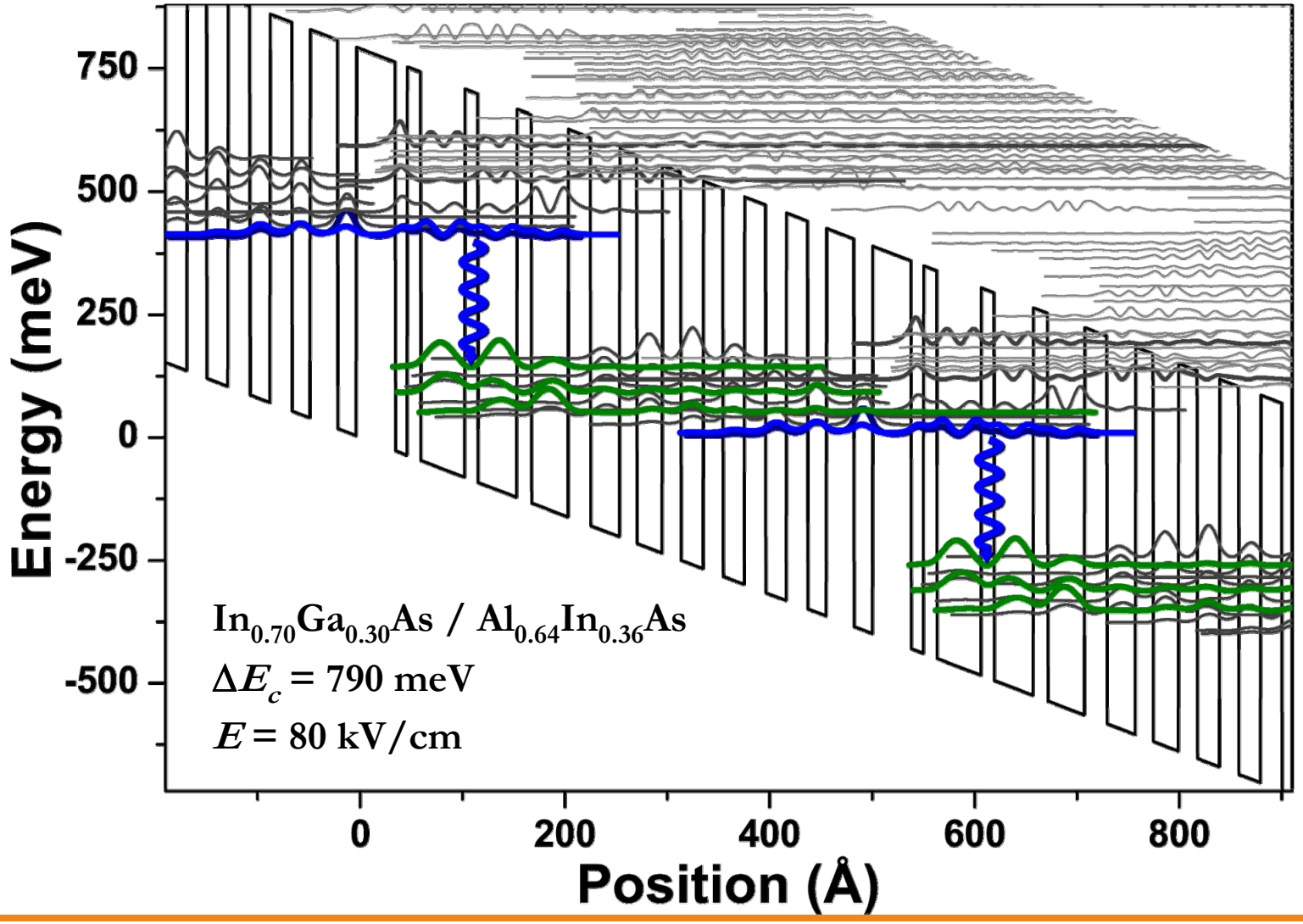
PRINCETON UNIVERSITY

Intersubband Electroluminescence from a ZnCdSe/ZnCdMgSe Quantum Cascade Structure

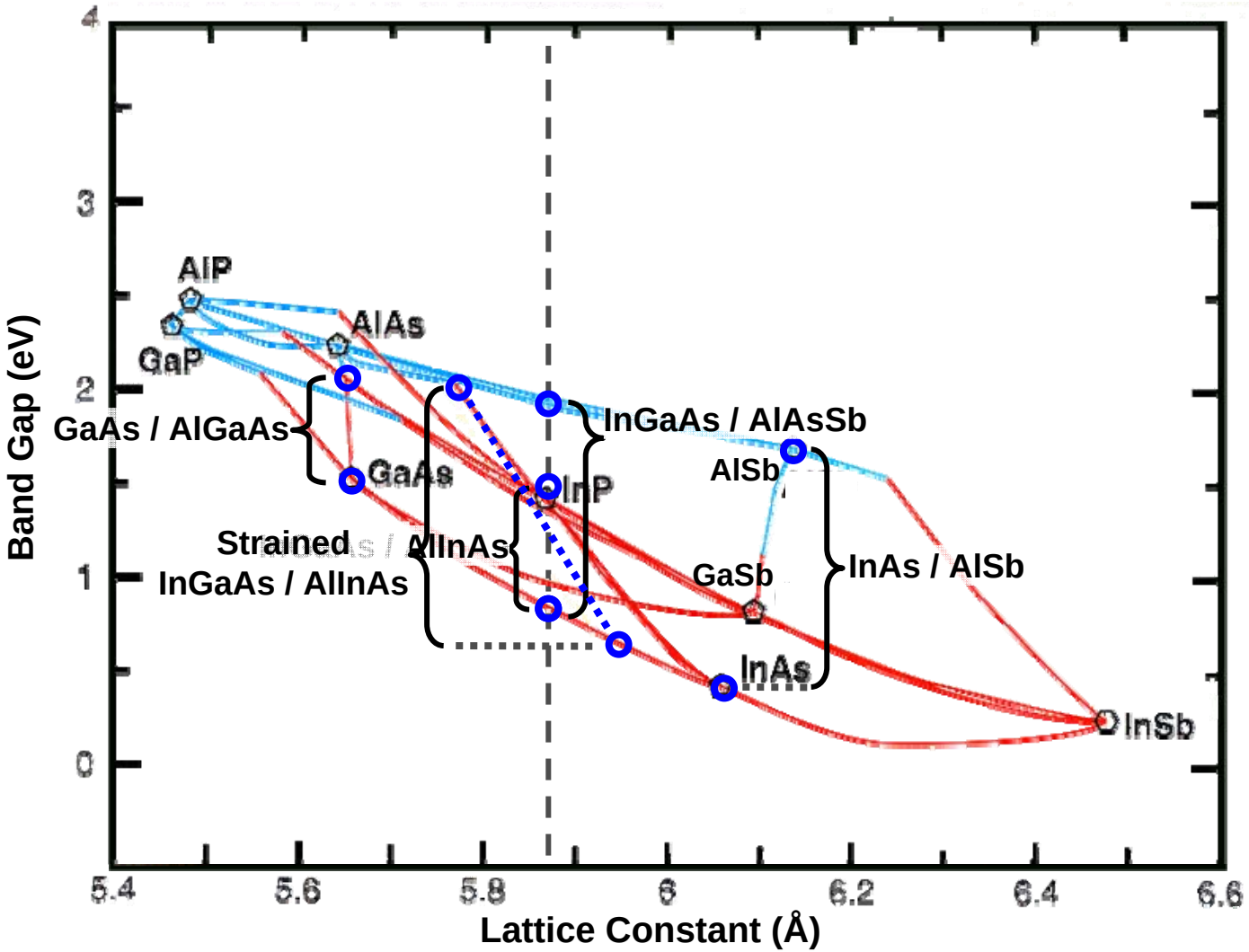
Kale J. Franz,[1] William O. Charles,[2] Aidong Shen,[2]
Anthony J. Hoffman,[1] Maria C. Tamargo,[3] and Claire Gmachl[1]

