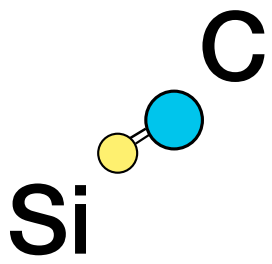
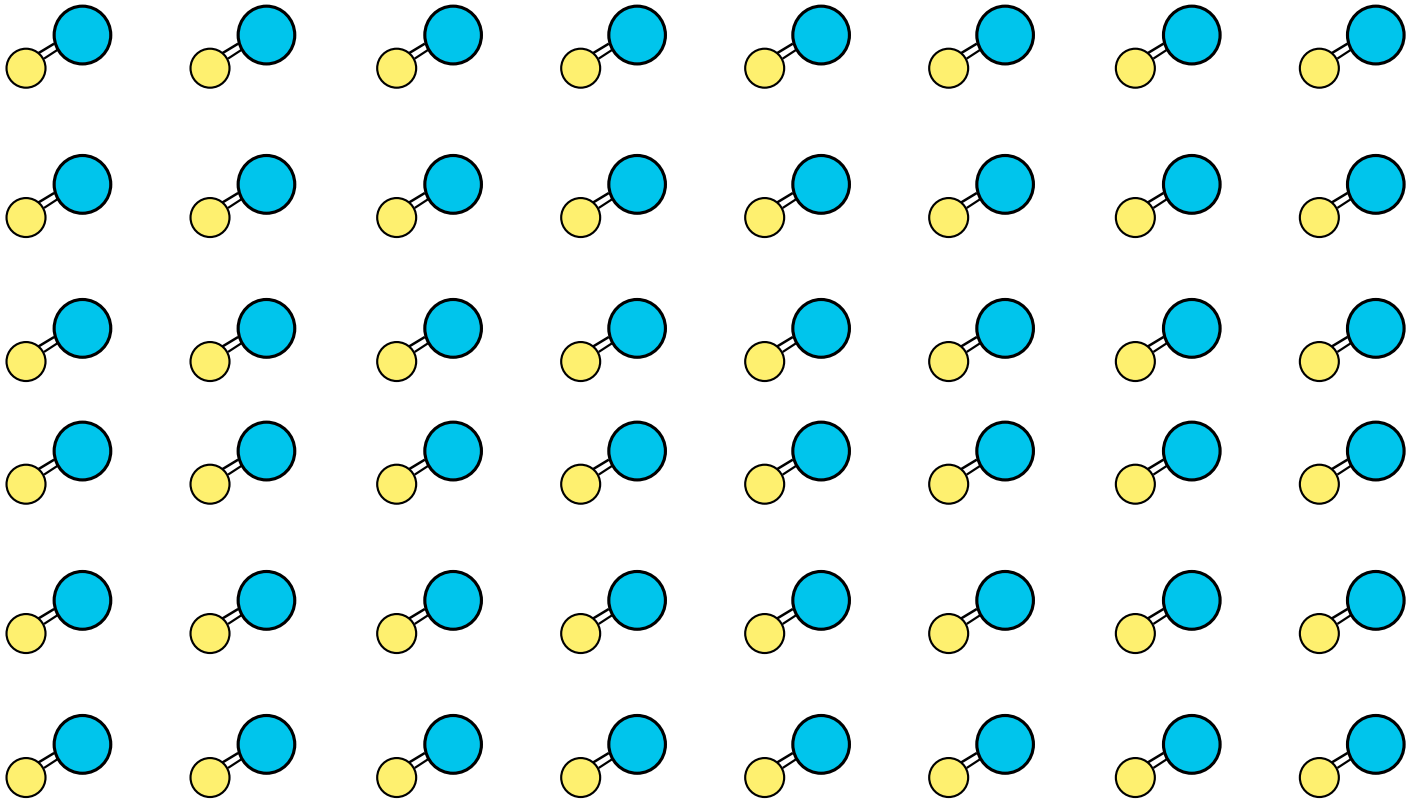
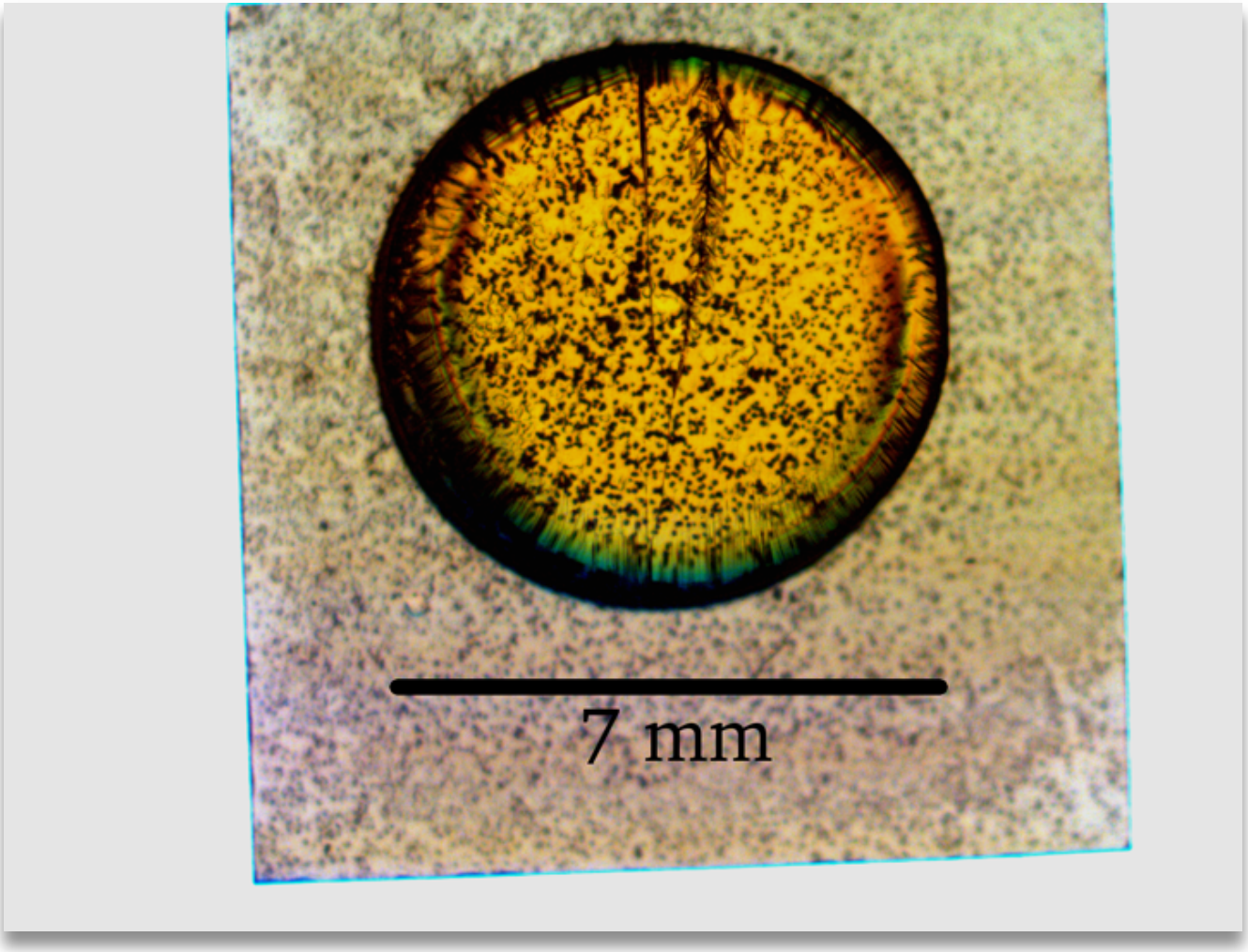
Optical properties of free-standing cubic silicon carbide

