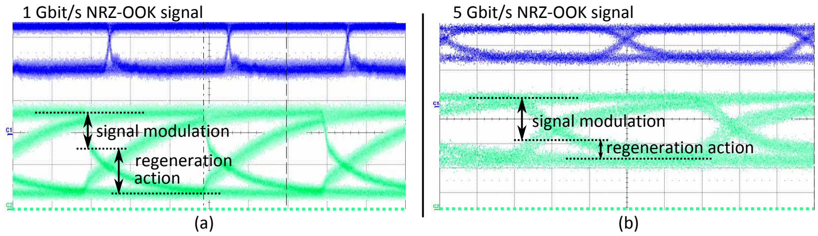

Fig. 5. Eye diagram for regeneration of (a) a 1 Gb/s signal at 1530 nm and a power of −1.5 dBm and of (b) a 5 Gb/s signal at 1530 nm and a power of 6 dBm.

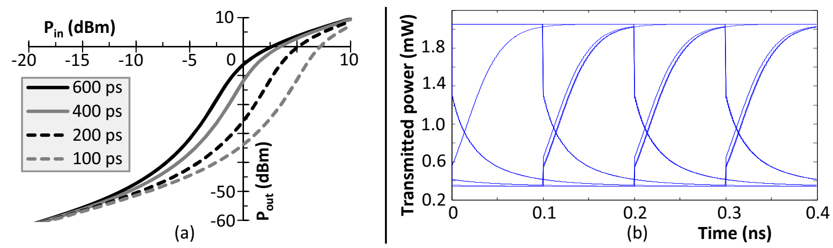

Fig. 6. (a) Simulated transmission curves in the MIPS for different values of τ_c (b) Simulated eye diagram at 10 Gb/s with $\tau_c = 100$ ps.

effect of τ_c on the simulated $P_{out}(P_{in})$ curves is shown. It seems that as τ_c decreases, the required power to bleach the device increases such that the delivered energy during a time τ_c stays the same. In Fig. 6(b) a simulated eye diagram for a signal with an input ER of 2 dB and average input power of 7.2 dBm shows that 10 Gb/s operation is feasible with a reduction of the receiver sensitivity power of 5 dB if the carrier lifetime is brought down from a measured 600 ps to 100 ps. There are several strategies to achieve this. First of all, the width of the III-V membrane waveguide could be brought down. This reduces τ_c due to an increased surface recombination. At the same time the necessary power to bleach the device will go down. Secondly, ions could be implanted to create intermediate energy states in the InGaAs band gap, which can provide for a rapid non-radiative carrier recombination. Finally, by applying a strong electric field across the device, the carriers can be swept out of the QWs, also leading to a reduction of τ_c.

6. Conclusion

In this paper, we have proposed to use the MIPS as an all-optical regenerator. The very high non-linearity in the transmission curve was used to demonstrate passive regeneration of extinction ratio from 2 dB to 6.2 dB, leading to a receiver sensitivity improvement of up to 4.5 dB at a bit rate of 1 Gb/s. Regeneration action was demonstrated across the entire C-band with varying receiver sensitivity improvements since it is dependent on the exact choice of band-edge for the quantum wells. The regenerator was operated with an 8 dB insertion loss (excluding the fiber coupling losses) and required no temperature control. A practical regenerator will be required to operate at 10 Gb/s and give similar regeneration across an entire band of wavelengths (full C-band/L-band) while incurring a minimum insertion loss. Based on the device we tested we believe that lower insertion losses and equal regeneration across the entire C-Band is possible by fine tuning the band gap of the quantum wells. Also, some of the improvement in extinction ratio can be traded for a lower insertion loss. Finally, we have shown, using simulation, that by shortening the carrier lifetime to 100 ps operation at 10 Gb/s is possible. In future work, the proposed strategies to decrease the carrier lifetime will be implemented.

86' 5HFHLYHG-DQUHYLVHG$UDFFHSWHG$USXEOLVKHG0D\