PD.15

Demonstration of optical bistability in narrow asymmetric coupled quantum wells

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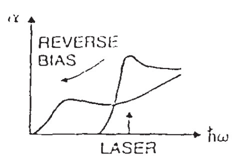
Contents

Conventional SEED

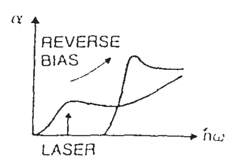


QCSE: Red-shift of effective bandgap

Arrays: 64×32 logic gates
Miller (1990)

Wannier-Stark localization:
* Voisin *et al.* (1988)
* Olbright *et al.* (1990)

Blue-shift SEED



Based on anticrossing of heavy-hole levels

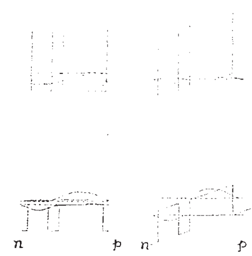
* Proposed by:
  Khurgin (1988)
  Miller (1989)

* Confirmed experimentally by Goosen *et al.* (1990): strained InGaAs-GaAs (<111>)

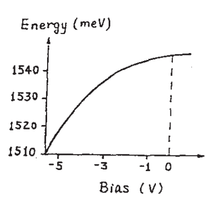
Advantages:
1. Low residual absorption
2. Large operating wavelength range
3. Relative lower voltage

Asymmetric coupled quantum wells

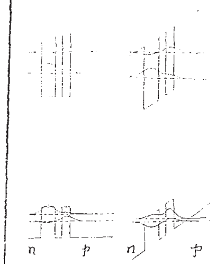
Red-shift



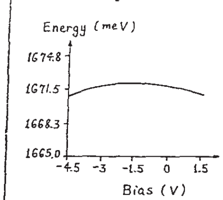
* Le *et al.* (1987)
* Little *et al.* (1989)
* Tokuda *et al.* (1990)



Blue-shift



Differences:
* ~ 3 times narrower
* Thicker QW's in n-doped side



Nonlinearity in ACQW's

I. Unrelated to external feedback
via photocurrent

* Second-order nonlinearity
(based on intersubband transitions):
proposed by Khurgin (1987)
confirmed by Rosencher *et al.* (1990)

* Third-order nonlinearity
(10^{-10} W/cm^2 - 10^{-6} W/cm^2):
Little *et al.* (1987)

* Anomalous excitation-intensity
dependence of photoluminescence:
Tokuda *et al.* (1989)

II. Nonlinearity based on intrinsic feedback

* Here we observed
strong excitonic nonlinearity
in photocurrent measurement

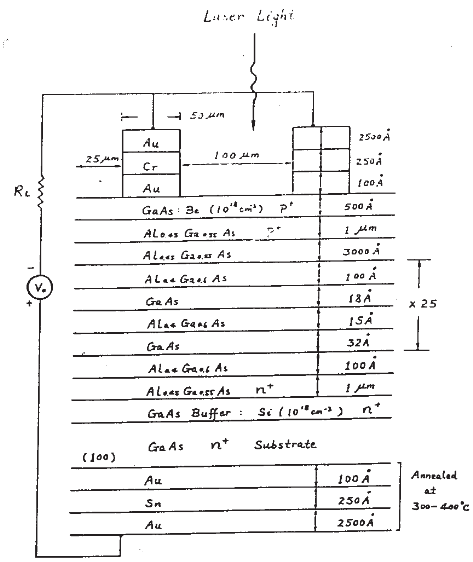
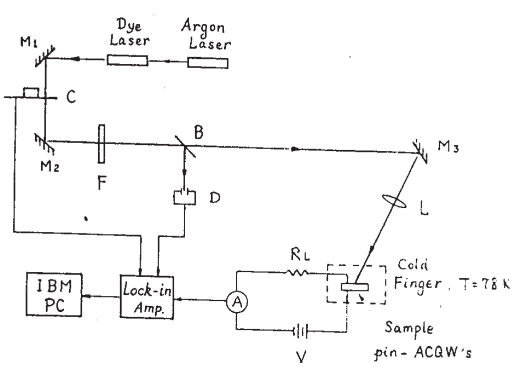
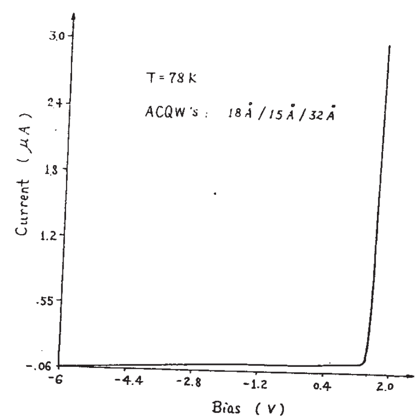


