MOCVD growth and characterization of wide band gap $ZnGeN_2$ thin films

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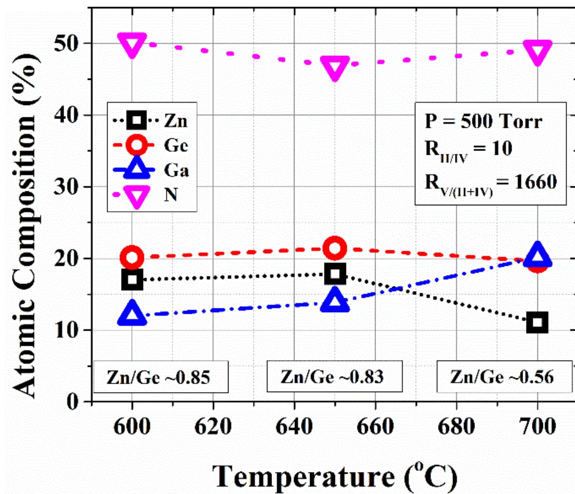

Figure 1. Atomic composition of Zn, Ge in three $ZnGeN_2$ films grown on GaN substrate at different temperatures. The compositions of Ga and part of the N corresponds to the substrate.

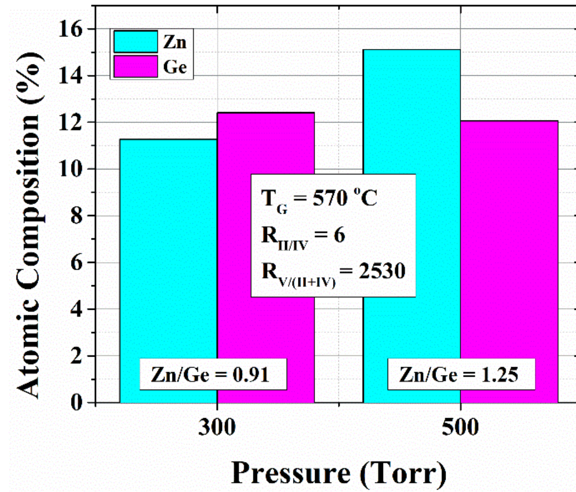

Figure 2. Atomic composition of Zn, Ge in two $ZnGeN_2$ films grown on GaN substrate with identical conditions except the pressure. With otherwise identical conditions, Zn/Ge atomic percentage ratio increases with increase in pressure.

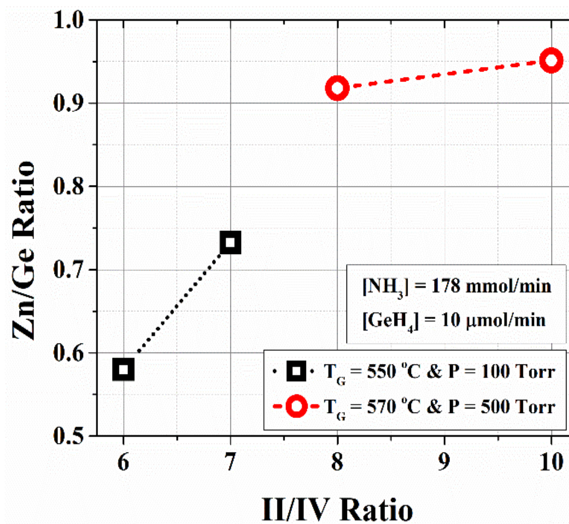

Figure 3. Effect of $DEZn/GeH_4$ molar flow rate ratio on Zn/Ge atomic ratio in the grown $ZnGeN_2$ films.

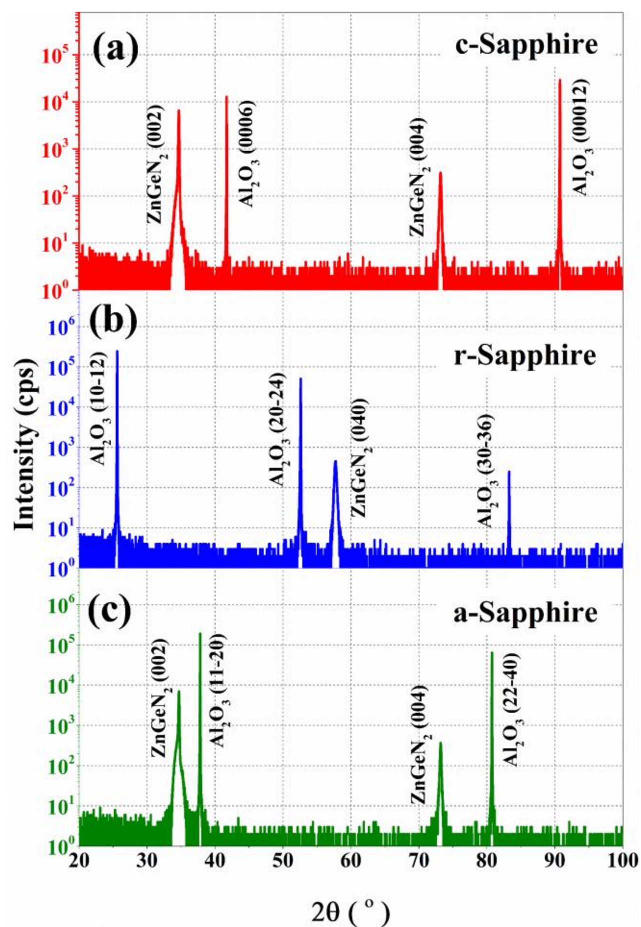

Figure 4. XRD 2θ-ω spectra of $ZnGeN_2$ films on (a) c-sapphire, (b) r-sapphire and (c) a-sapphire substrates. $ZnGeN_2$ grows along c-axis on c-and a-sapphire substrates whereas along $Pna2_1$ (010) direction on r-sapphire.

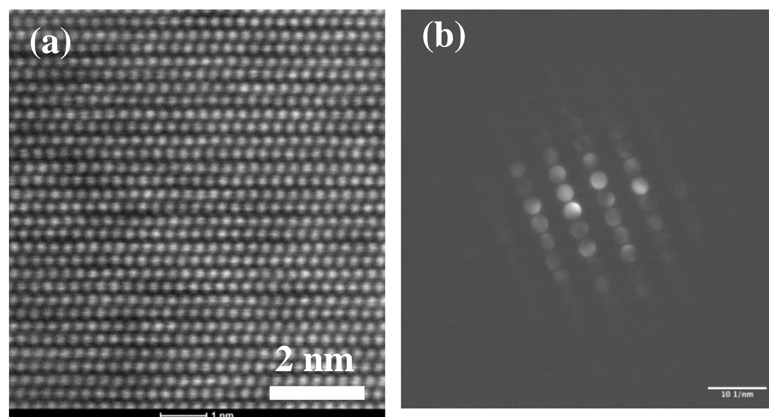

Figure 5. High resolution scanning transmission electron microscopy (STEM) high angle annular dark field (HAADF) image (a) and convergent beam electron diffraction pattern (b) of $ZnGeN_2$ film grown on c-sapphire.