[1] *Department of Electrical Engineering, Princeton University*
[2] *Department of Electrical Engineering, The City College of New York*
[3] *Department of Chemistry, The City College of New York*

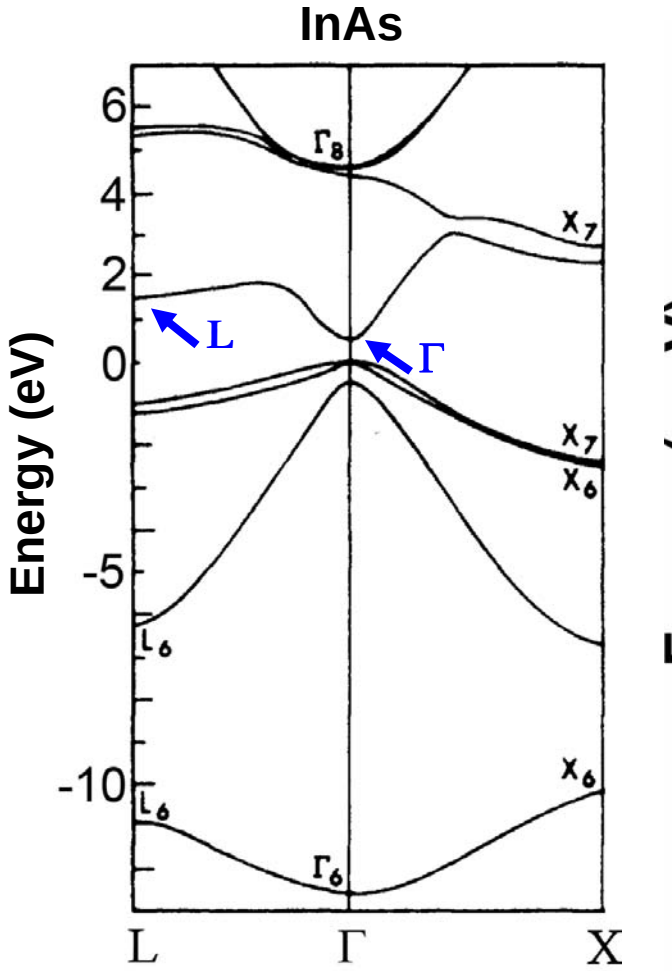
