Faculty of Engineering and Physical Sciences

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UNIVERSITY OF SURREY

Wavelength dependence of the performance of GaInAsSb mid-infrared lasers

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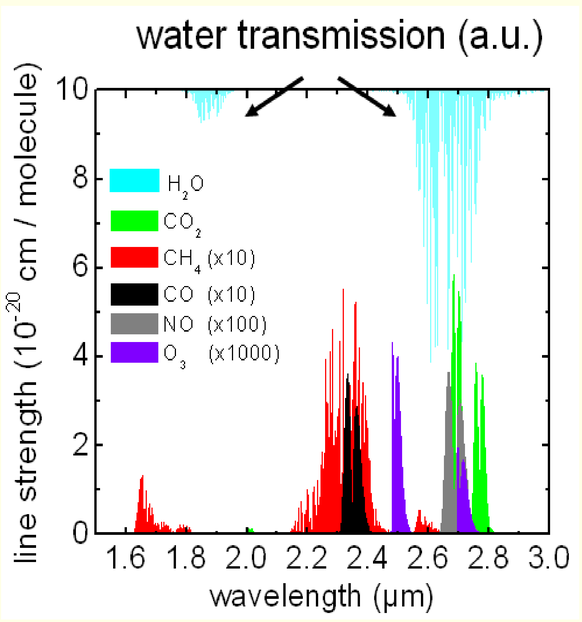
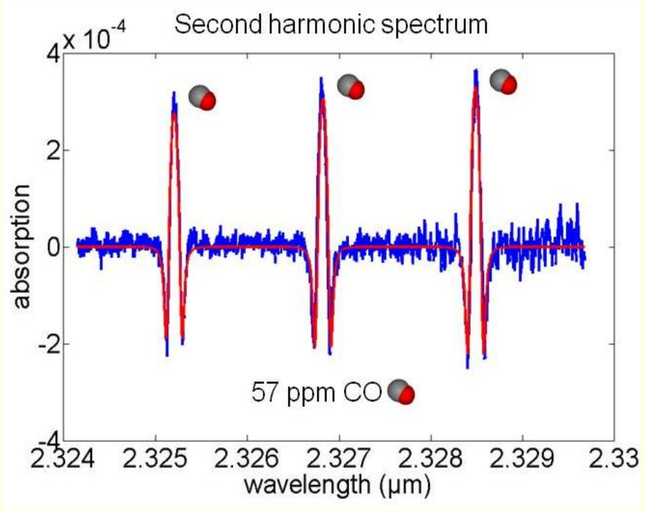
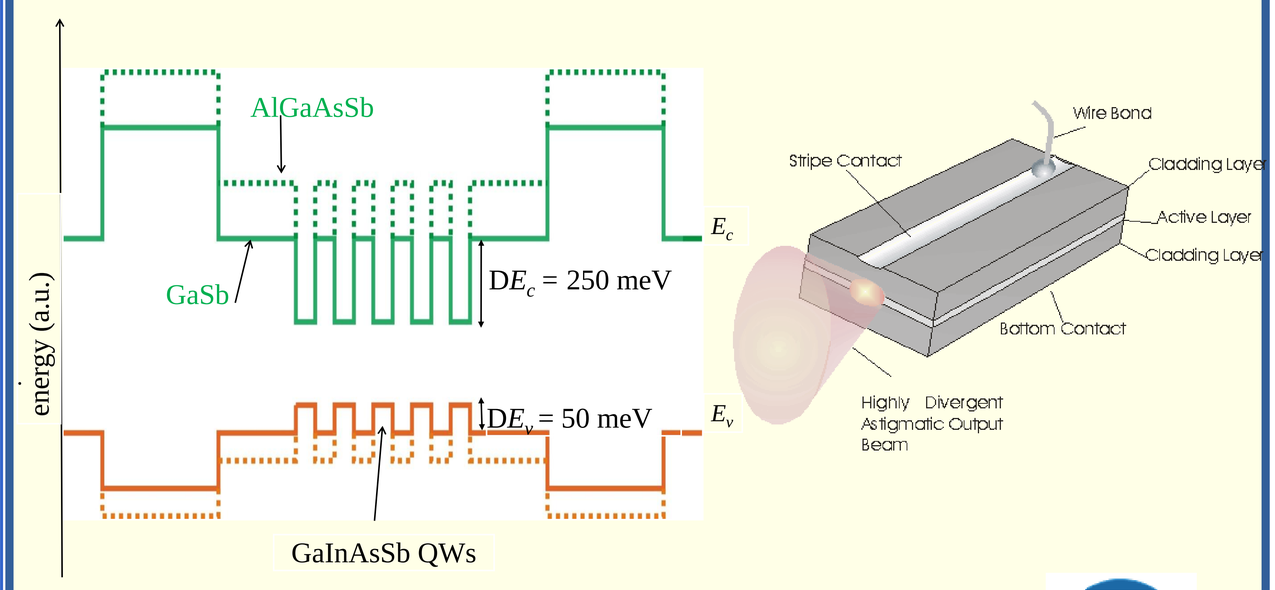
1. MIR sources for medical diagnostics and gas sensing

