Growth and modelling of distributed Bragg reflectors for quantum microcavities

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- scientific abstract -

Simulation and computer assisted design of Bragg reflectors

Simulation and computer assisted design of Bragg reflectors, which will be grown using laser techniques during the next stages, offers the possibility to model a multitude of Bragg reflectors for semiconductor microcavities using the *transfer matrix theory*. This approach makes it possible to estimate *a priori* the effects that different types of interactions and physical mechanisms might have on the optical properties of the resulting structures, such as: i) wavelength dependence of materials optical coefficients; ii) the spectral broadening induced by the presence of doping agents; iii) the possible variation of optical coefficients due to the presence of dopants, etc.

A simulation of a reflectance spectrum is illustrated in Figure 1 below, for the case of a Bragg reflector made of 8 pairs of $Al_{0.2}Ga_{0.8}N$/AlN grown on a Si (111) substrate. The thickness of the layers is in such a way as to have a reflection band centered around an energy ν_0 of 3.49 eV (~355 nm), this being the radiative recombination energy of a free exciton in GaN, at room temperature. Parameters used in this simulation are: the refraction index of the incidence medium (air), n_0 = 1; refraction indexes of AlN (n_{AlN} = 2.165) and $Al_{0.2}Ga_{0.8}N$ ($n_{Al0.2Ga0.8N}$ = 2.52) at 355 nm [N. Antoine-Vincent *et al.*, J. Appl. Phys. 93, 5222 (2003)]; the refraction index of the Si (111) substrate (n_{Si} = 5.64) at 355 nm [J. Humlicek *et al.*, J. Appl. Phys. **65**, 2827 (1989)].

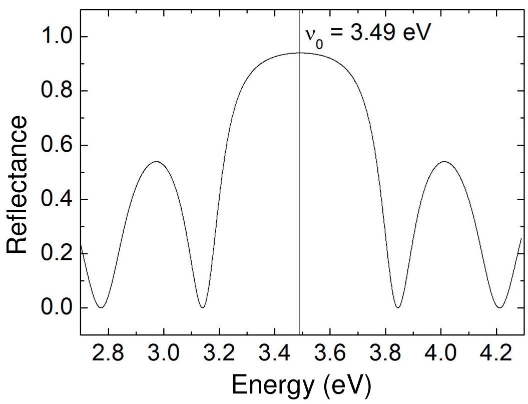

Figure 1. Theoretical reflectance spectrum of a Bragg reflector made of 8 pairs of $Al_{0.2}Ga_{0.8}N$/AlN layers of λ/4 thickness grown on Si (111).

Laboratory setup

Concerning the laboratory setup, during this period we performed adaptations of the deposition installations for the growth of Bragg reflectors, with applications in the field of semiconductor microcavities. To this end, the allocated logistics funds were used for: i) acquisition of a quartz microbalance system used for *in situ* monitoring of the deposited layers thickness; and ii) acquisition of a radiofrequency generator necessary for experiments of plasma beam assisted pulsed laser deposition of dielectric layers.