QC Laser Photon Energy Limit



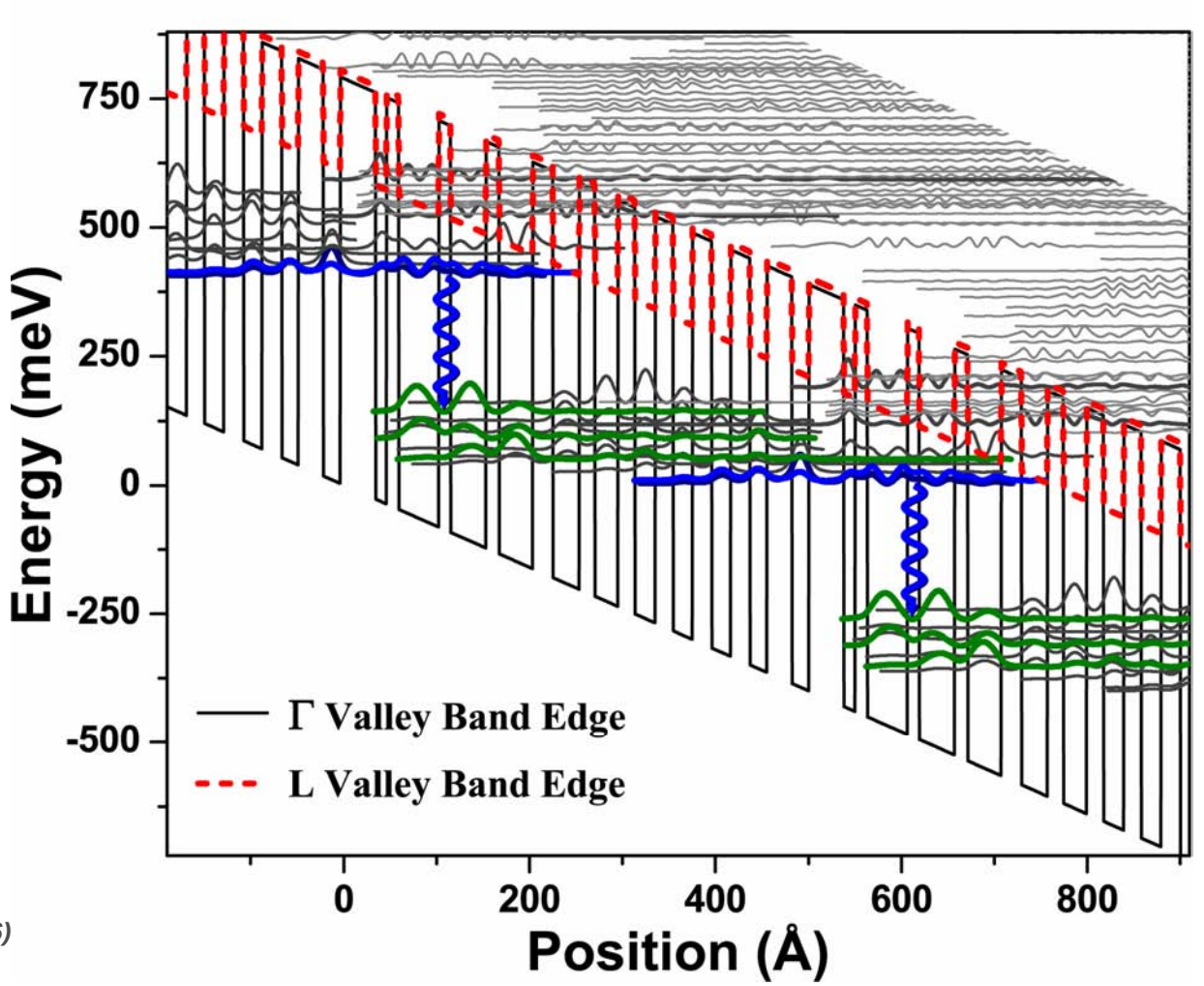
QC Laser Materials Systems



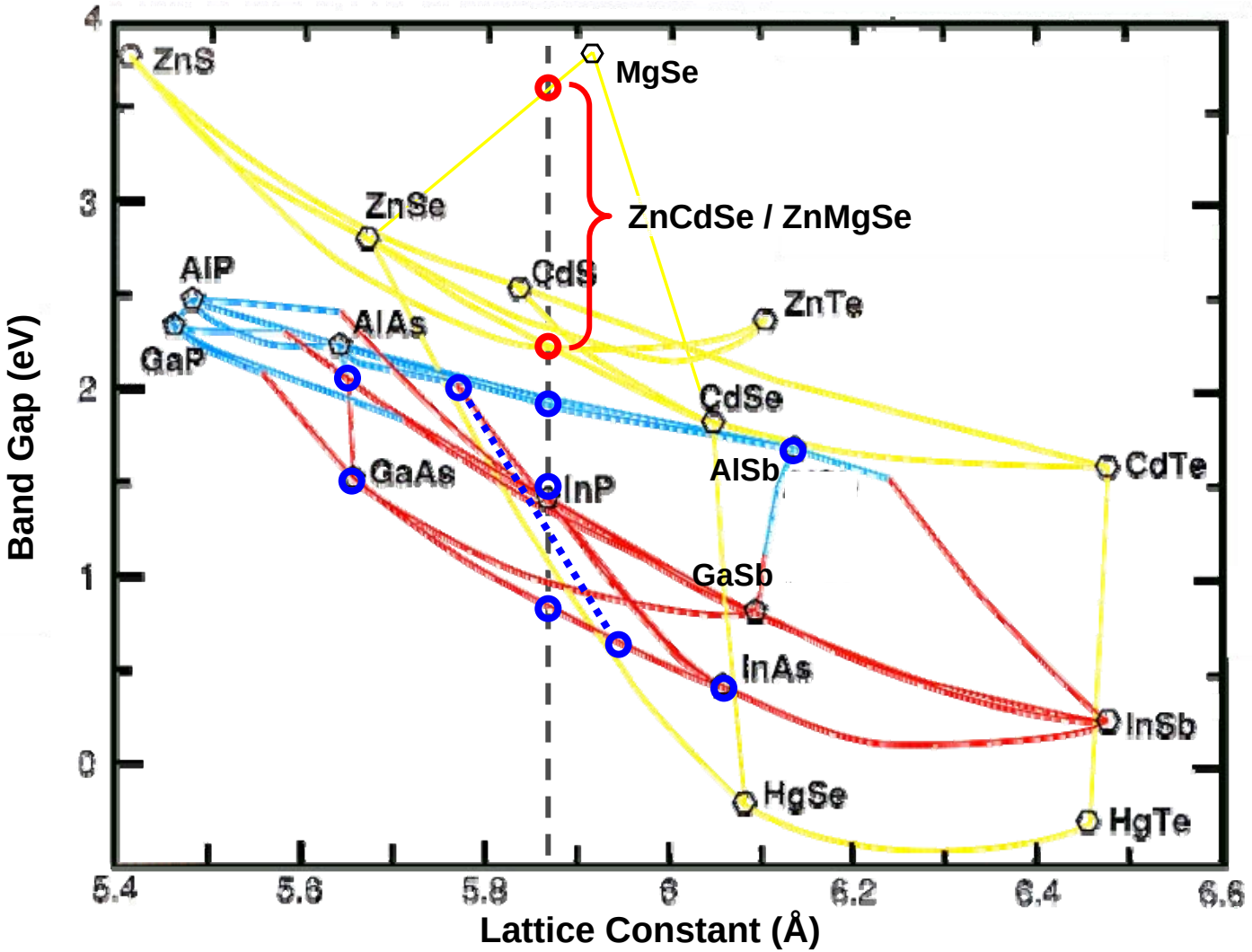
QC Laser Photon Energy Limit & Inter-valley Scattering