- strong gas absorption lines at λ=2-3.5 μm
- GaSb based devices best for λ>2 μm
- development of tuneable devices for spectroscopic applications
- MIR lasers are still at an early stage of development
- Issues of limited temperature performance restrict wide-spread exploitation



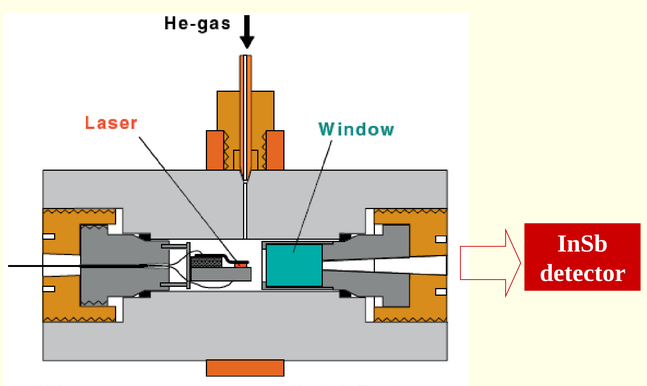


2. Devices

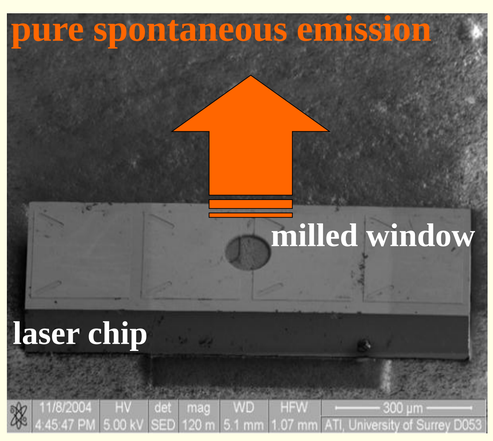


- The active region of 2.6μm $Ga_{0.57}In_{0.43}As_{0.14}Sb_{0.86}$ /GaSb.
- 2.3μm $Ga_{0.63}In_{0.37}As_{0.11}Sb_{0.89}$ /$Al_{0.33}Ga_{0.67}As_{0.03}Sb_{0.97}$.
- Devices are broad area emitting lasers

3. Experiment

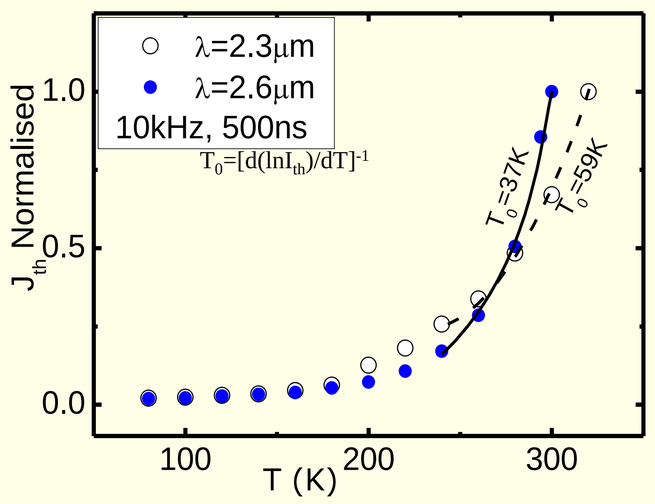


High pressure cell (0-1GPa)