Mattias Jansson

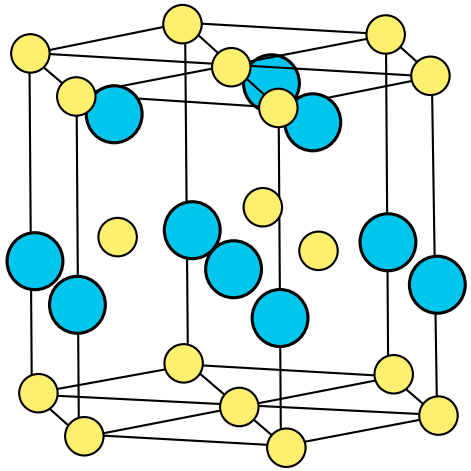
LINKÖPING UNIVERSITY


C
Si

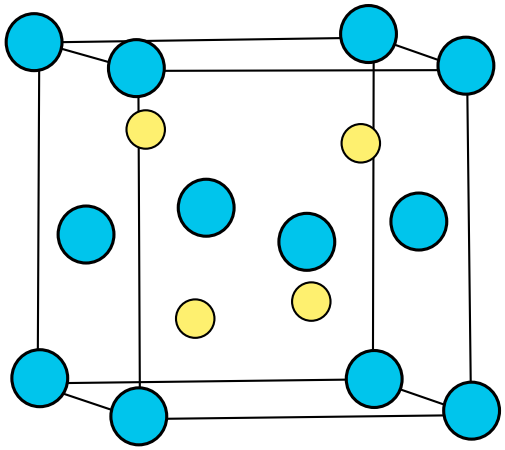



7 mm

Polytypes - atomic arrangements

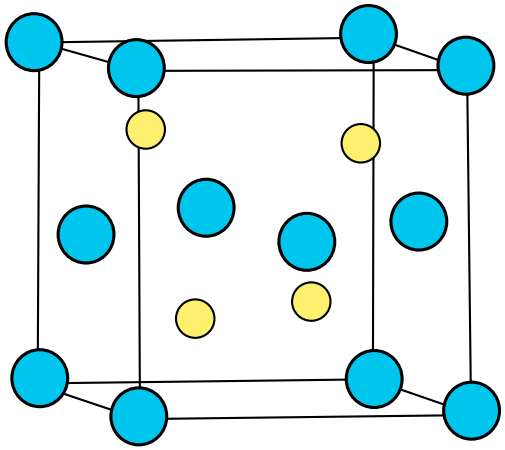


Hexagonal

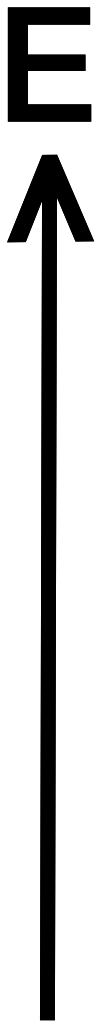


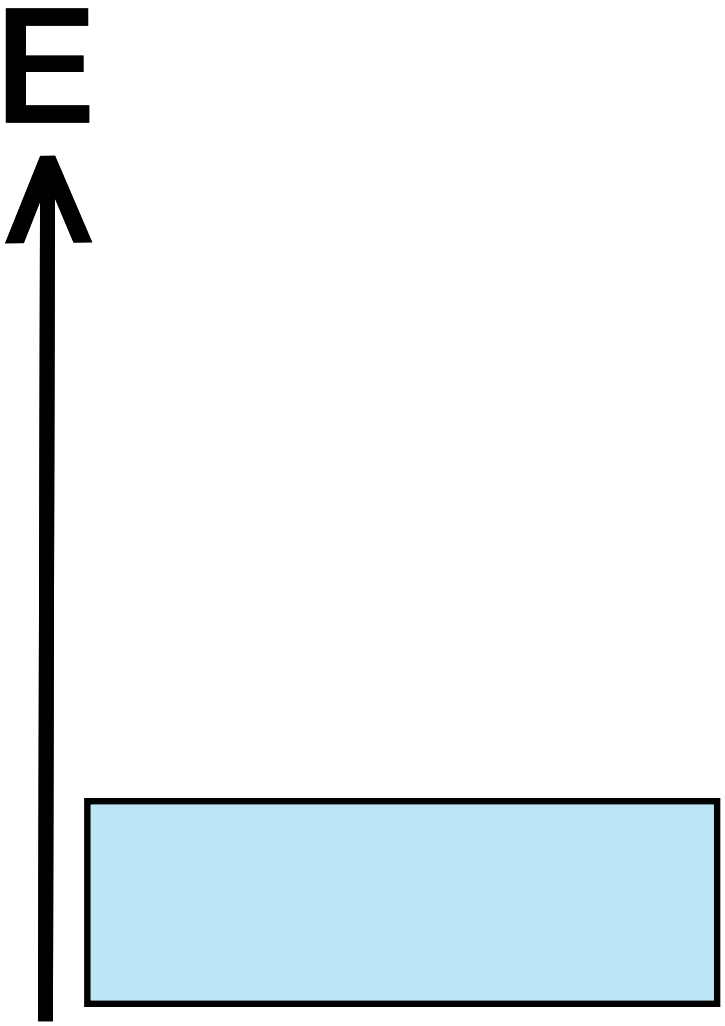
Cubic

Polytypes - atomic arrangements

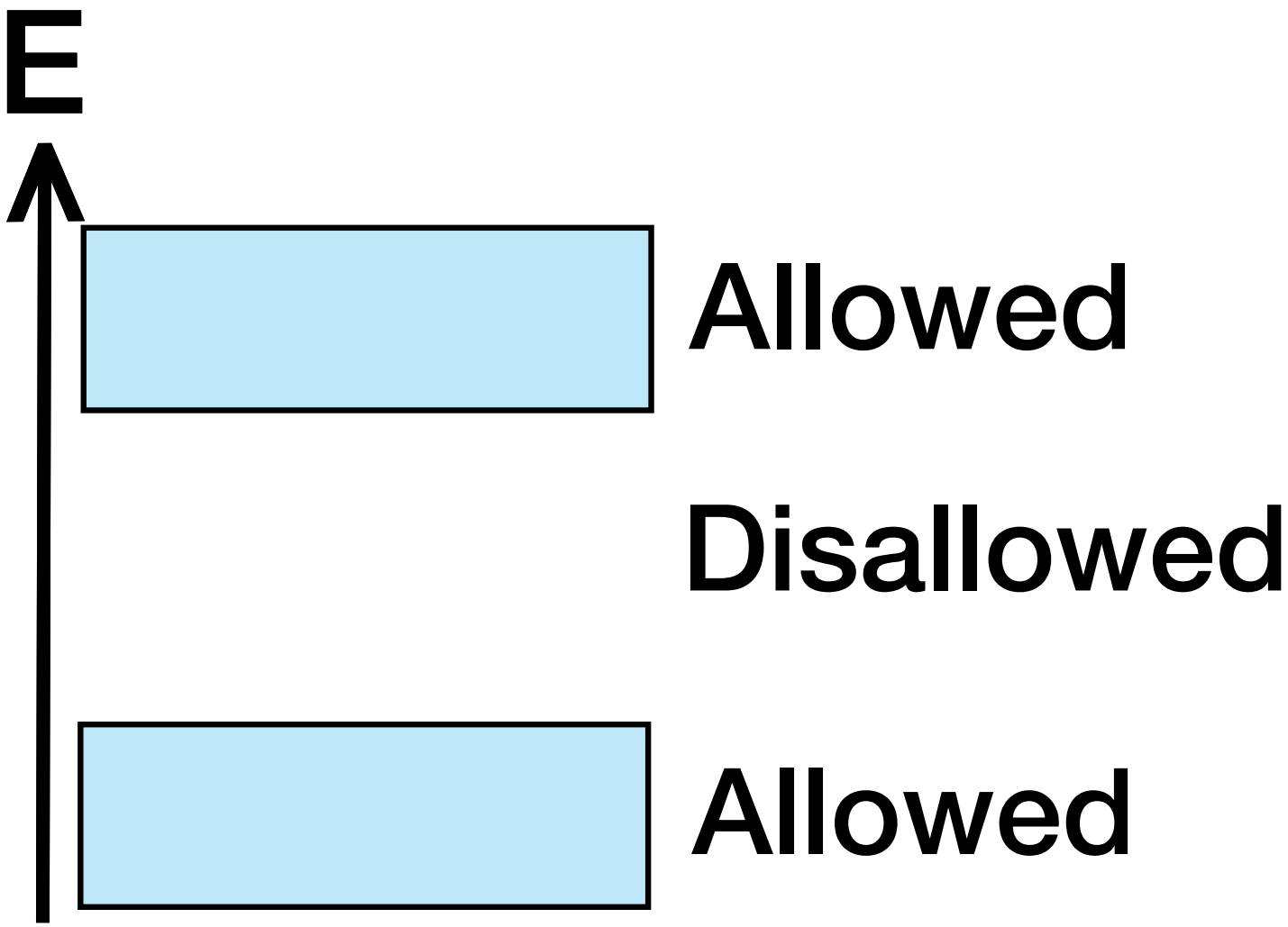


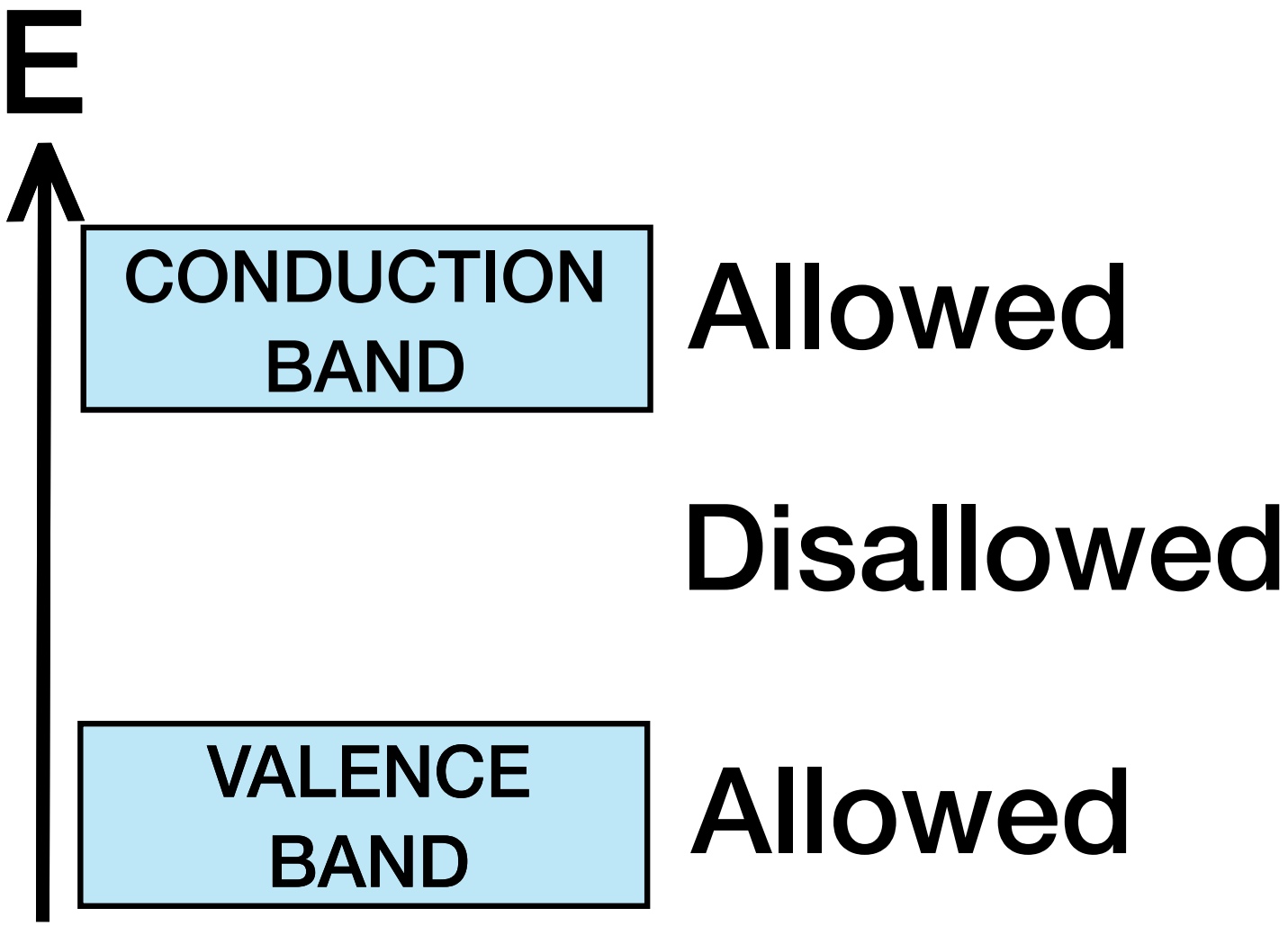
Cubic
3C-SiC

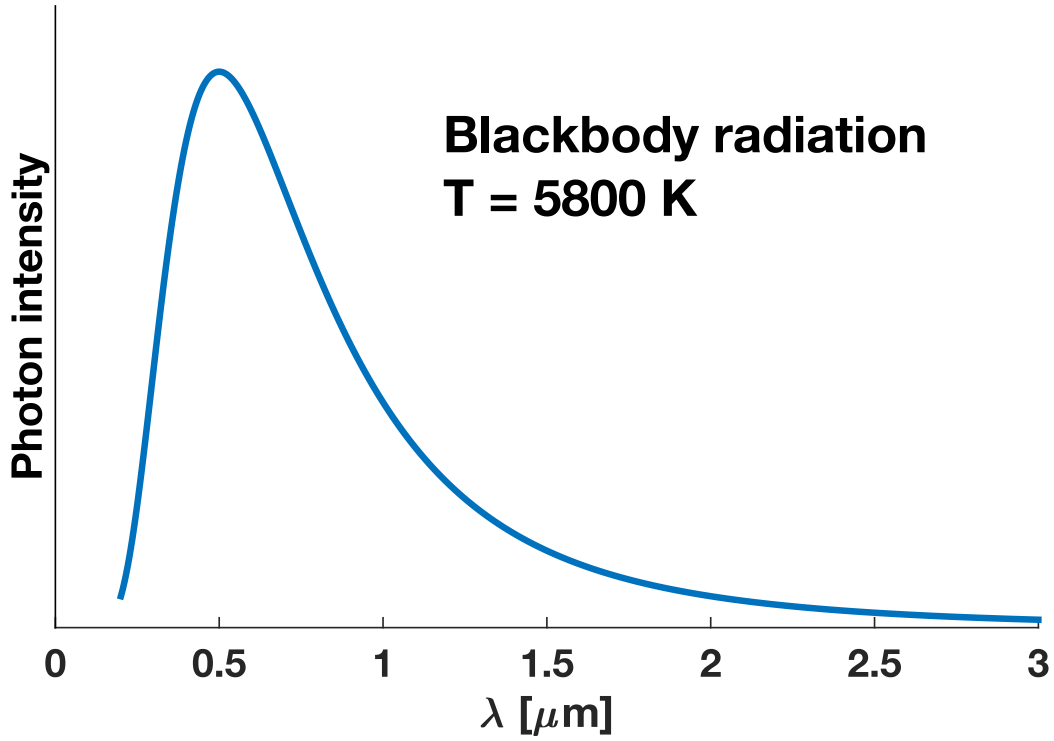

E

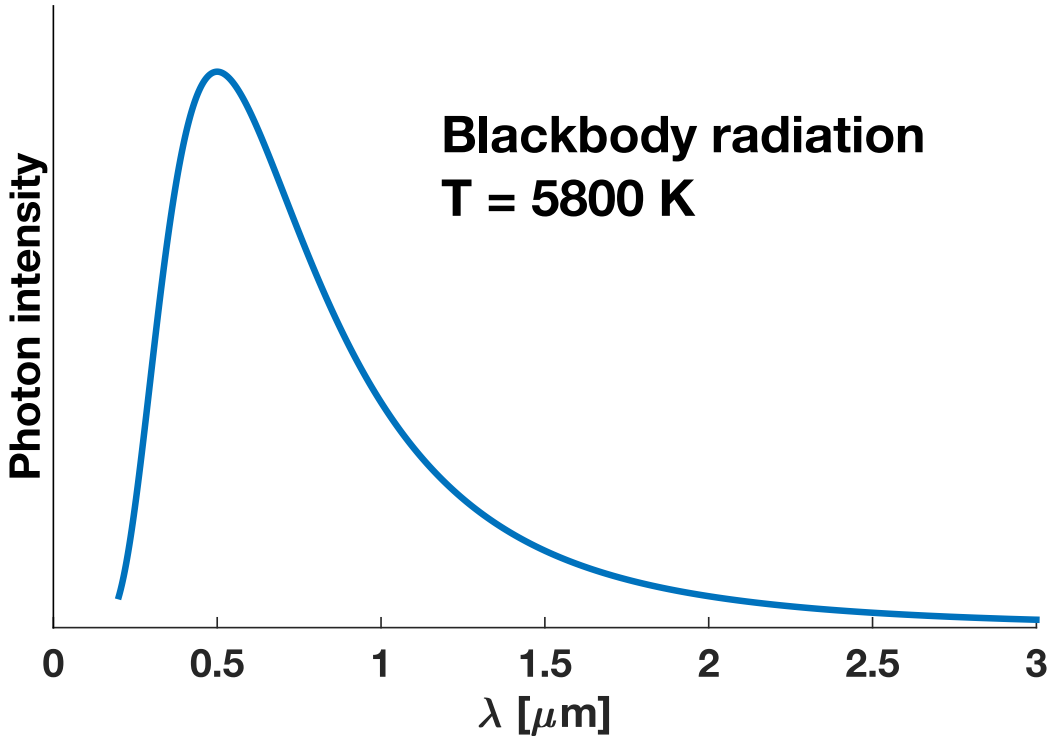


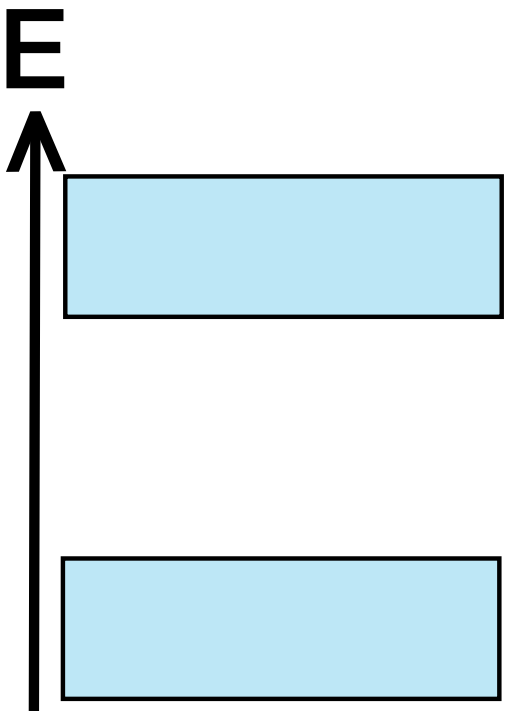