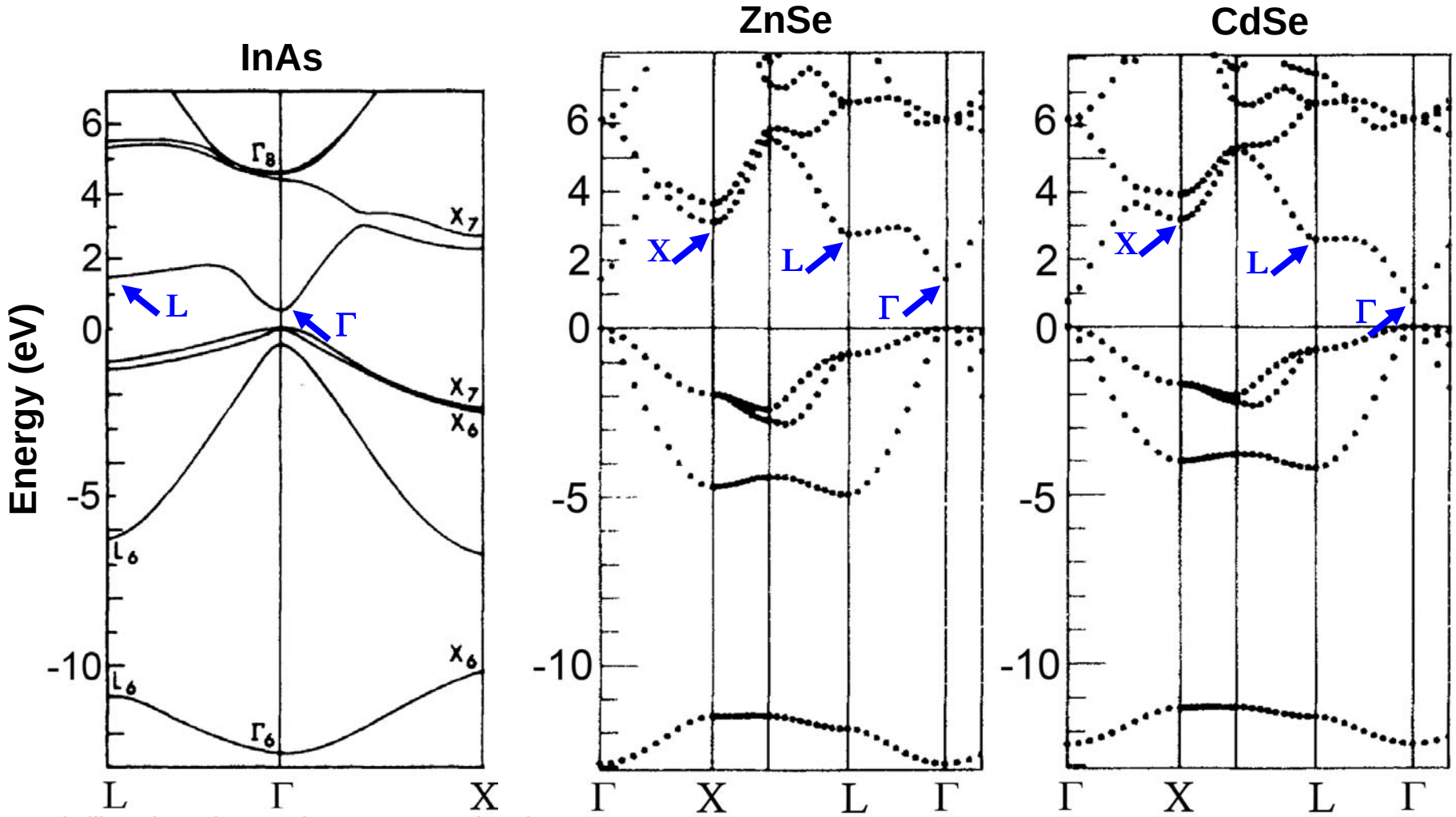
J.R. Chelikowsky and M.L. Cohen, PRB 14 566 (1976)



