NANOCAVITIES AND NANOEMITTERS WITH ALN/GaN BRAGG REFLECTORS GROWN BY MBE IN NANOPILLAR ARRAYS.

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The growth of GaN multi-quantum discs (MQDs), embedded in (Al,Ga)N nanocolumns grown by MBE on Si(111) substrates, was recently reported [1,2]. The self-assembled nanostructures grow under highly N-rich conditions, showing an outstanding crystal quality and very high luminescence efficiency, with no traces of extended defects, like dislocations or stacking faults. The (Al,Ga)N nanocolumns, with diameters ranging from 30 to 150 nm, are strain free, whereas the GaN MQDs are fully strained, though the strain is inhomogeneously distributed. Photoluminescence and cathodoluminescence data revealed quantum confinement effects in a nanostructure with 4 nm thick 5xGaN MQDs.

In this work we report on the growth of a wide variety of nanostructures with GaN MQDs of different disc thicknesses (2 nm to 8 nm), and 8 to 10 nm thick (Al,Ga)N barriers (Al content between 16% and 100%). The nanostructures were grown on Si(111) substrates starting with GaN and followed by the (Al,Ga)N and the GaN MQDs. This new approach avoids the growth of mixed compact/columnar material when starting to grow (Al,Ga)N nanocolumns, due to a much higher surface diffusion of the Al versus Ga adatoms. Photoluminescence measurements clearly show emissions related to the GaN MQDs that blueshift as their thickness is reduced from 8 to 2 nm.

AlN/GaN Bragg reflectors, with 10 (bottom) and 5 (upper) periods and nominal reflectivities of 87% and 50% at 345nm respectively, have been grown on the nanostructures previously mentioned, to form a nanocavity with an active region of 5xGaN MQDs in between. Results from photoluminescence experiments, transmission electron microscopy, and strain distribution calculations will be presented.

[1] E. Calleja, M.A. Sánchez-García, F.J. Sánchez, F. Calle, F.B. Naranjo, E. Muñoz, U. Jahn, and K.H. Ploog, Phys. Rev. B **62**, 16 826 (2000).

[2] J. Ristiç, E. Calleja, M.A. Sánchez-García, J.M. Ulloa, J. Sánchez-Páramo, J. M. Calleja, U. Jahn, A. Trampert, and K.H. Ploog, Phys. Rev. B **68**, 125305 (2003).