Allowed

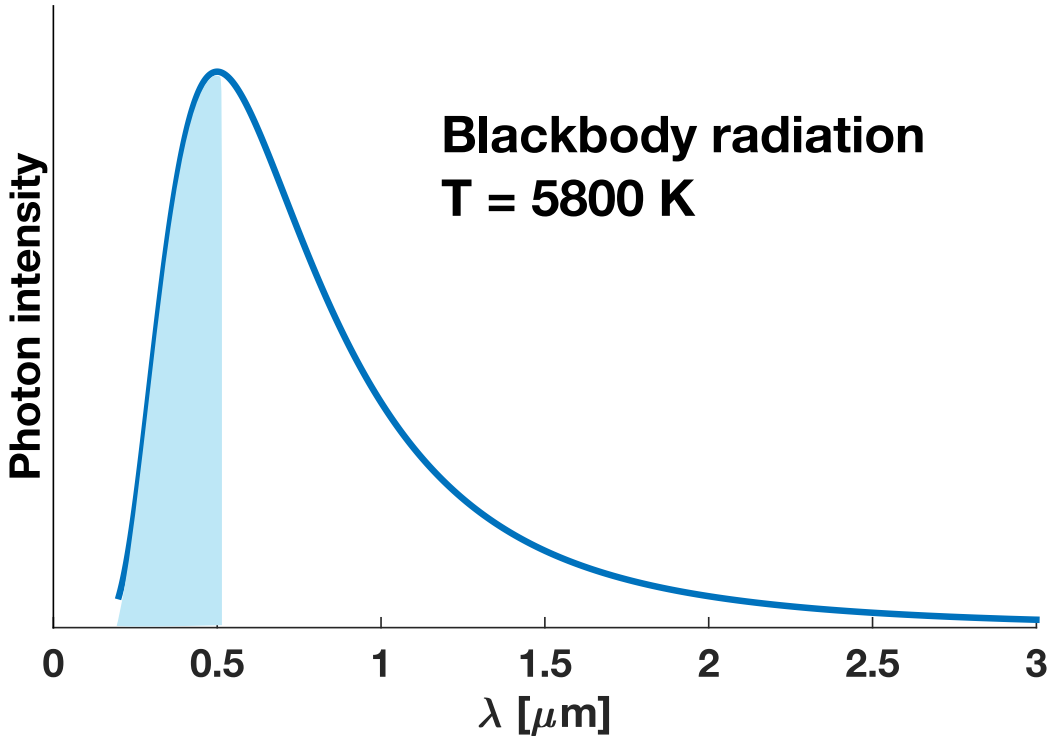

E
Allowed
Disallowed
Allowed

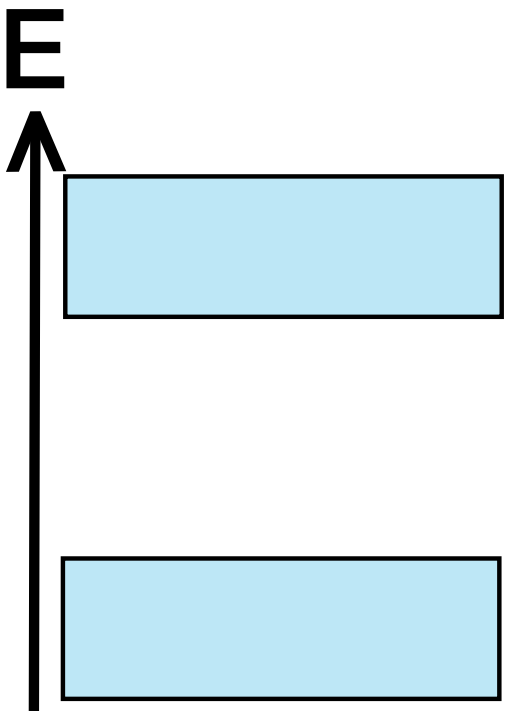

E
CONDUCTION BAND
Allowed
Disallowed
VALENCE BAND
Allowed

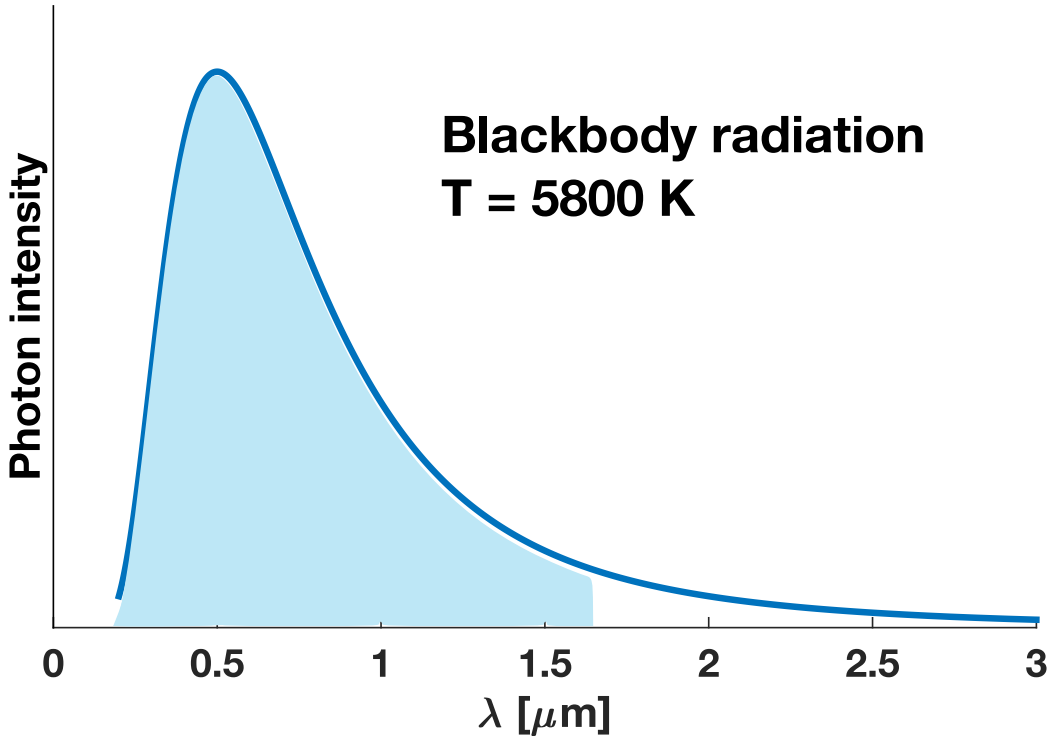

Blackbody radiation
T = 5800 K
Photon intensity
0
0.5
1
1.5
2
2.5
3
λ [μm]

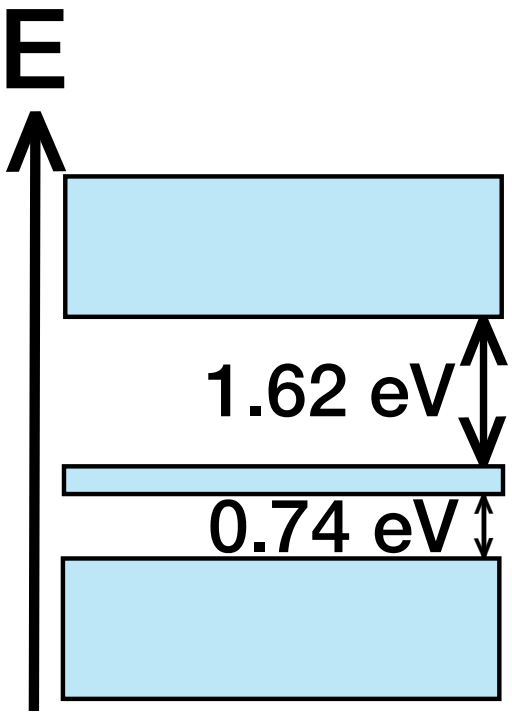

Blackbody radiation
T = 5800 K
Photon intensity
0
0.5
1
1.5
2
2.5
3
λ [μm]


E


Blackbody radiation
T = 5800 K
Photon intensity
0
0.5
1
1.5
2
2.5
3
λ [μm]


E


Blackbody radiation
T = 5800 K
Photon intensity
0
0.5
1
1.5
2
2.5
3
λ [μm]