QC Laser Materials Systems



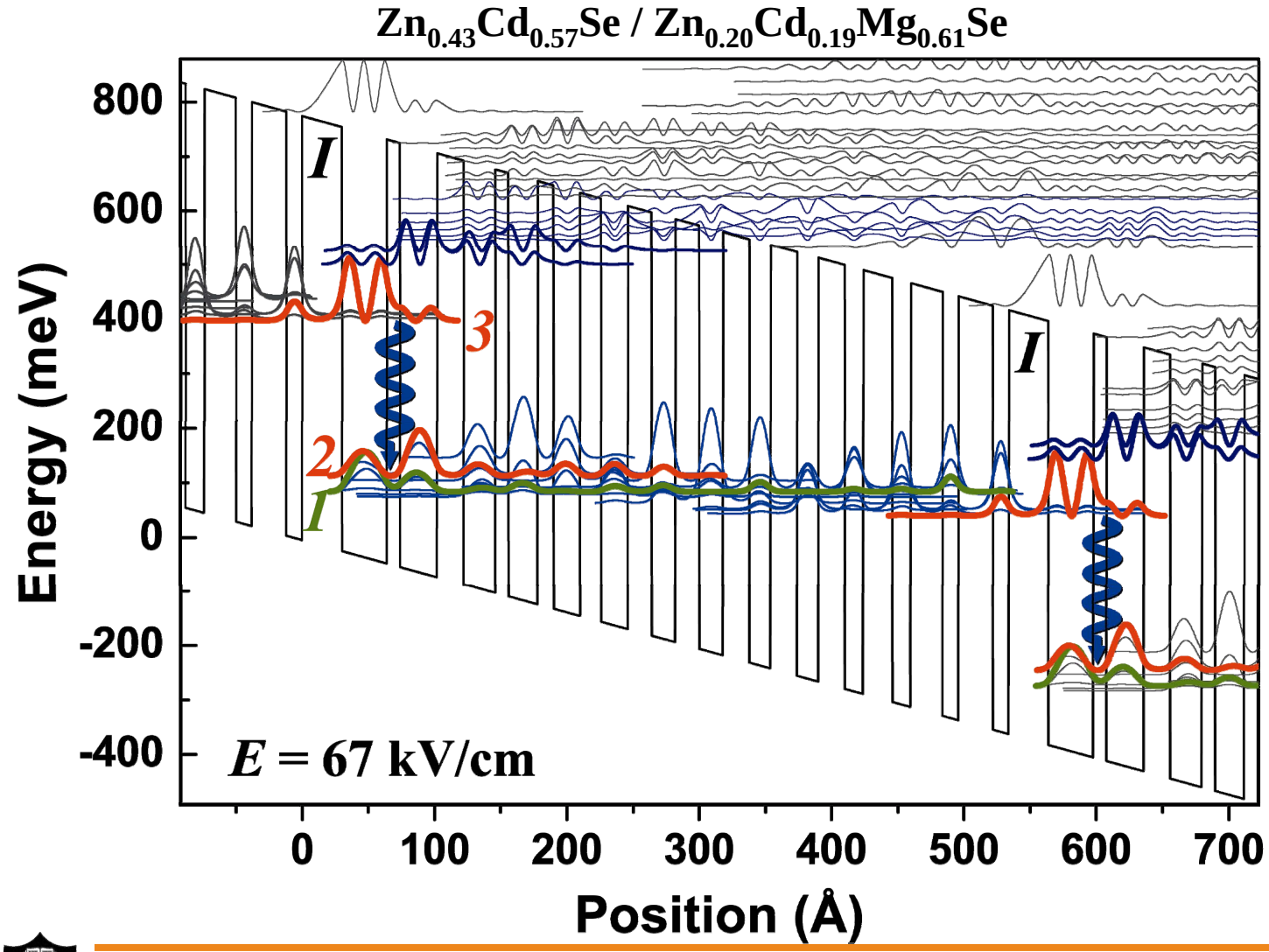
Energy Bands in our II-VI System



J.R. Chelikowsky and M.L. Cohen, PRB 14 566 (1976)

