

Influence of the electron beam on the initial stage of AlN formation in ammonia MBE

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Nitridation process is a fundamental stage in the formation of III-nitrides on sapphire substrate. This process represents exposition the heated substrate to a flux of ammonia, followed by the formation of crystalline AlN. When the temperature of substrate reaches 1150 °C reconstruction transition (1x1) - ($\sqrt{31} \times \sqrt{31}$) R9 occurs. We discovered that the continuous exposure by the high-energy electrons (11 keV) leads to the reverse reconstruction transitions ($\sqrt{31} \times \sqrt{31}$) R9 - (1x1). Moreover, the nitridation of (1x1) surface accelerates in a few times under the influence of e-beam. Successful nitridation of the ($\sqrt{31} \times \sqrt{31}$) R9 surface occurs exclusively under e-beam exposure. It was concluded that the e-beam stimulates desorption of oxygen accelerating thereby the nitridation process of sapphire substrate. The correct time of sapphire nitridation without the influence of the electrons was determined. The structural quality of AlN layers was significantly improved, the density of inversion domains and dislocations were decreased in AlN layers. The reported study was funded by RFBR according to the research projects № 17-02-00947 and № 16-02-00018.