E
1.62 eV
0.74 eV

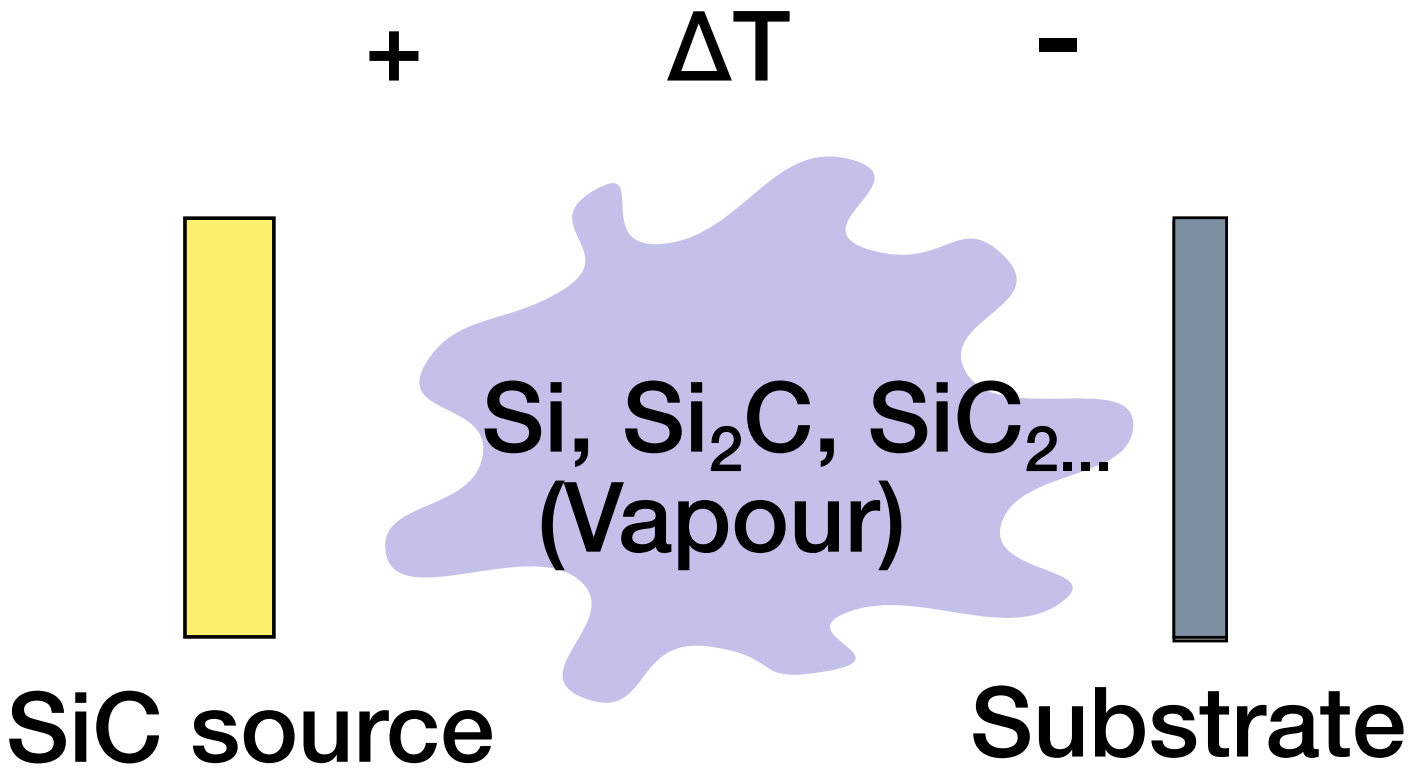
My contributions

- Growth of boron-doped samples

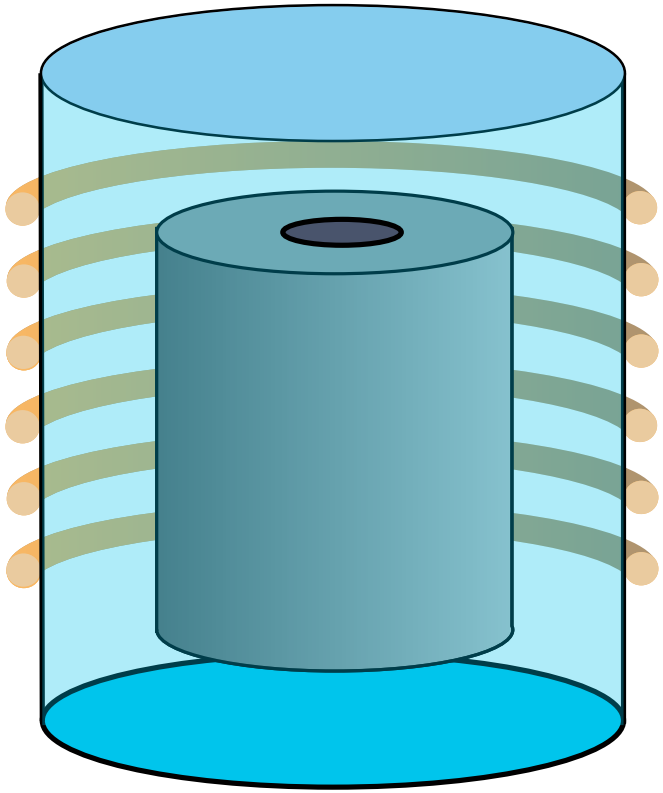
My contributions

- Growth of boron-doped samples
- Optical characterization

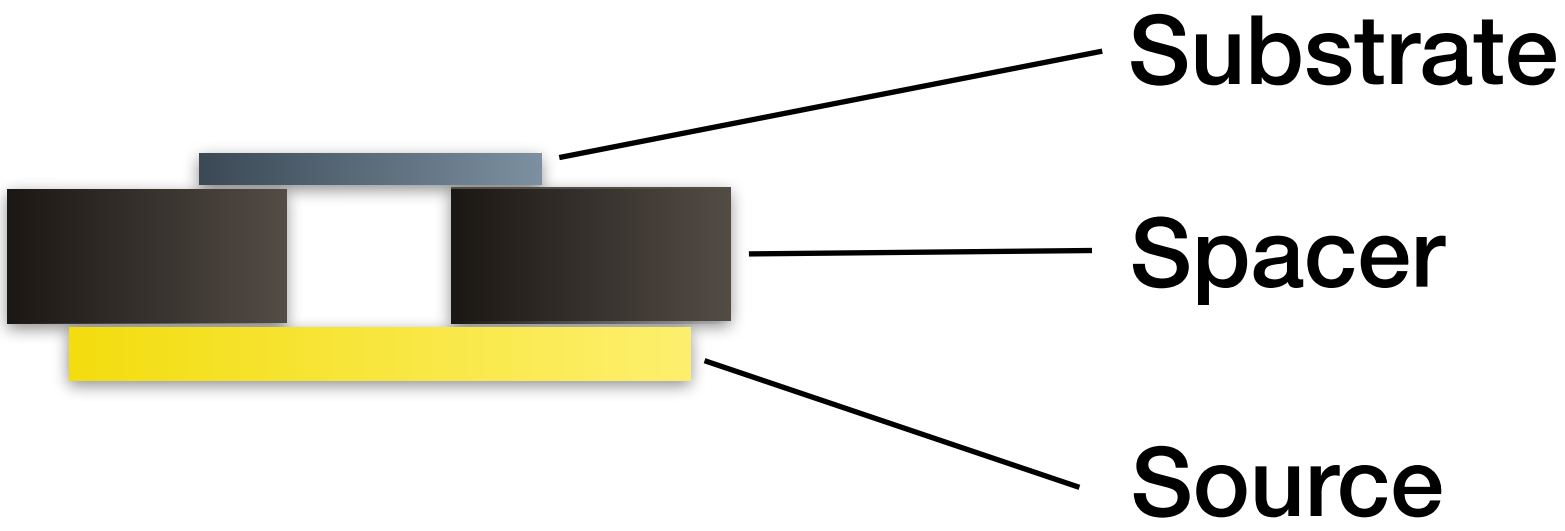
Sublimation growth



The reactor

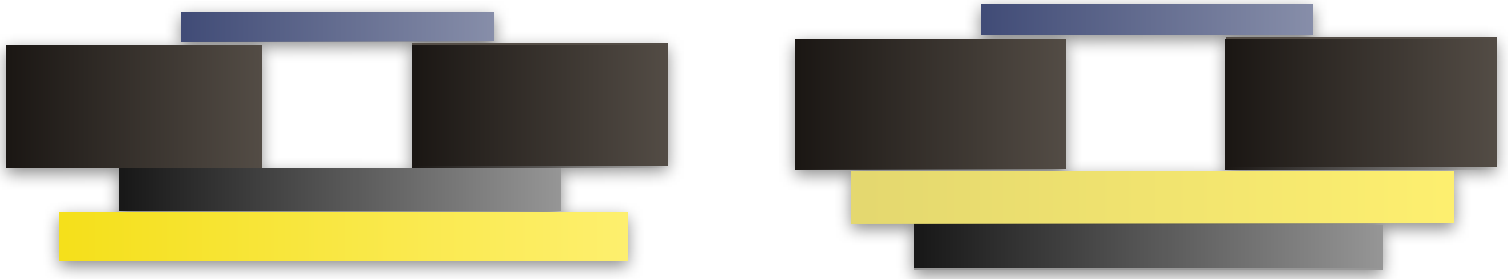


The growth setup

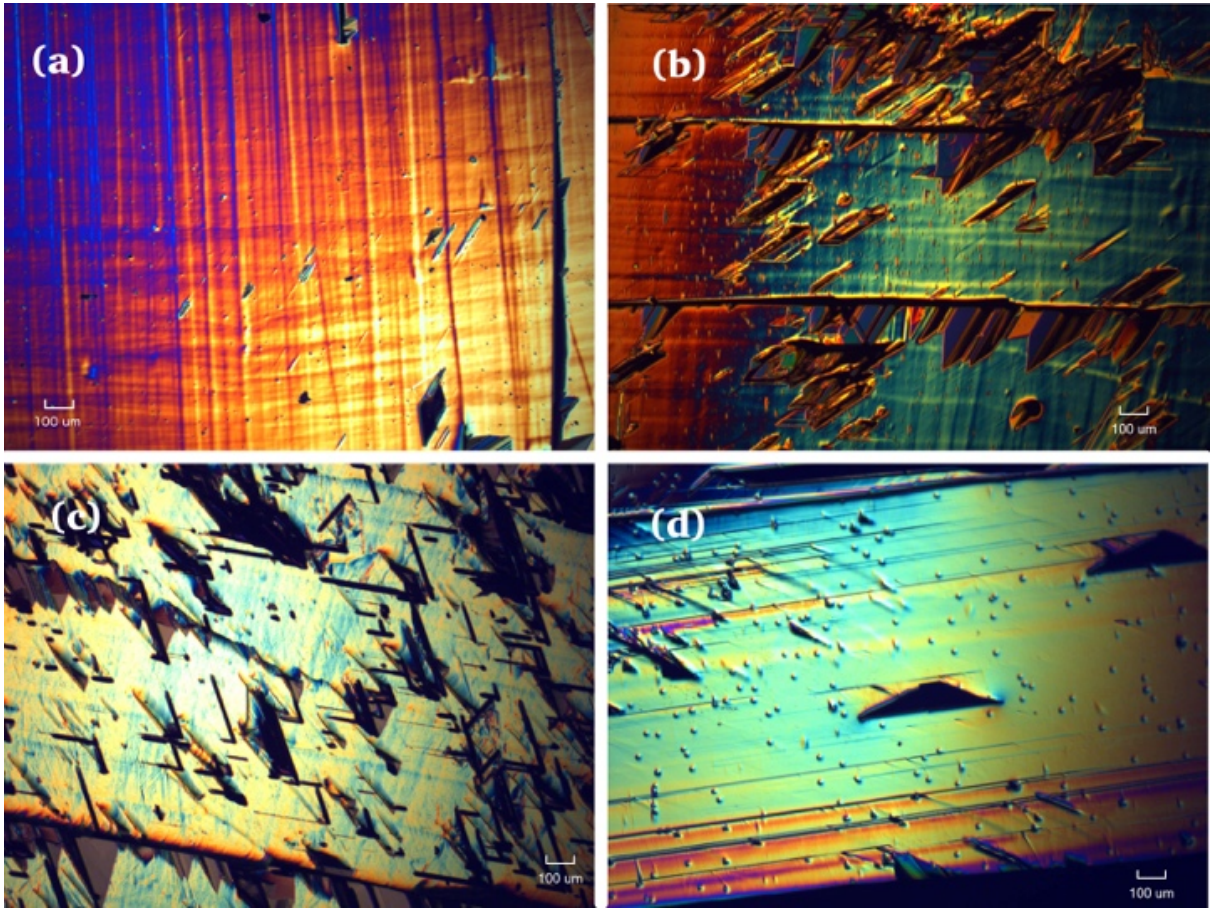


Investigated parameters

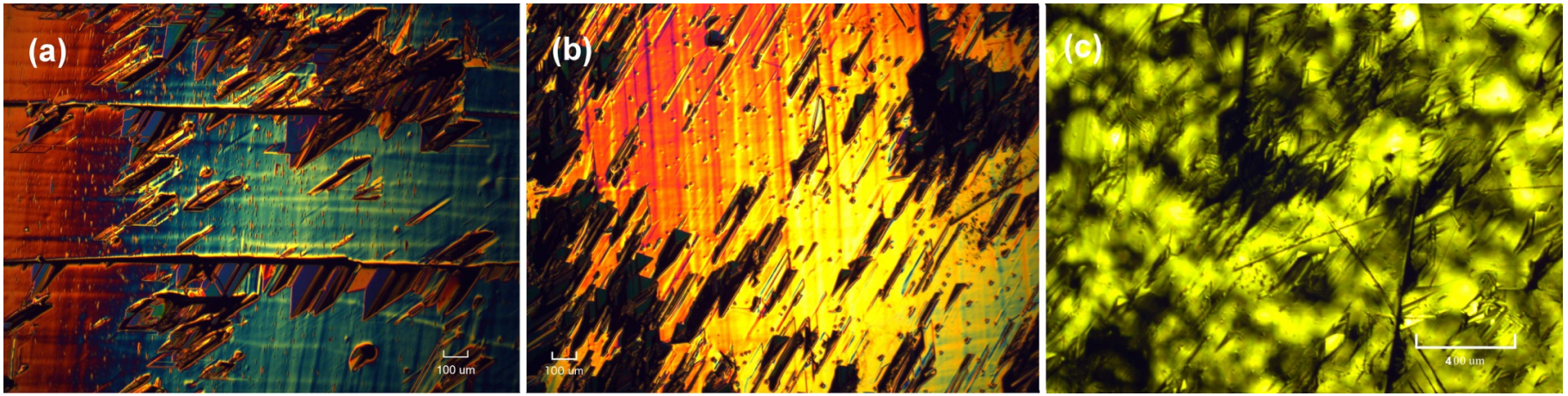
- Doping concentrations (10^{18} - 10^{20} cm^{-3})
- Growth on 3C seed or 4H substrate
- Direct or indirect doping method