O. Zakharov, A. Rubio, X. Blase, M.L. Cohen, and S.G. Louie, PRB 50 10780 (1994)

II-VI QC Structure



ΔE_c = 780 meV

E_{ph} = 284 meV

λ = 4.4 μm

L_p = 534 Å

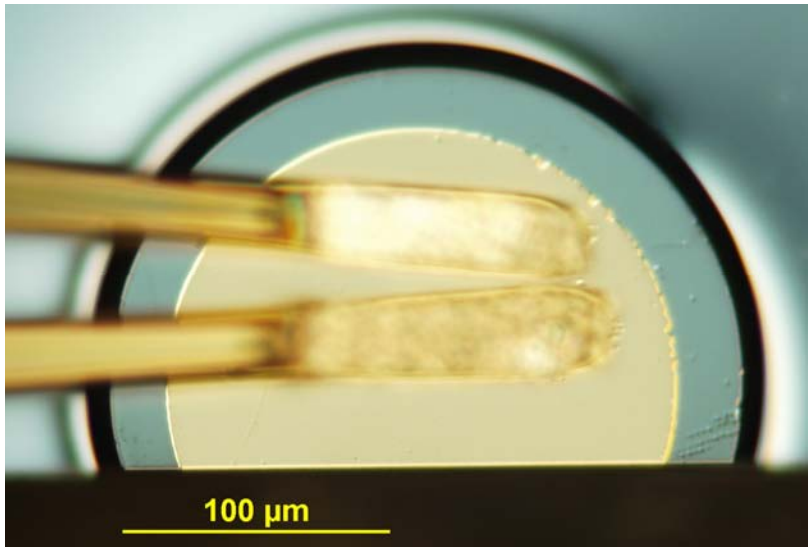
$\hbar\omega_{LO} \approx$ 30 meV

m^*_{ZnCdSe} = 0.128

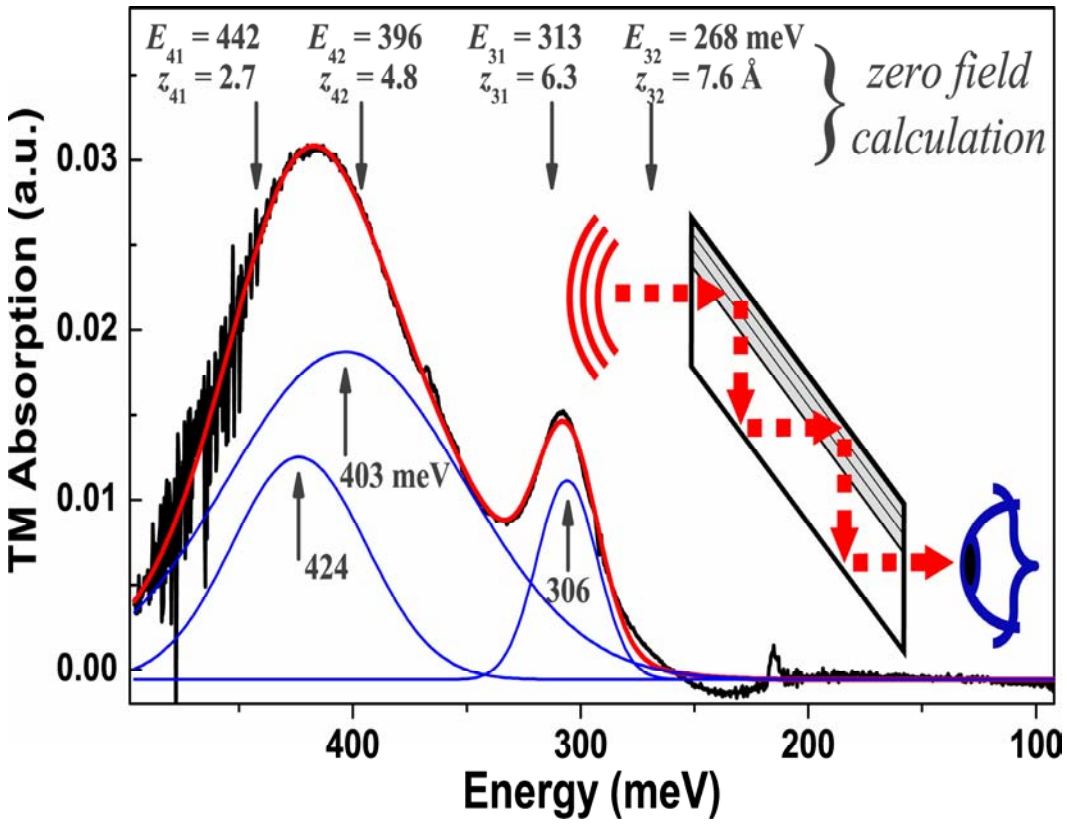
$m^*_{ZnCdMgSe}$ = 0.181

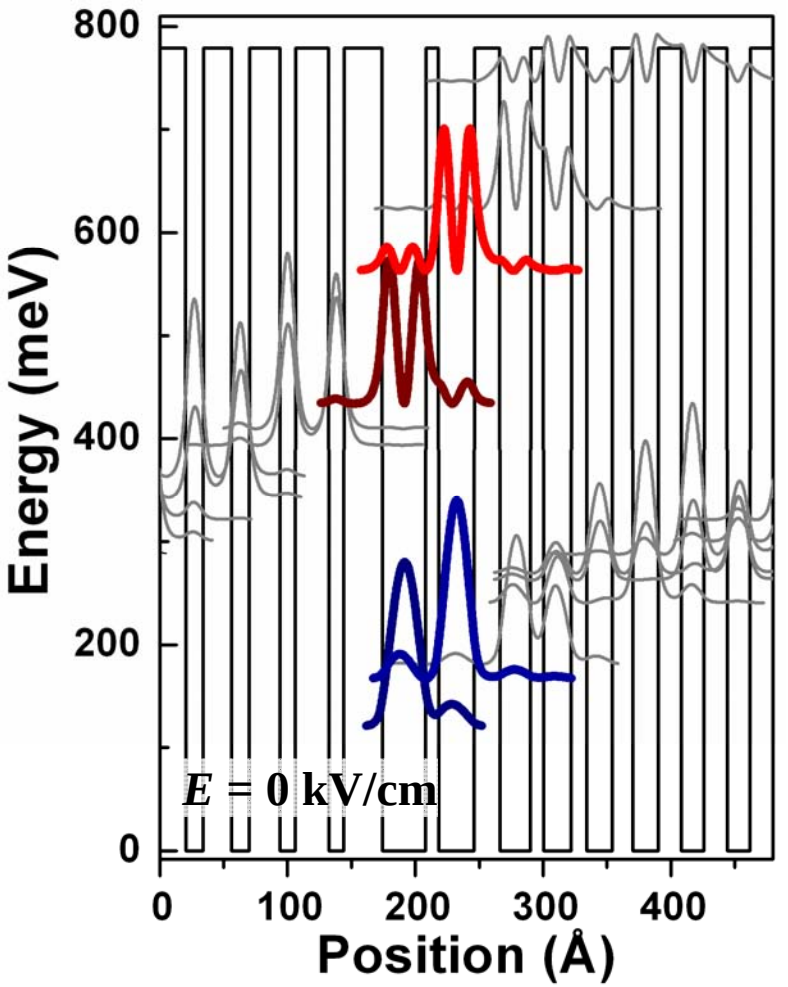
Growth & Processing

ZnCdSe $n_{Cl} = 5\times10^{17}$ cm^{-3} **2000 Å**
QC Active Core **ZnCdSe / ZnCdMgSe 5340 Å** 10 periods
ZnCdSe $n_{Cl} = 5\times10^{17}$ cm^{-3} **400 Å**
ZnCdSe T = 230 °C **100 Å**
Zn exposure
InGaAs $n_{Si} = 5\times10^{17}$ cm^{-3} **2500 Å**
InP substrate $n_S < 2\times10^{17}$ cm^{-3}

