Growth and characterization of unstrained GaAs/AlGaAs quantum dots

S.F.C. da Silva [1*], Huiying Huang [1], Xueyong Yuan[1] and A.Rastelli[1]

[1] *Institute of Semiconductor and Solid State Physics,Johannes Kepler University,Altenbergerstr. 69,A4040, Linz, Austria*

Epitaxial semiconductor quantum dots are attracting much interest for their potential use in emerging quantum technologies. These fascinating structures can be created by different approaches, such as the Stranski-Krastanow growth mode, the overgrowth of patterned pits[1] or self-assembled nanoholes[2] with an optically active AlGaAs/GaAs heterostructure. In turn, nanoholes can be obtained by using Al droplets to locally etch AlGaAs[3]. This has the versatility of being fully performed in a III-V molecular beam epitaxy system and does not require any kind of ex-situ process. These dots can grow with a highly symmetric shape, resulting exciton emission with a small fine structure splitting[4] that could be applied for entangled photon generation[5]. However some unknown slow relaxation mechanism[5]resulting in a time-jitter in the photon emission for these dots when exctied non-resonantly. We present here results on the growth of GaAs/AlGaAs dots and the correlation between decay dynamics and dot size. The latter is controlled systematically by changing the amount of GaAs used to fill the AlGaAs nanoholes.

(1) Hartmann, A.; Ducommun, Y.; Loubies, L.; Leifer, K.; Kapon, E. Structure and Photoluminescence of Single AlGaAs/GaAs Quantum Dots Grown in Inverted Tetrahedral Pyramids. *Appl. Phys. Lett.* **1998**, *73*, 2322–2324.

(2) Rastelli, A.; Stufler, S.; Schliwa, A.; Songmuang, R.; Manzano, C.; Costantini, G.; Kern, K.; Zrenner, A.; Bimberg, D.; Schmidt, O. G. Hierarchical Self-Assembly of GaAs/AlGaAs Quantum Dots. *Phys. Rev. Lett.* **2004**, *92*, 166104.

(3) Heyn, C.; Schnüll, S.; Hansen, W. Scaling of the Structural Characteristics of Nanoholes Created by Local Droplet Etching. *J. Appl. Phys.* **2014**, *115*, 24309.

(4) Huo, Y. H.; Rastelli, A.; Schmidt, O. G. Ultra-Small Excitonic Fine Structure Splitting in Highly Symmetric Quantum Dots on GaAs (001) Substrate. *Appl. Phys. Lett.* **2013**, *102*, 152105.

(5) Jahn, J.-P.; Munsch, M.; Béguin, L.; Kuhlmann, A. V.; Renggli, M.; Huo, Y.; Ding, F.; Trotta, R.; Reindl, M.; Schmidt, O. G.; *et al.* An Artificial Rb Atom in a Semiconductor with Lifetime-Limited Linewidth. *Phys. Rev. B* **2015**, *92*, 245439.

Contact: saimoncovre@gmail.com