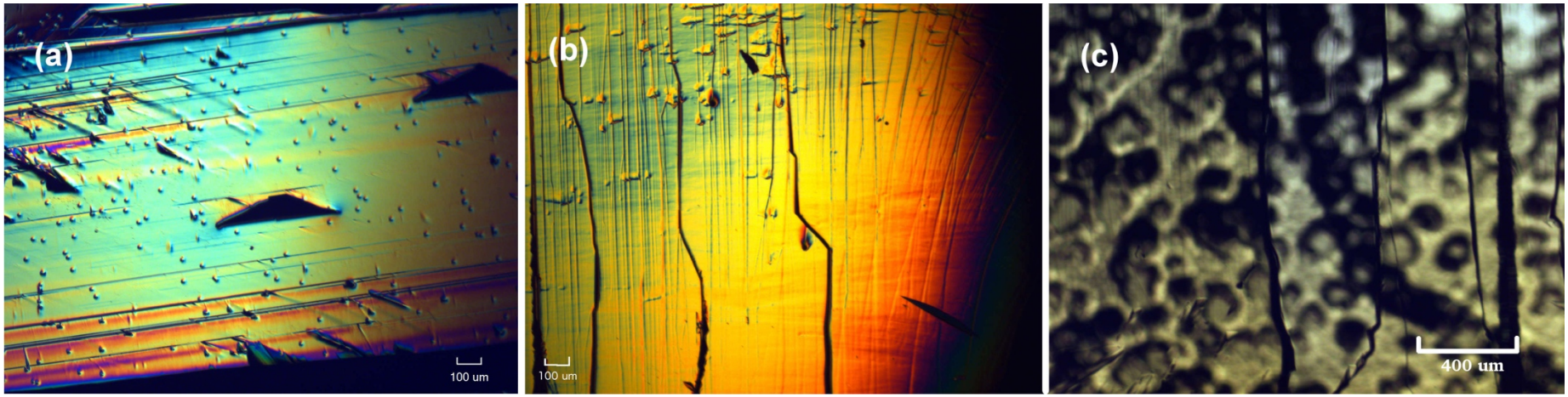
Doping concentrations



Indirect/direct doping, 10^{18} cm^{-3}

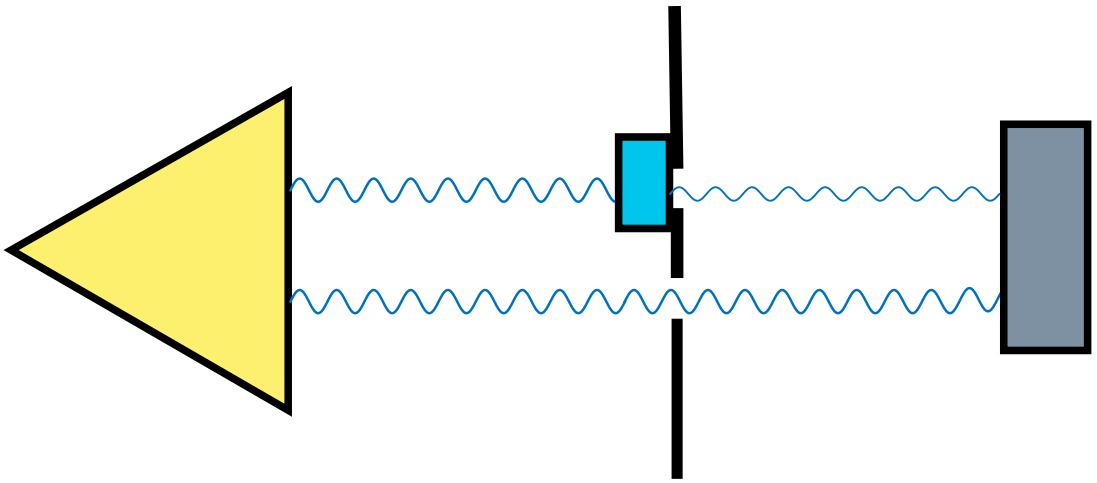


Indirect/direct doping, 10^{20} cm^{-3}

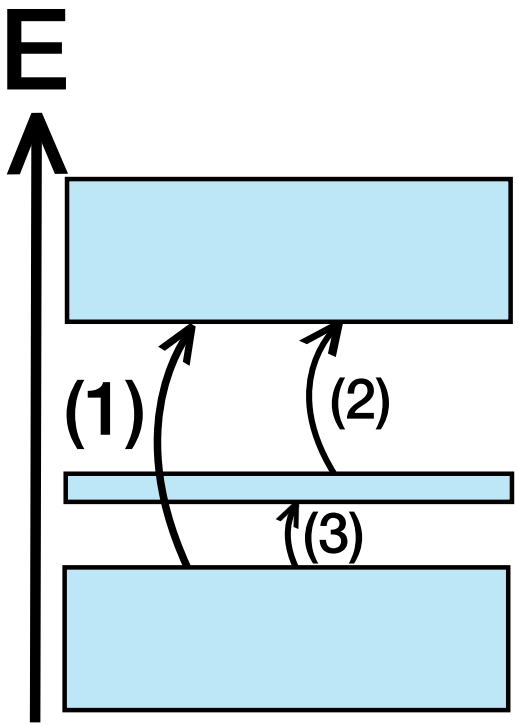


Absorption spectroscopy

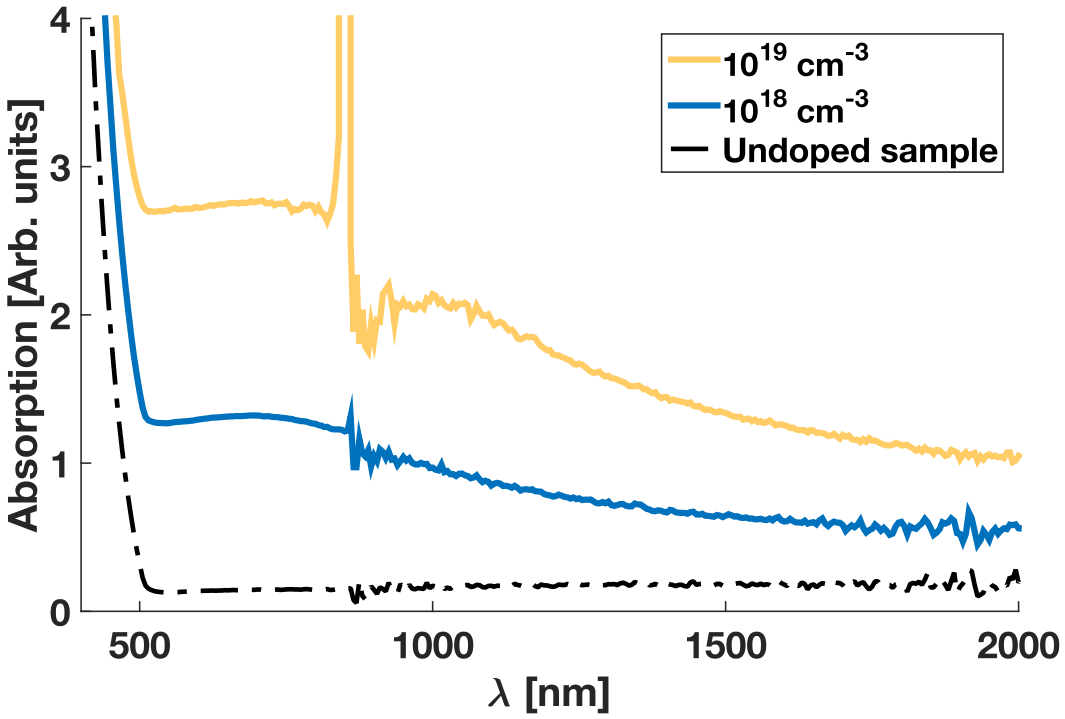
Absorption spectroscopy

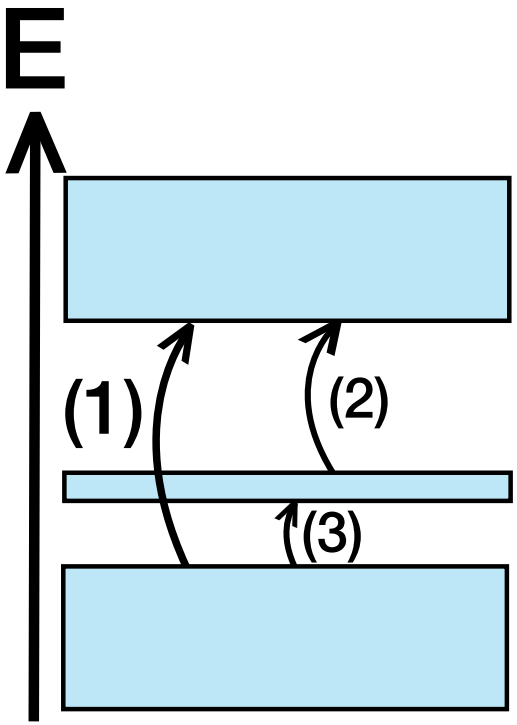


Absorption spectroscopy

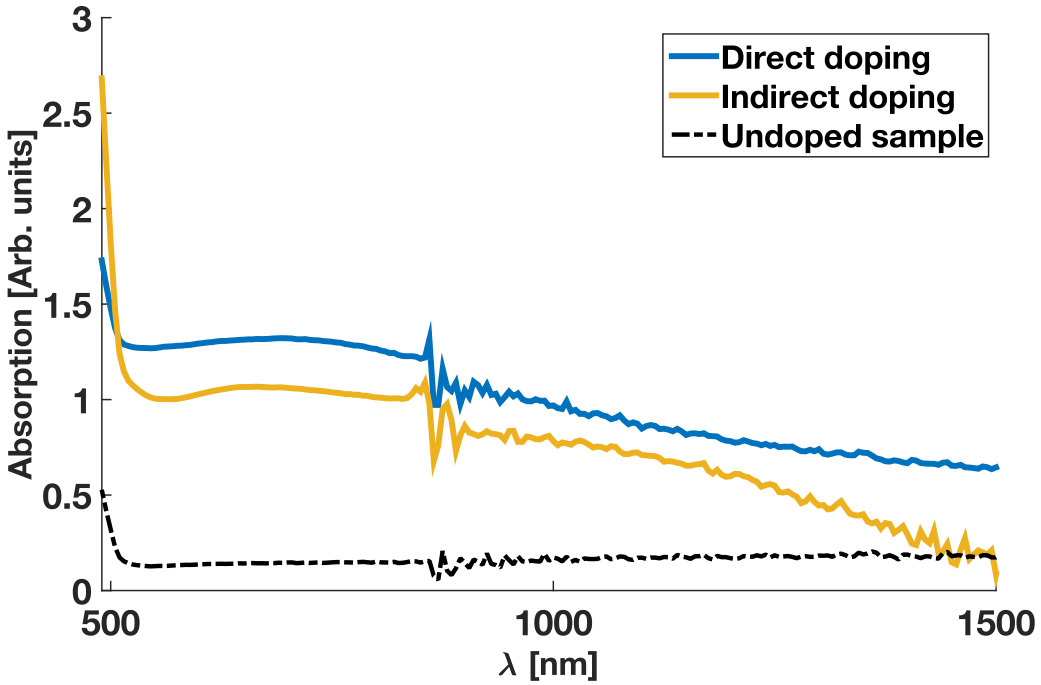


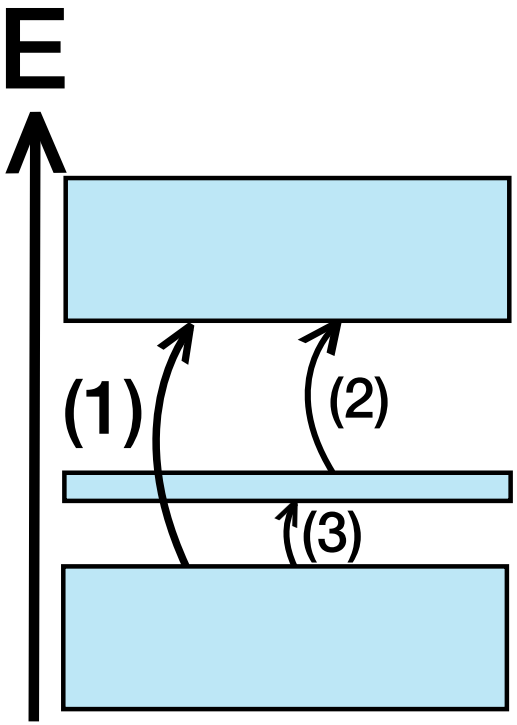
Absorption spectroscopy



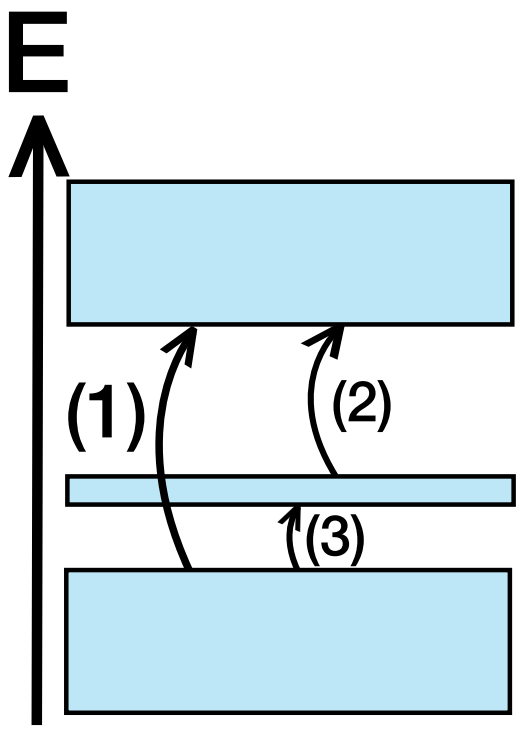


Absorption spectroscopy



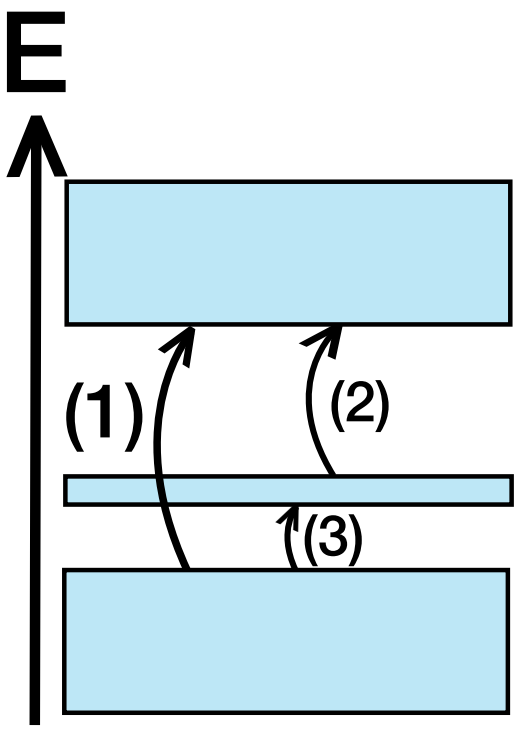


Fermi level



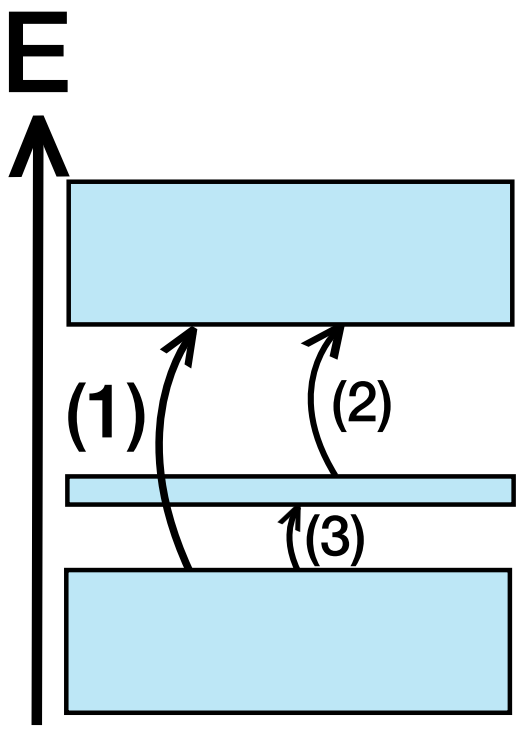
Fermi level

$$p - n = N_A^- - N_D^+$$



Fermi level

$$p - n = N_A^- - N_D^+$$



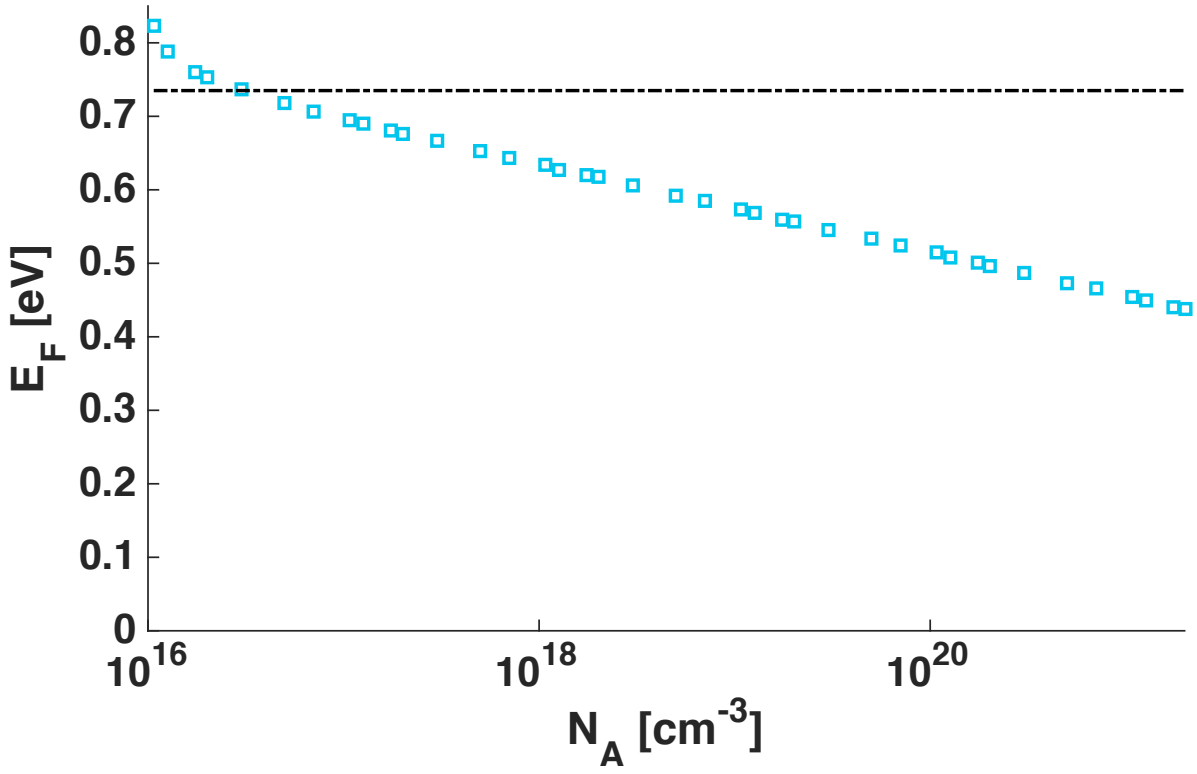
$$p >> n$$

$$N_D^+ \approx N_D$$

$$p \approx N_V e^{-E_F/kT}$$

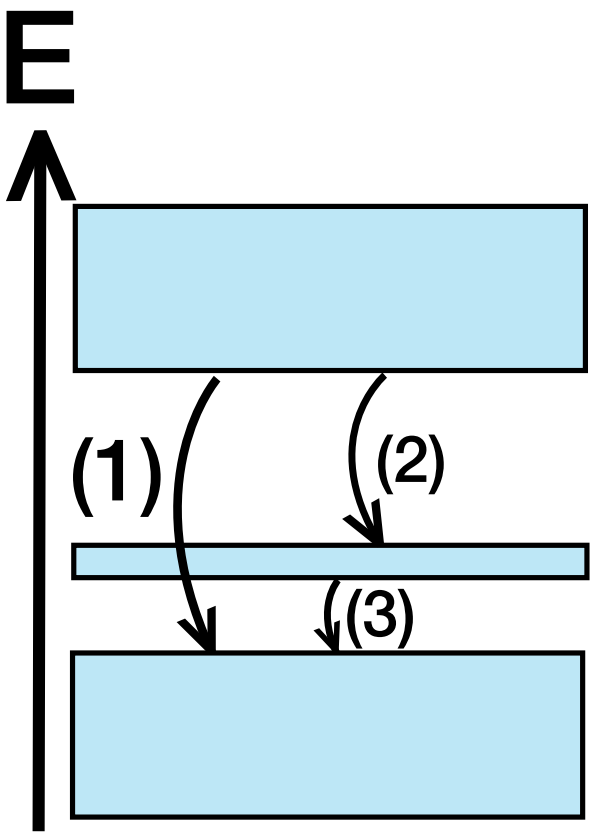
$$N_A^- = \frac{N_A}{1+2e^{\frac{E_A - E_F}{kT}}}$$

