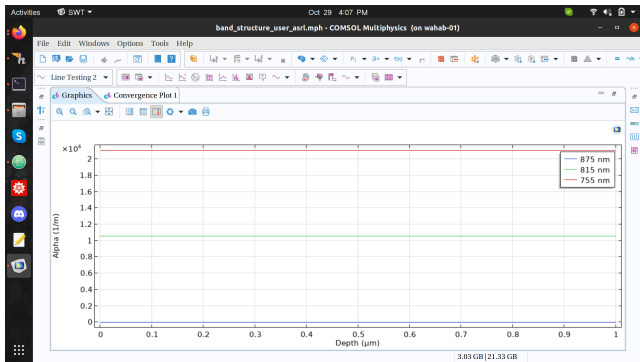


Absorption coefficient in my model

The absorption coefficient in my model is calculated independently



By definition

$$\alpha = \frac{4\pi k}{\lambda}$$

α is given to the code based on the known k

How is this given to the code?

I define a functional form for α and k

Activities SWT Oct 29 4:14 PM band_structure_user_asr1.mph - COMSOL Multiphysics (on wahab-01)

File Edit Windows Options Tools Help

Physics

Model Builder

- Default Model Inputs
- Materials
- Component 1 (comp1)
 - Definitions
 - Geometry 1
 - Materials
 - Semiconductor (semi)
 - Semiconductor Mate
 - Insulation 1
 - Zero Charge 1
 - Insulator Interface 1
 - Continuity/Heterojun
 - Initial Values 1
 - Optical Transitions 1
 - Manual Optical Tran
 - Constant p doping
 - n+ Doping
 - p-Contact
 - n-Contact

Settings

Indirect Optical Transitions

Override and Contribution

Equation

Transitions Model

Transitions model:

User-defined absorption

Specify Absorption

Specify absorption:

Absorption coefficient

Real part of refractive index:

n 4.68[1]*exp(315722[1/m]*lda0) 1

Absorption coefficient:

α (-1.75596e13[1/m^2]*lda0+15364681.5[1/m]) 1/m

Graphics Convergence Plot 1

1.5 μm

1

0.5

0

-0.5

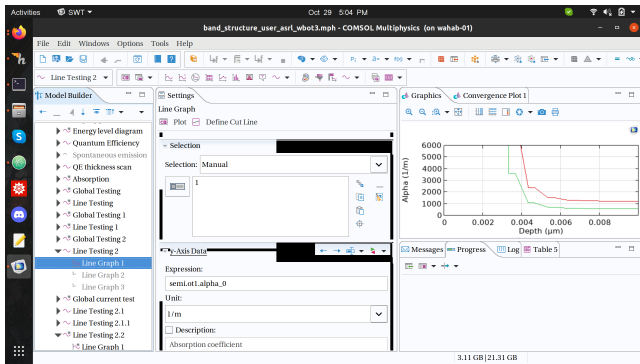
-1 0 1 2 3 μm

Messages Progress Log Table 3

3.04 GB | 21.33 GB

Absorption coefficient in COMSOL's model

COMSOL attempts to account for doping - KK integral



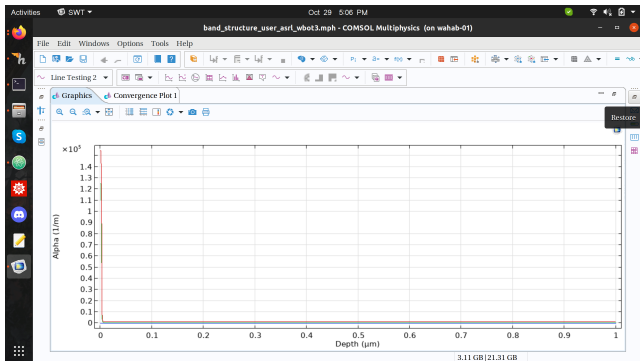
By definition

$$\alpha = \frac{4\pi\Delta k}{\lambda}$$

Does COMSOL care about refractive index? Relative permittivity? What is Δk ?

Absorption coefficient in COMSOL's model 2.0

The model has an option to turn off changes to n and k ... trying today



By definition

$$\alpha = \frac{4\pi\Delta k}{\lambda}$$

Does COMSOL care about refractive index? Relative permittivity? What is Δk ?

Maybe how does COMSOL get the info?

I define the same functions as I do in my model in parameters

The screenshot displays the COMSOL Multiphysics interface. The main window shows the 'Parameters' table for 'Parameters 1'. The table lists various parameters with their expressions, values, and descriptions. A red box highlights the 'Expression' column, and a black box highlights the 'Value' column. The 'Description' column contains text that is partially obscured by a black box.

Name	Expression	Value	Description
lda0	6.95e-7[m]	6.95E-7 m	Incident wavelength
f0	c_const/lda0	4.3136E14 1/s	Incident frequency
omega0	2*pi*1[rad]*f0	2.7103E15 rad/s	Incident angular frequency
E_ph	f0*h_const	2.8582E-19 J	Incident photon energy
n0	3.5	3.5	Refractive index of GaAs
tau	2[ns]	2E-9 s	Spontaneous lifetime
d0	2e-6[m]	2E-6 m	Out-of-plane thickness
Pin	1e-5[W]	1E-5 W	Incident power for out-of-plane emission prob
Pe	0.5	0.5	emission prob
nreal	4.68[1]*exp(-315722[1/m]*lda0)	3.7579	wavelength dep n
kimag	-832727[1/m]*lda0+0.73[1]	0.15125	wavelength dep k
alpha	4*3.1415*kimag/lda0	2.7348E 1/1	absorption

The right side of the interface shows a 'Graphics' window with a plot of a square region in a 2D coordinate system. The x and y axes are labeled in micrometers (μm) and range from -0.5 to 1.5. The plot shows a gray square centered at (0,0) with a side length of 1 μm.