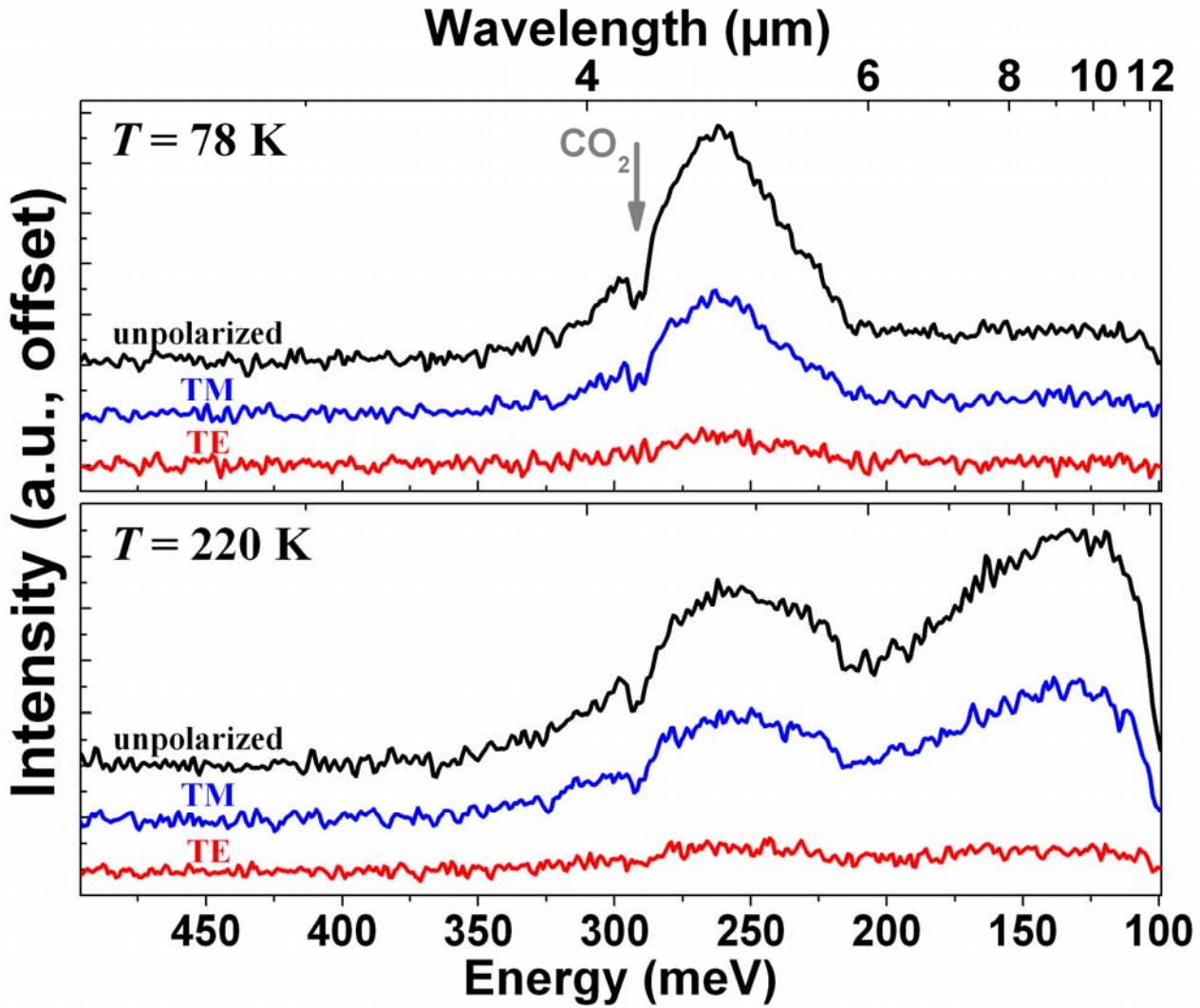


Intersubband Absorption

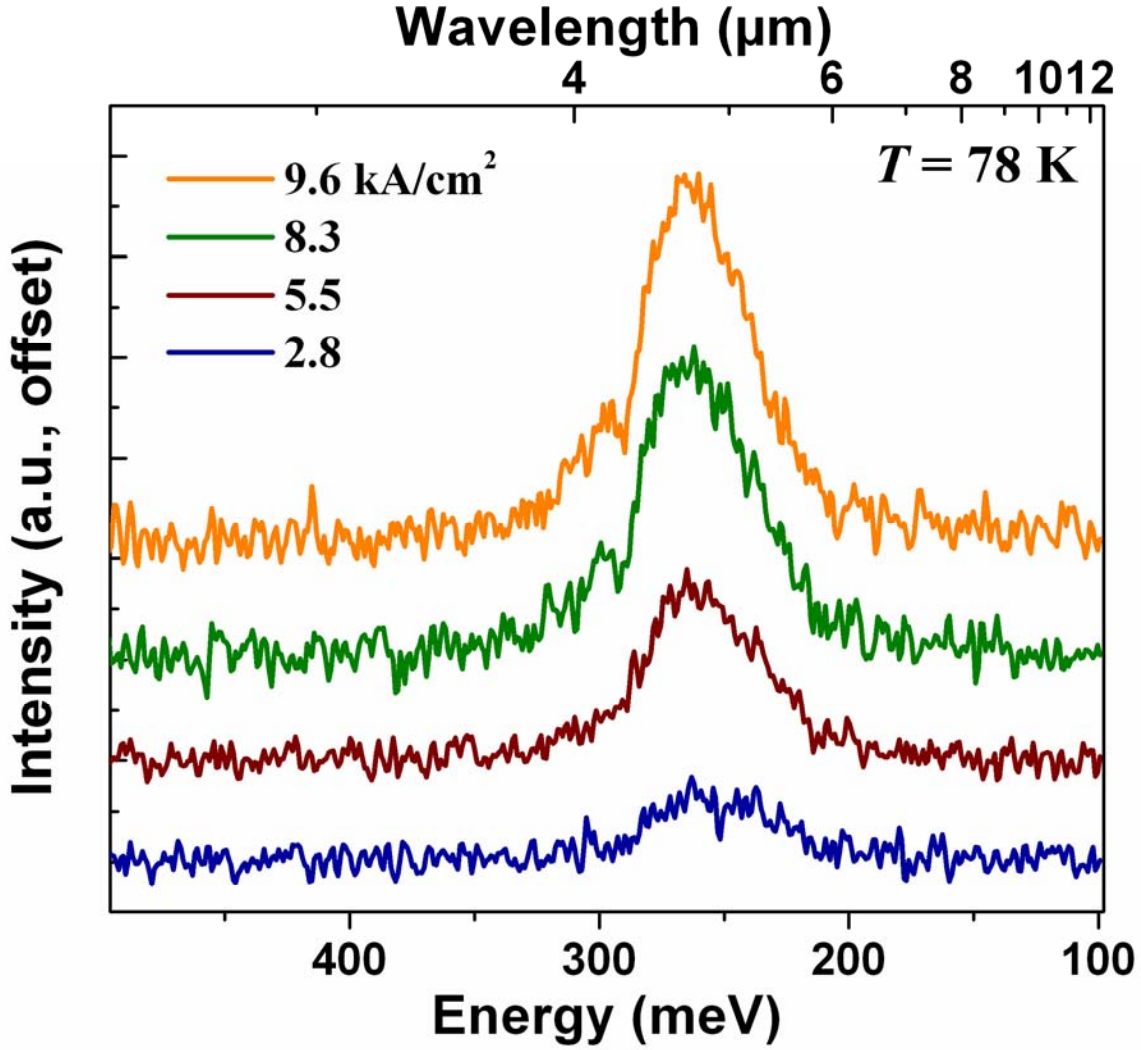




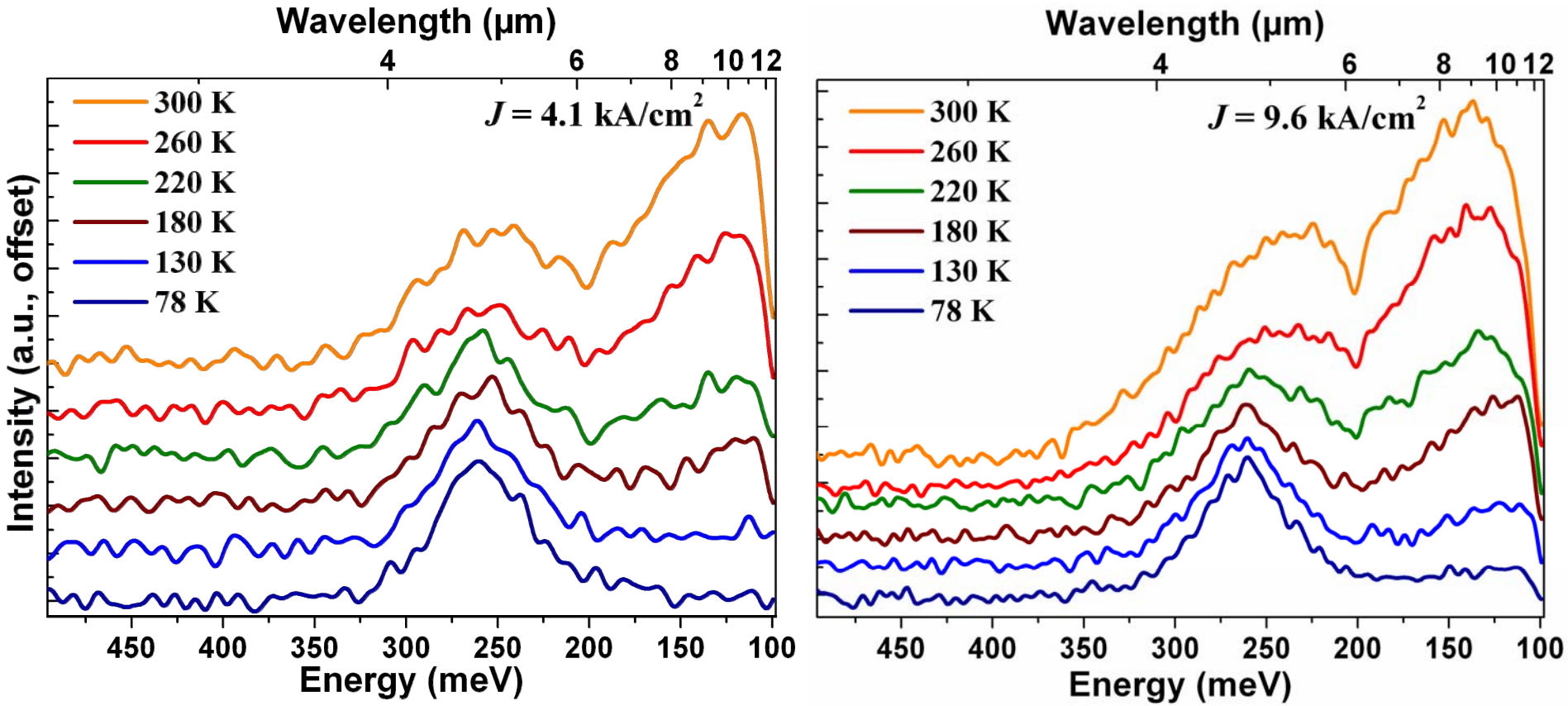
Polarization-Resolved Electroluminescence