Fermi level

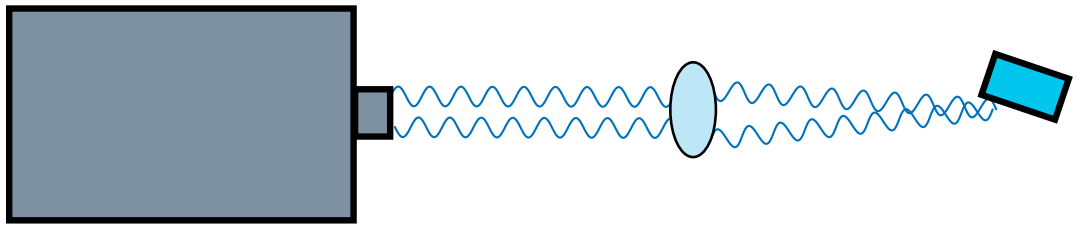


Photoluminescence spectroscopy

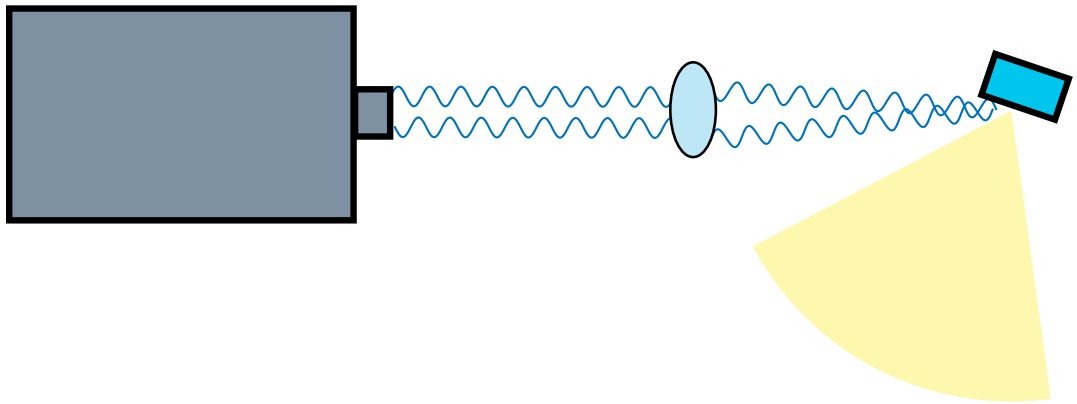
Photoluminescence spectroscopy



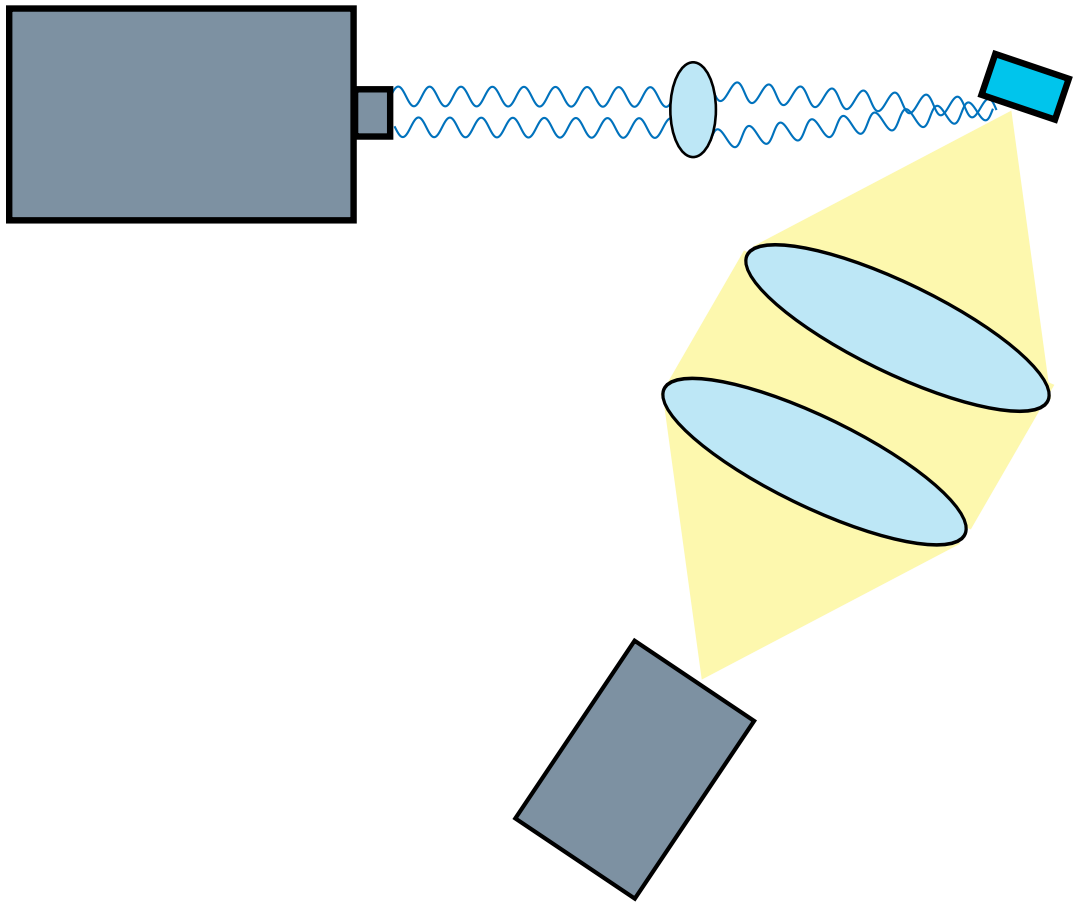
Photoluminescence spectroscopy



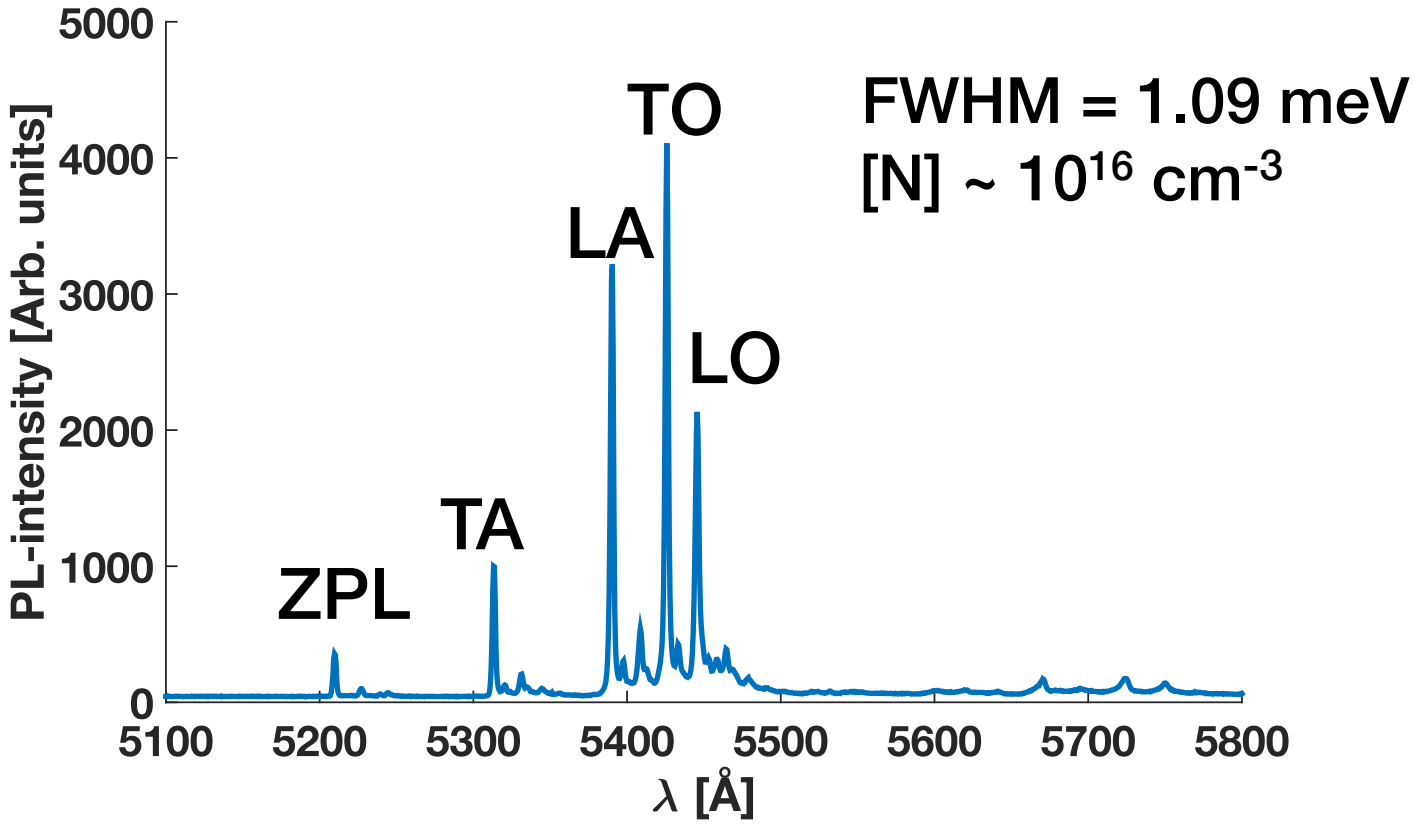
Photoluminescence spectroscopy



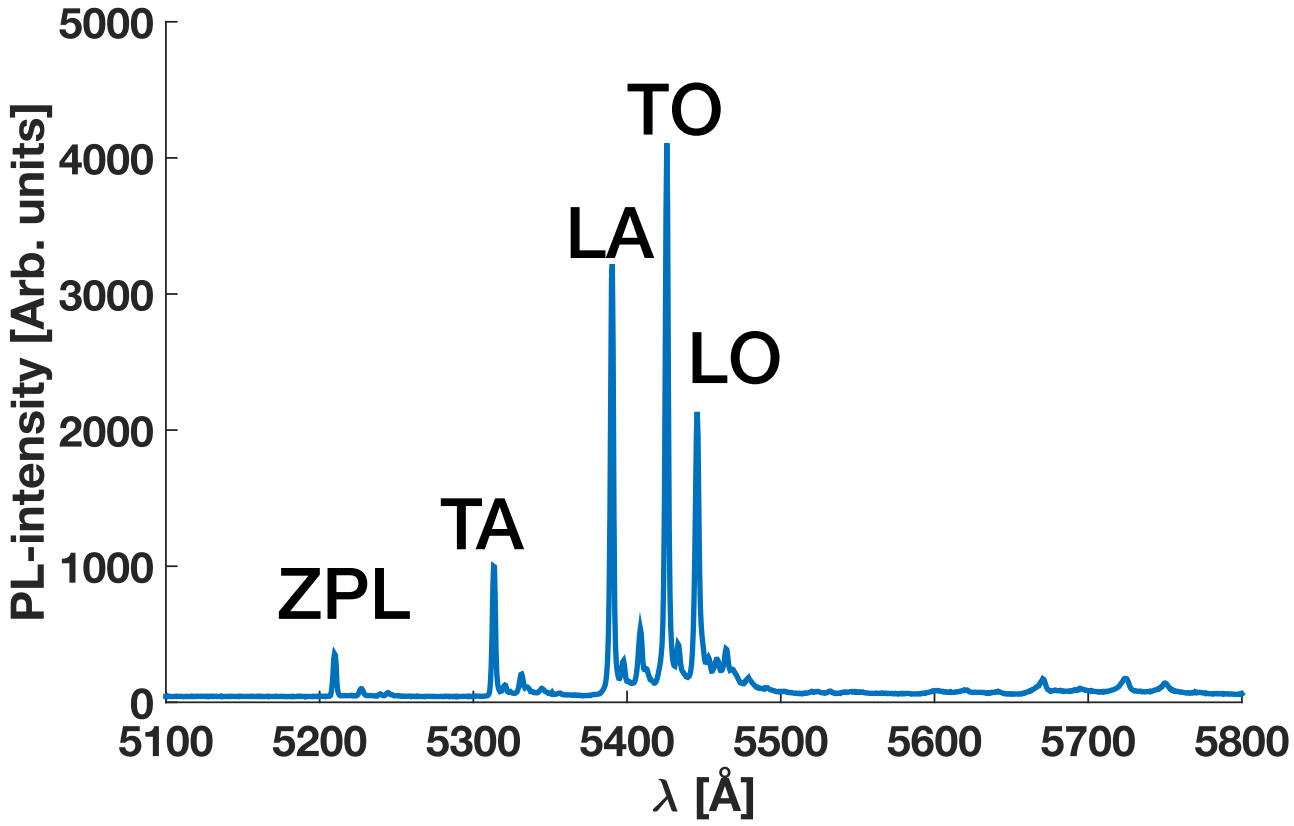
Photoluminescence spectroscopy



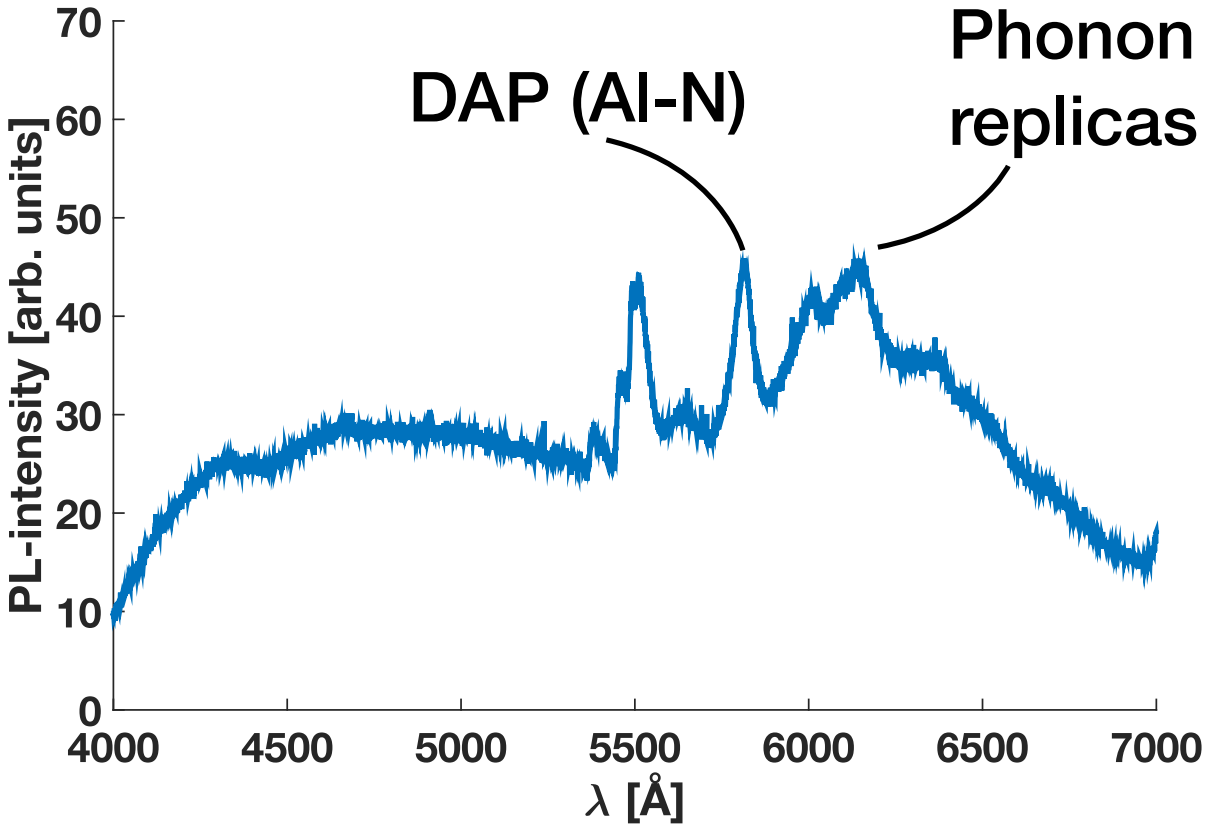
