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Amorphous silicon for post-processed photonic layer on top of a CMOS microchip

Sandro Rao
Università degli Studi "Mediterranea" di Reggio Calabria, Italy

Silicon photonics is a new emerging and disruptive technology aimed at using cost-effective silicon-based materials for the generation, control and detection of modulated light signals for optical communications and many sensing applications. So far, most of the research has demonstrated a two dimensional (2D) approach to the photonic components, nevertheless, the possibilities to design and fabricate a three dimensional (3D) CMOS photonic integrated chip is of fundamental importance as it enables increased complexity and scalability of optical circuitry and the continuation of the Moore's law. In this context, hydrogenated amorphous silicon (a-Si:H) is a particularly promising platform for enabling the desired matching between electronics and on-chip photonics. Thin a-Si:H layers can be in fact deposited using the CMOS-compatible low-temperature plasma-enhanced chemical vapor deposition technique, with no impact at all on the microelectronic layers. Moreover, the flexibility of depositing a-Si:H on a wide range of substrates can be exploited for a readily available, truly CMOS-friendly, PIC technology for those applications where communication rates of a few Gbps are adequate. It is worth noting that the use of a-Si:H in microelectronics is in fact already an industrial standard. It is sufficient to think of the huge and established industry of TFT-based displays where yields and reliability are comparable to those of the crystal silicon industry. Recently, first experimental results have been reported on waveguide integrated, a-Si:H-based, electro-optic devices operating at the telecommunication wavelengths, demonstrating that this technology is a suitable platform for the low cost fabrication of PICs on standard electronic microchips.

sandro.rao@unirc.it

Ordered arrays of III- nitride nanorods grown on polar and semi-polar orientations: From light emitters to pseudo-substrates

E Calleja[1], A Bengoechea-Encabo[1], S Albert[1], M A Sanchez-García[1], D Lopez-Romero[1], A Trampert[2], U Jahn[2], F Bertram[3] and J Christen[3]
[1]University Politécnica, Spain
[2]Paul-Drude-Institut, Germany
[3]Otto-von-Guericke-University Magdeburg, Germany

New advances on Selective Area Growth (SAG) of InGaN/GaN nanostructures by plasma-assisted MBE on GaN/sapphire templates and Si (111) substrates are presented. Both, axial and core-shell structures are considered. Very intense green electroluminescence is achieved on axial nanoLEDs grown on Si(111). Blue emission is observed in core-shell nanoLEDs. First results on core-shell InGaN/GaN structures grown by MBE on GaN templates are also presented. Cylindrical micro-rods are etched down by ICP from a 3 micron thick GaN/sapphire template. GaN and InGaN layers are then grown both in axial and radial directions so that the initial GaN cylinder is covered in a conformal way. Hexagonal symmetry is fully recovered once the GaN shell layer is grown. Potential advantages of this core-shell structure as compared to the axial one are twofold: The increase of emission surface (lateral area) and the absence of internal electric fields (m-plane). The crystal perfection is much better than that of 2D InGaN films of similar in % composition. Ordered arrays of GaN and InGaN axial nanostructures are grown on non-polar and semi-polar directions and subsequently merged into a continuous film to produce high quality pseudo substrates. Results show that in both cases the resulting films exhibit a very strong luminescence, orders of magnitude higher that from the substrate used. Semi-polar GaN templates have a huge density of stacking faults (SFs) most of them are filtered upon coalescence of the nanostructures grown on top. In all cases there is a preferential growth direction along the c-plane (0001). PL and spatially resolved CL measurements on individual nanostructures, polar, non-polar, or semi-polar show that the incorporation depends strongly on the crystal plane considered.

calleja@isom.upm.es