Res. Rev. J Mat. Sci. 2018, Volume 6
DOI: 10.4172/2321-6212-C2-018

Inhibit source of 1.3 um quantum dot intermixing using STO for high laser performance

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Significant behavior has been observed by studying the PL emission for post growth thermal annealing in a long wavelength QDs materials, capped with STO, highly recommended as inhibit source for intermixing, and a promising materials for highly laser performance. For intermixing studies, samples were deposited with Strontium titanium oxide (STO) 100 nm thickness using pulsed layer deposition (PLD), annealing used rapid thermal annealing (RTP) under GaAs overpressure at temperature ranging 650 to 725°C for 2 minutes were applied on it to cause thermal interdiffusion with a different rate. Samples were excited by 1064 nm laser source, and PL spectrum under 77 K were measured for all different annealing samples. Figure 1 shows a clear inhibition diffusion behavior when intermixing until 725°C annealed temperature, this gives a good reason for recommendation of this material in multiple wavelength chip, when using a mask with it, and SiO_2 as a second promote intermixing source. A strain effect clear in the deposited samples shows as a red shift in the spectra. A second observation have been seen is the merging of the two peaks, GS and first excited state, while annealing the diffusion of In in the dots cause a change in the QDs density of state, which seen as a merging in the two states, in order to estimate the critical temperature that the states have been merged, we plot the different in energy between GS, ES1 as a function of annealing temperatures- figure 2, the point where the linear line intercept with X axis represent the critical temperature. Gaussian fitting have been used to estimate the peaks wavelength for all spectrum, figure (3) shows the behaviors when annealing, for whole spectrum a decrease in FWHM has been observed while annealing until 700°C around critical temperature it started to increase (because of third peak effect), For GS behavior, it started to decrease with annealing (because of merging with ES1, above TC, it completely merge so couldn't be estimated from Gaussian fitting. For ES1: it started to increase, (cause of GS merge with it), then at TC started to decrease (because of appearance of third peak).

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