Photoluminescence spectroscopy



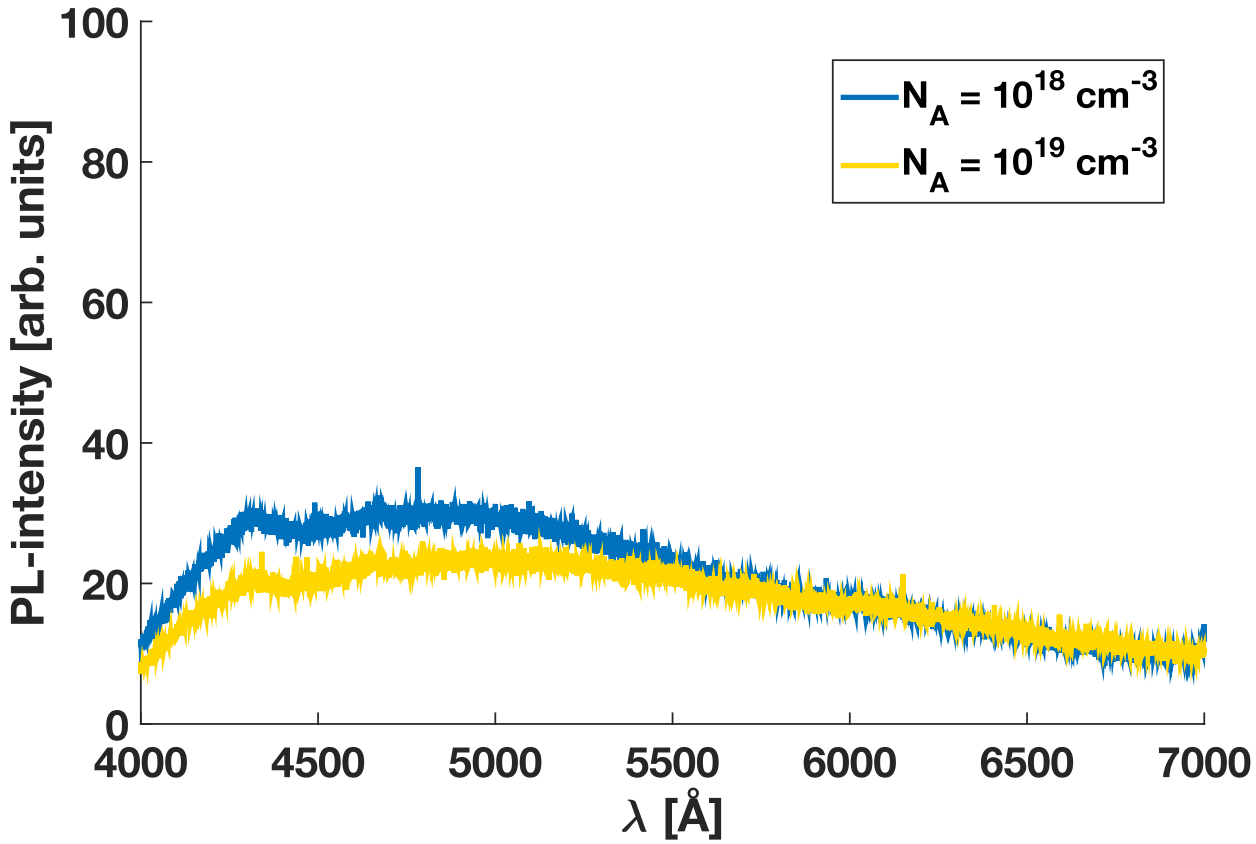
Photoluminescence spectroscopy



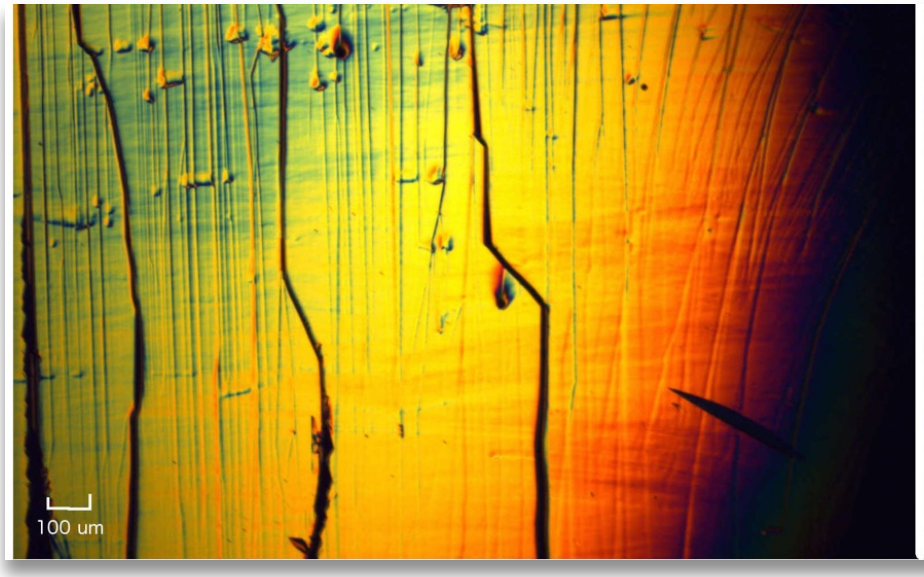
Photoluminescence spectroscopy

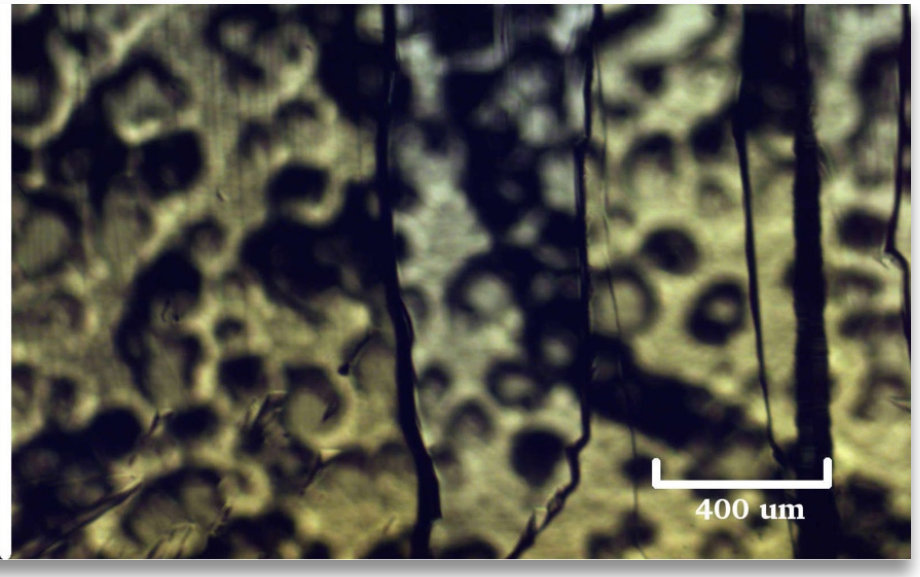


Photoluminescence spectroscopy



Photoluminescence spectroscopy



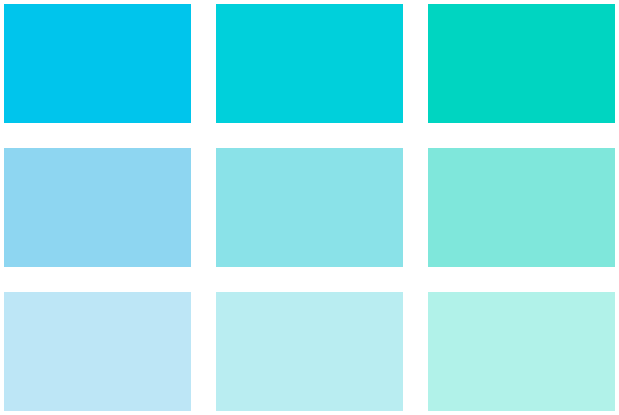


Growth

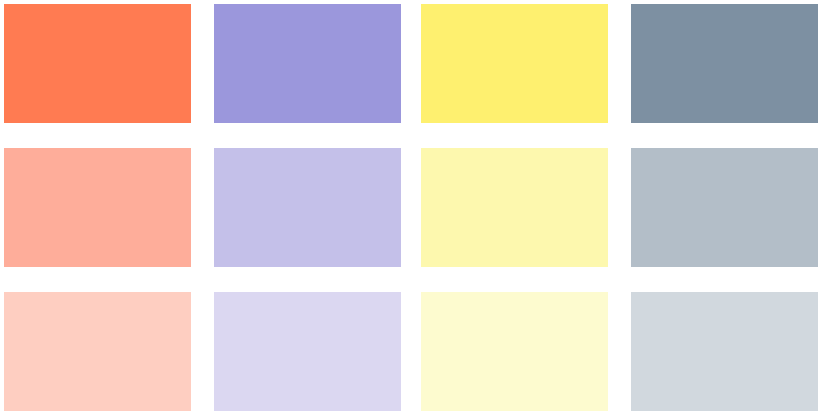
Growth

Linköping University's colour chart