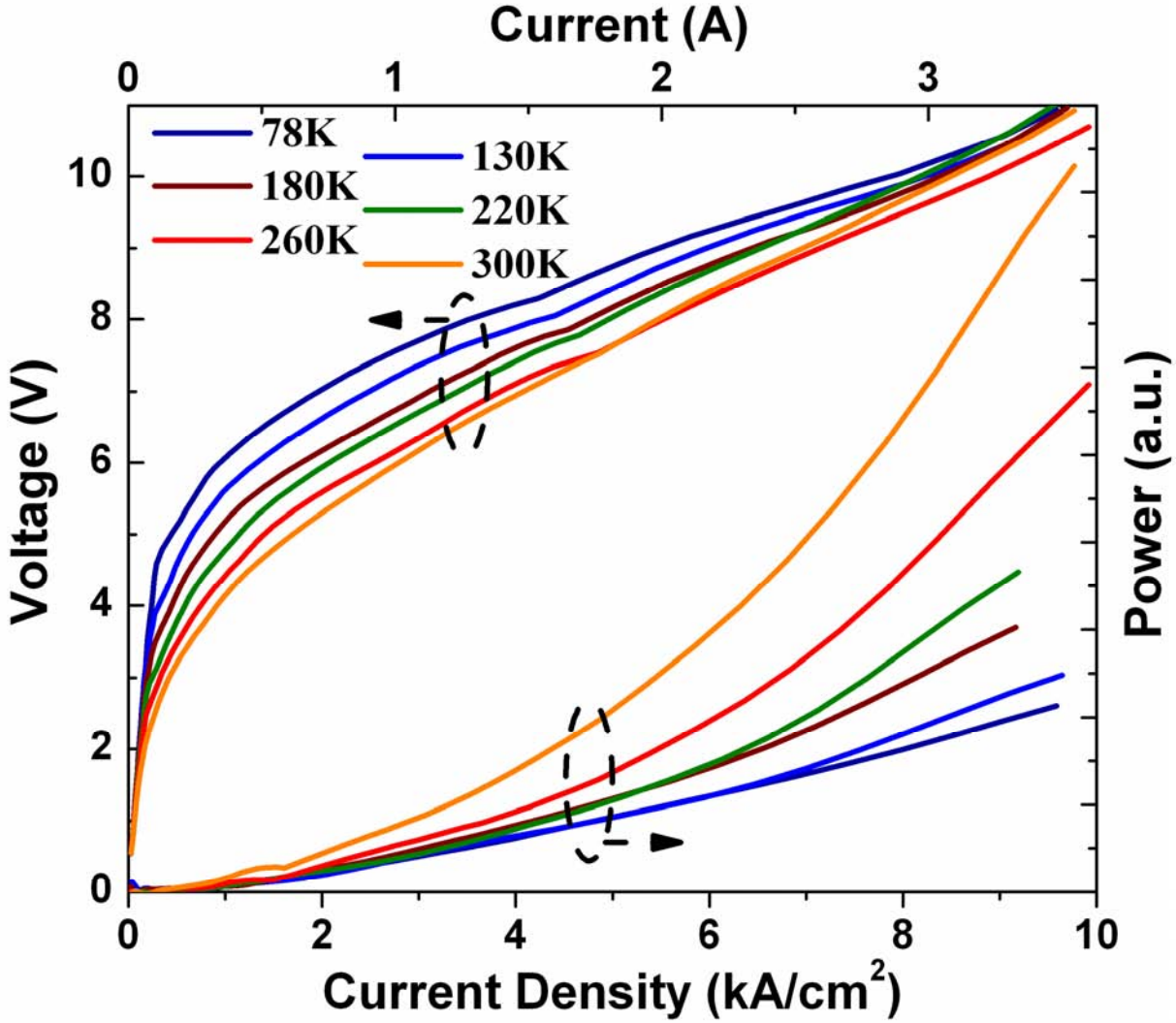
Emission v. Pumping Current



Emission v. Temperature



Light – Current – Voltage



Summary

- ZnCdSe / ZnCdMgSe QC structure
- 4.8 μm emission
- Room temperature
- Future work