# MBE growth of Quantum nanostructures for optoelectronics

J. M. García[1,2,*], S. Wang[2], A. Plaut[3], U. Wurstbauer[2], A. Pinczuk,[1,2] J. M. Ripalda[1], D. Granados[1], B. Alen[1], Y. González[1], L. González[1]
[1]*MBE-LAB, Instituto de Microelectrónica de Madrid, CNM-CSIC, Tres Cantos, Spain*
[2]*Department of Applied Physics, Columbia University in the city of New York, NY, USA*
[3]*University of Exeter, Exeter, UK.*
*email: jm.garcia@csic.es

Molecular Beam Epitaxy (MBE) is a powerful technique for the fabrication of several self-assembled III-V nanostructures such as quantum rings, quantum dots, [1] and quantum wires that can cover a wide range of the spectrum from 0.98 μm to 1.6 μm (fig. 1).

The possibility of performing in-situ, real-time, measurements of accumulated stress (Σσ) during growth of these nanostructures enables to achieve a deep understanding of the growth processes. For example, whereas quantum rings (QR) formation is crucially linked to the presence of liquid indium on the surface, quantum wires (QWR) are produced [2] as an effective way of relaxing a large asymmetrical accumulated stress present on the sample (fig. 2).

This information allows a fine-tuning of the optoelectronic properties by controlling their size and shape. Furthermore, the capability of tracking Σσ during growth is used to engineer strain compensated structures like multilayer quantum dot solar cells [3].

The growth of Graphene by MBE on h-BN (Fig. 3) will also be discussed [4]. Aknowlegments:, CHE-0641523, CSIC-PIF200950I154,S2009ESP-1503, S2009ENE-1477 and AIC-B-2011-0806, MAT2011-26534.

[1] Phys. of Quantum Rings. Springer, F. Vladimir, (Ed.). ISBN 978-3-642-39196-5 (2013)
[2] J.M. Garcia, et al., J. of Crys. Growth., **227**, 975-979 (2001)
[3] D. Alonso-Alvarez, et al., Ad. Mat., **23**, 5256-5261 (2011)
[4] J.M. Garcia, et al., **152**-12, 975-978 (2012)

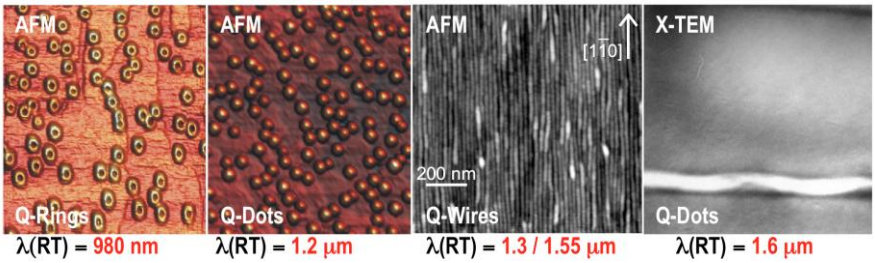


Fig.1 Self-assembled nanostructures covering the spectrum from 0.98 to 1.6 μm emission at RT.

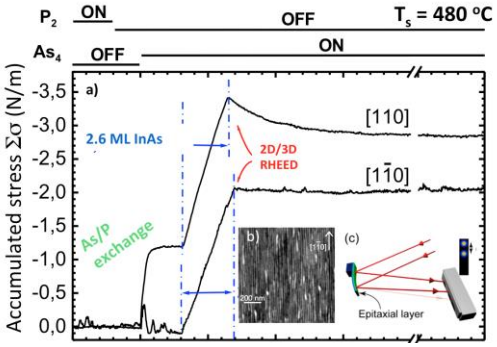


Fig. 2 In-situ, real-time measurements of accumulated stress are crucial for a deep undertanding of the formation mechanisms.

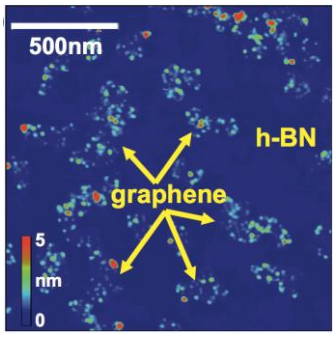


Fig.3 MBE growth of graphene nanodomains on h-BN.