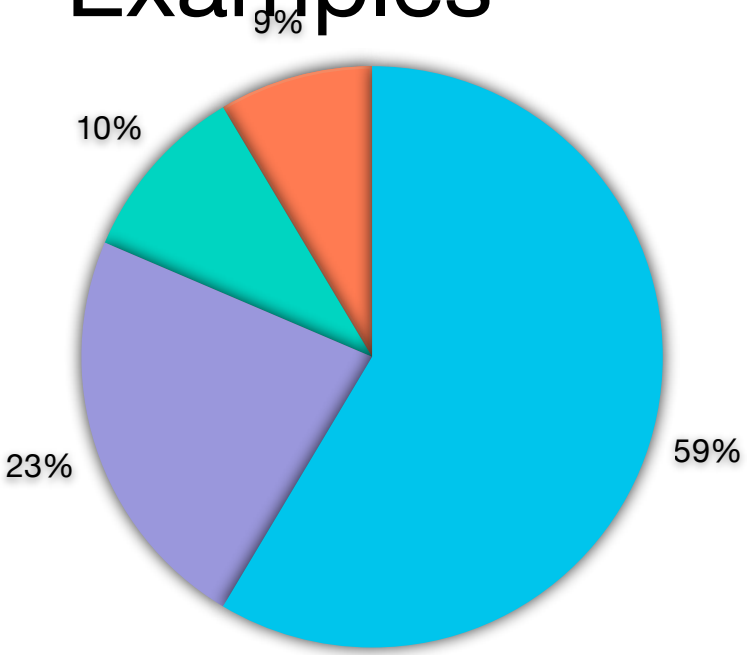
Primary colours



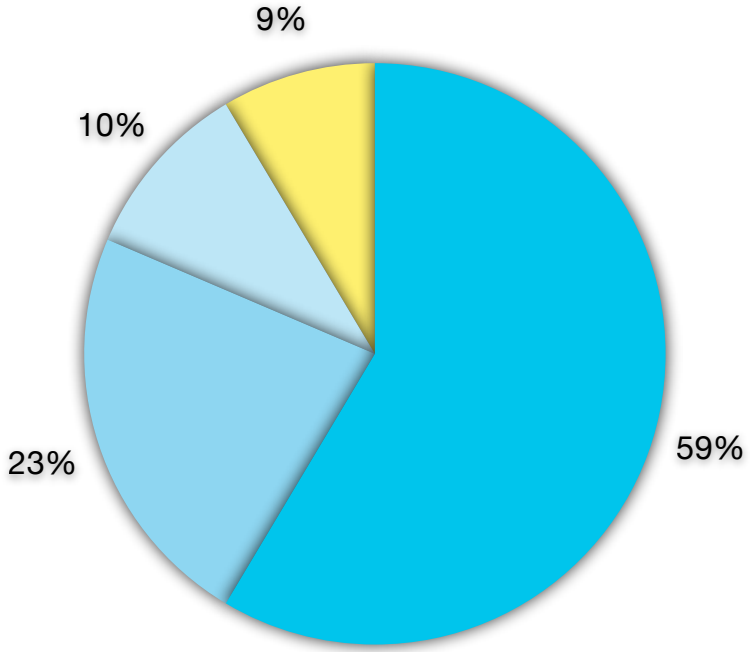
Complementary colours



Examples

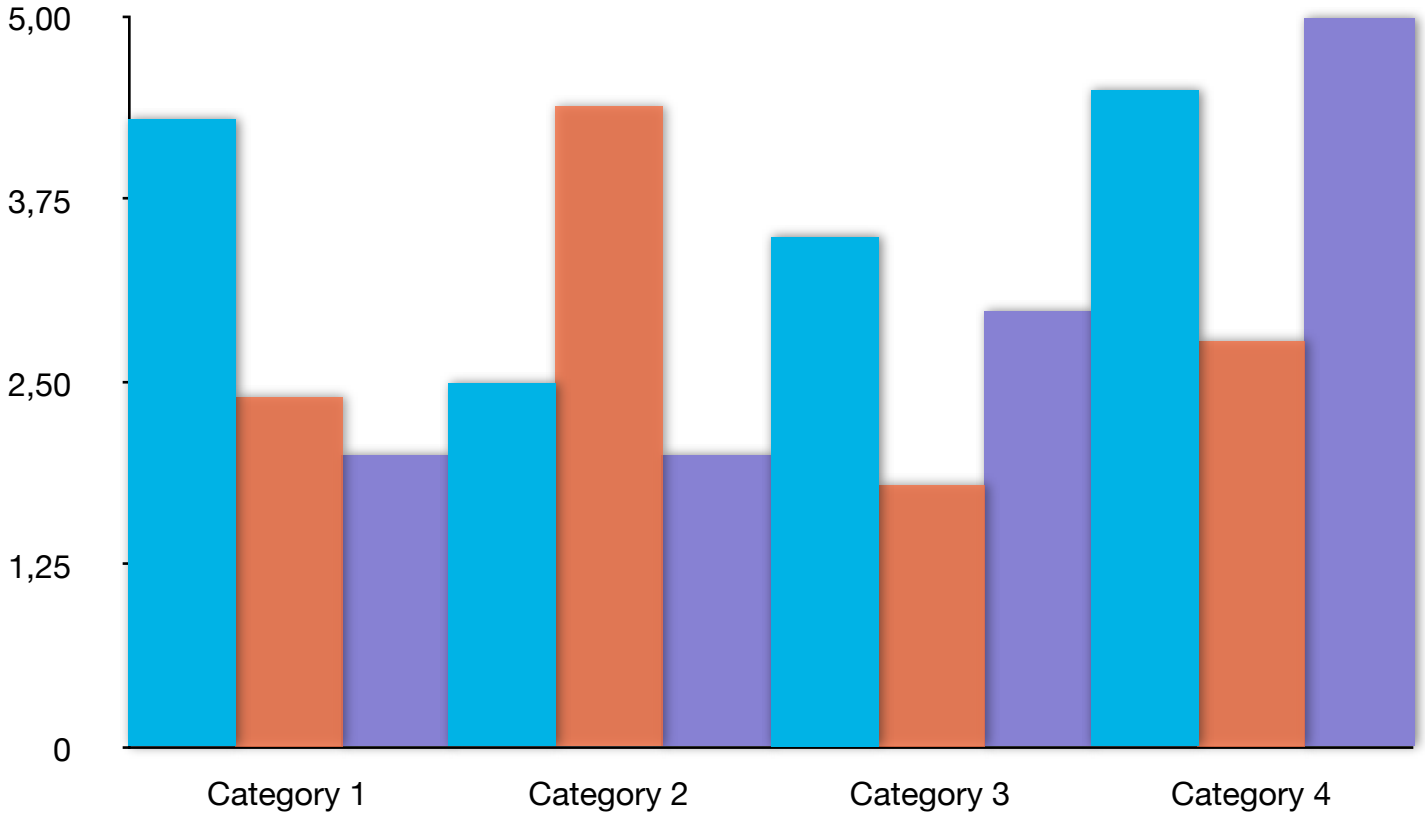


Category 1	3 357
Category 2	1 147
Category 3	886
Category	562

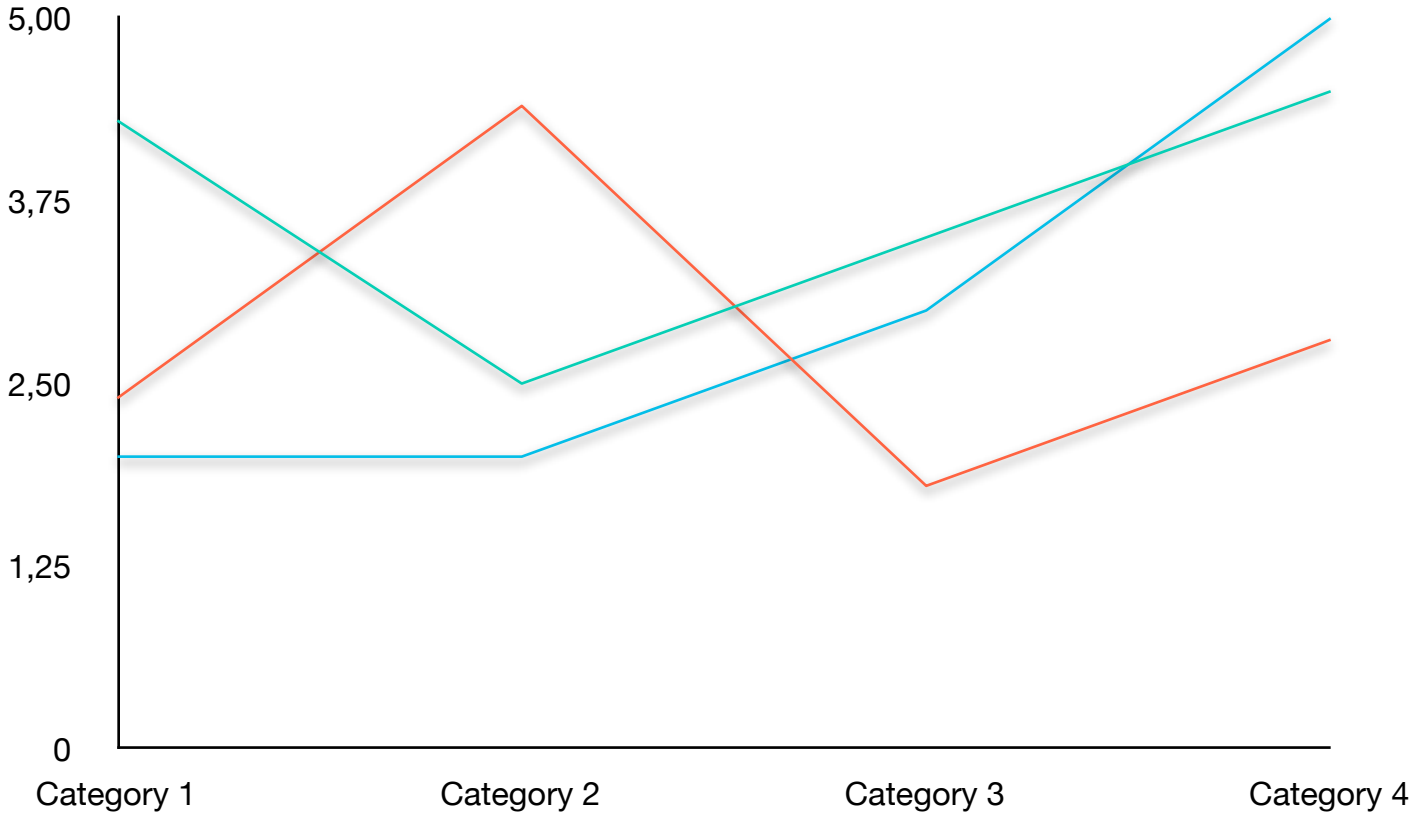


Category 1	3 357
Category 2	1 147
Category 3	886
Category	562

Examples



Examples



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