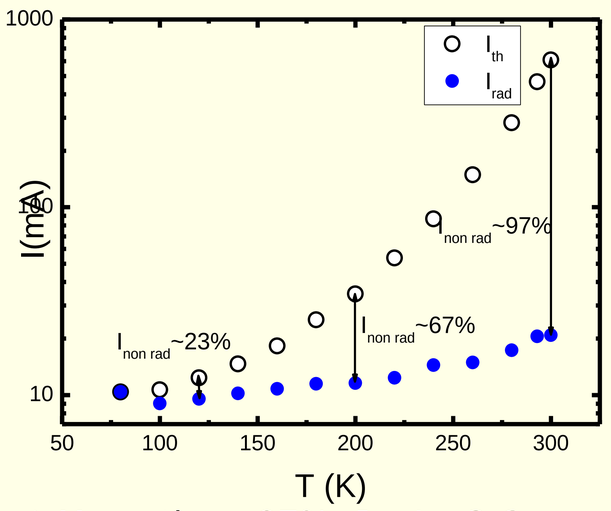


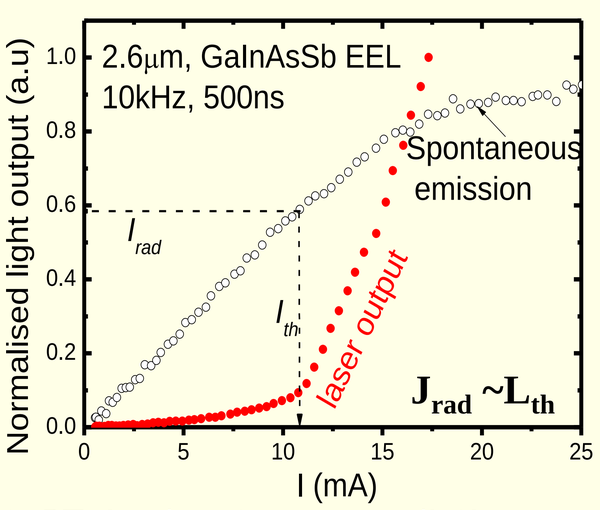
- T and P techniques used to investigate the of non-radiative recombination.
- Hydrostatic pressure changes E_g @ constant T
- Enable probe of recombination processes

4. Temperature dependence of threshold current

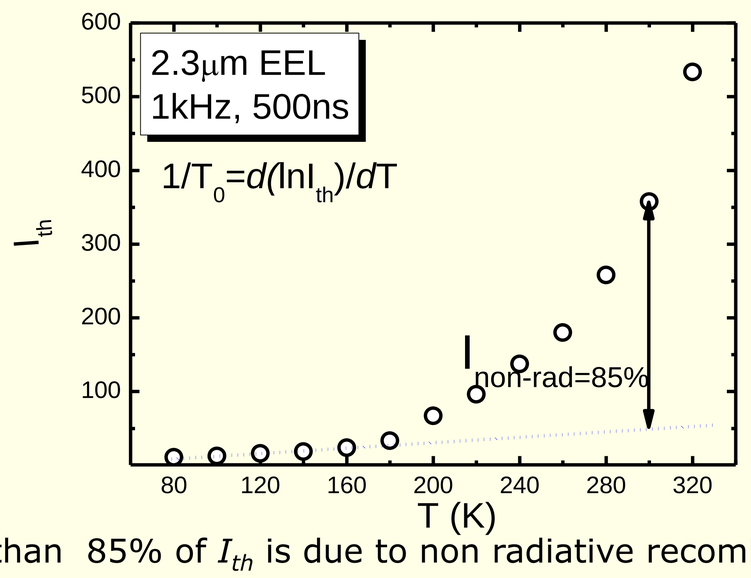


- 2.6μm device is more temperature sensitive, with T_0=37K at T>200K
- 2.3μm is less temperature sensitive with T_0=59K at T >200K



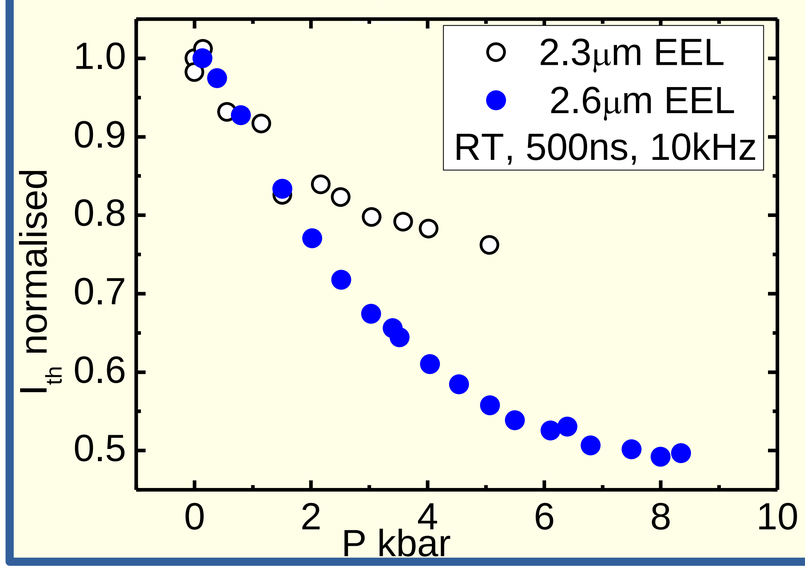


- More than 97% I_{th} in 2.6μm at RT is due to non radiative recombination



- More than 85% of I_{th} is due to non radiative recombination

5. Pressure Dependence of threshold current



- Ith decreases with increasing pressure in both devices.
- The decrease is due to decreasing Auger recombination.
- More decrease of I_{th} in 2.6μm device signify more Auger compared to 2.3μm.

6. Summary

- Temperature performance and Recombination processes InGaInAsSb base EEL emitting at 2.6μm and 2.3μm investigated
- We found that the higher wavelength 2.6μm device is more temperature sensitive with T_0=37K above 200K with more than 97% non radiative contribution to I_{th}
- Auger recombination is the dominant current path in both devices
- Auger recombination is more dominant in 2.6um devices due to its reduce band gap