Fig. 2

Experimental Set-up



Red line : Optics ; Blue line : Electronics .



$V_{bi} = -1.49$ V

U-M-I

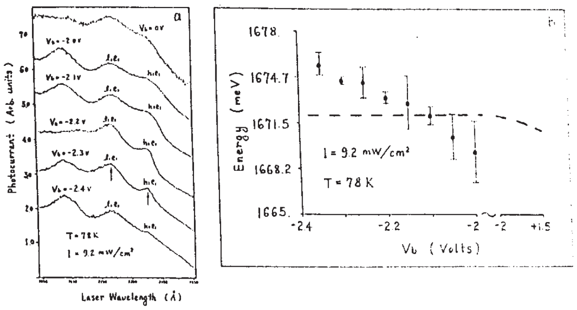


Fig. 3

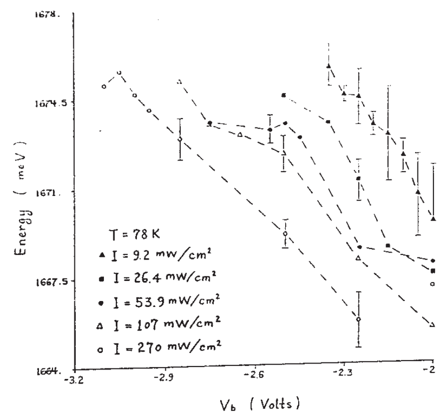


Fig. 4

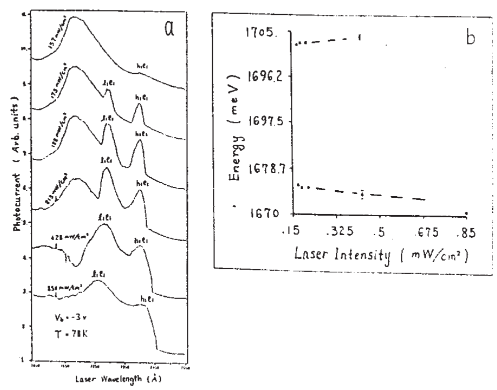
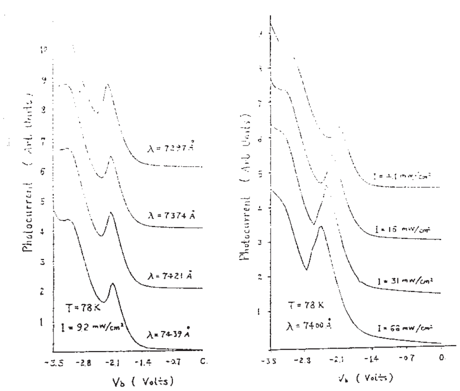
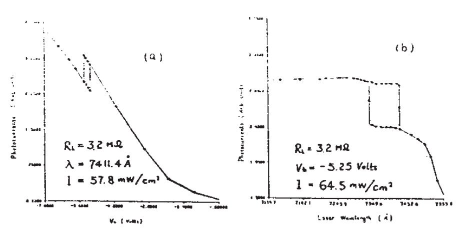


Fig 3





Conclusion

* Based on anticrossing of heavy-hole levels in GaAs-$Al_{1-x}Ga_xAs$ asymmetric coupled QW's, blue-shift as large as 6.1 meV at reverse bias - 2.35 V was observed.

* We also observed intensity-enhanced blue-shift of heavy-hole excitonic transition (~ 10 meV)

* Existence of feedback inside QW's structure

* Optical bistability was achieved based on the observed blue-shift and excitonic nonlinearity.