement. Therefore we should found the optimum growth condition for AlN layer with better crystal quality by changing various growth parameters.