Maybe how does COMSOL get the info? 2.0

COMSOL gets assigned the same function in materials

The screenshot displays the COMSOL Multiphysics interface for a model named "band_structure_user_asrl_wbot3.mph". The "Materials" tab is active, showing the material "GaAs - Gallium Arsenide" selected in the "Material Contents" table. The material type is set to "Solid".

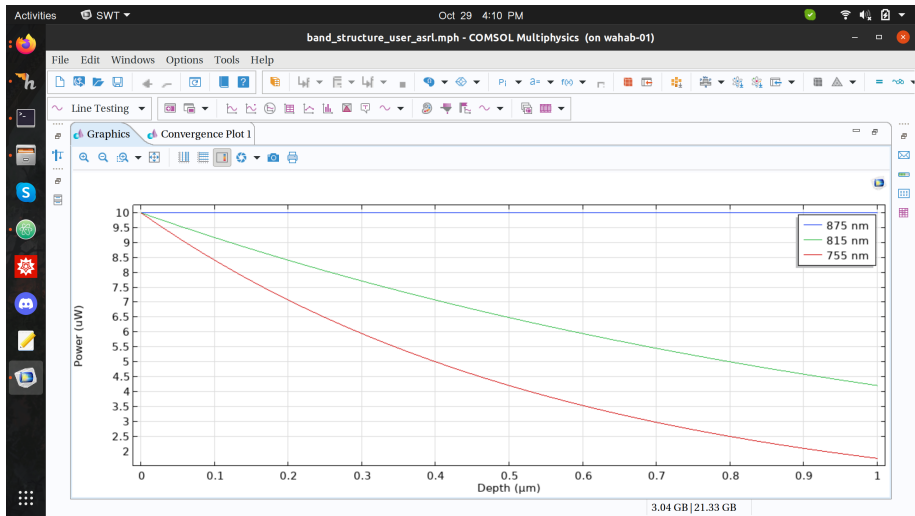
Material Contents Table:

Property	Variable	Value	Unit
<input checked="" type="checkbox"/> Relative permittivity	epsilon0	$(n_{\text{real}} - i \cdot n_{\text{kimag}}) \cdot \epsilon_0$	1
<input checked="" type="checkbox"/> Band gap	Eg0	1.424[V]	V
<input checked="" type="checkbox"/> Electron affinity	chi0	4.07[V]	V
<input checked="" type="checkbox"/> Effective density of st Nv		$(T/1[K])^{\wedge}(3/2) \cdot 1.83e15[1/cm^3]$	1/m ³
<input checked="" type="checkbox"/> Effective density of st Nc		$(8.63e13 \cdot (T/1[K])^{\wedge}(3/2) \cdot (1 - 1.93e-4 \cdot (T/1[K])^{-4}))$	1/m ³
<input checked="" type="checkbox"/> Refractive index, real n_iso; n	nreal		1
<input checked="" type="checkbox"/> Refractive index, ima ki_iso; l	kimag		1
<input checked="" type="checkbox"/> Electron lifetime, SR1 taun	tau		s
<input checked="" type="checkbox"/> Hole lifetime, SRH taup	tau		s

The "Graphics" window on the right shows a 2D plot of a rectangular domain with a blue background, representing the material geometry. The axes are labeled in micrometers (μm), with the x-axis ranging from 0 to 2 and the y-axis from -0.5 to 1.5.

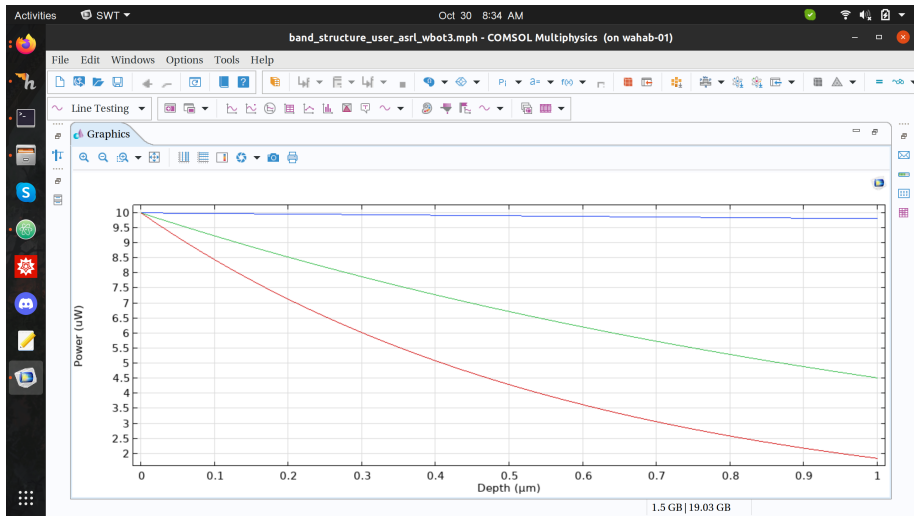
The absorption curve (Beer-Lambert)

Curve looks like what is expected - same "function" given to COMSOL



The absorption curve (Beer-Lambert) COMSOL?

Results from EM module seem to work... but not semiconductor!



My QE results

IQE now below 100 % and emission prob between 10-50 % (here 50 %)

