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# Optimisation of PECVD parameters in order to obtain aluminium nitride nano-dots

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Compact high-efficiency ultraviolet solid-state light sources, such as light-emitting diodes (LEDs) and laser diodes, are of considerable interest as alternatives to large, toxic, low efficiency gas lasers and mercury lamps, high-density optical data storage or biomedical research. With a band gap of 6.1 eV, AlN appears to be an ideal material for the development of deep UV light sources and extreme detectors. AlN LEDs (at a 210 nm emission wavelength, which is the shortest ever reported) have been manufactured but their power and efficiency are still very low due to the high dislocations density in the AlN layers. Studies have already shown the importance of the crystalline quality and orientation for the light emission or detection in nitride based semiconductors. A way to improve their efficiency is to introduce carrier confinement structures such as quantum dots.
Such devices based on AlN nano-dots have not been obtained yet, and the Plasma Enhanced Chemical Vapor Deposition technique for this kind of application is new. The most used techniques are Molecular Beam Epitaxy (MBE) which is more appropriated to laboratory studies and Metal-Organic Chemical Vapor Deposition (MOCVD) which requires a high temperature (1000°C) to allow the reaction of AlN formation. So the PECVD technique makes possible to reduce the deposition temperature by using a $N_2$ microwave plasma and trimethylaluminium ($Al(CH_3)_3$) precursor. The aim of this work is to find the deposition parameters allowing the obtention of aluminium nitride nano-dots on Si(111) by microwave PECVD and to study their properties.
PECVD process parameters influence on the deposition rate was studied to highlight the conditions allowing the nucleation and growth of nanometric clusters instead of those forming a continuous film. X-ray diffraction measurements were performed to verify the crystalline development and to get indication of preferential orientations relative to the substrate. Surface morphology was analysed by atomic force microscopy (AFM) and scanning electron microscopy (SEM). Then correlations between the growth mechanisms and the structure of films were considered.

**Keywords**
PECVD
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Nucleation and growth