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Growth of AlGaN alloys under excess Group III conditions: Formation of Vertical Nanorods

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Abstract

Droplet Epitaxy of AlGaN nanostructures was investigated in this work. Growth was carried out by Plasma Assisted Molecular Beam Epitaxy (PA-MBE) under extreme group III rich conditions, where the excess metal remained on the growth surface and formed nanoscale metallic droplets due to the interplay of surface energy, surface diffusion and desorption, all of which are strongly dependent on the relative arrival rates of Gallium and Aluminum and the substrate temperature. Intermittent exposure of this metallic film to active nitrogen forms various types of nanostructures, whose morphology, composition and luminescence properties were evaluated. Our results indicate that for AlN, the droplet epitaxy process forms random arrays of uniform well oriented [0001] nanorods with a height of ~1µm and a diameter of 250nm. For AlGaN grown under excess gallium, and intermittent exposure to the active plasma, structures with diameters of 200µm to 600µm and a height of 80nm were observed. We report the spontaneous formation of lateral concentric heterostructures under these conditions. A single photoluminescence (PL) peak was observed at about 260nm with a room temperature to 4K intensity ratio of ~25%.

Keywords: A1. Nanostructures, A3. Molecular Beam Epitaxy, A3. Migration Enhanced Epitaxy, B1. Nitrides

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