ECE 445 Assignment 2

PEI-YU LIN

1 Design a structure

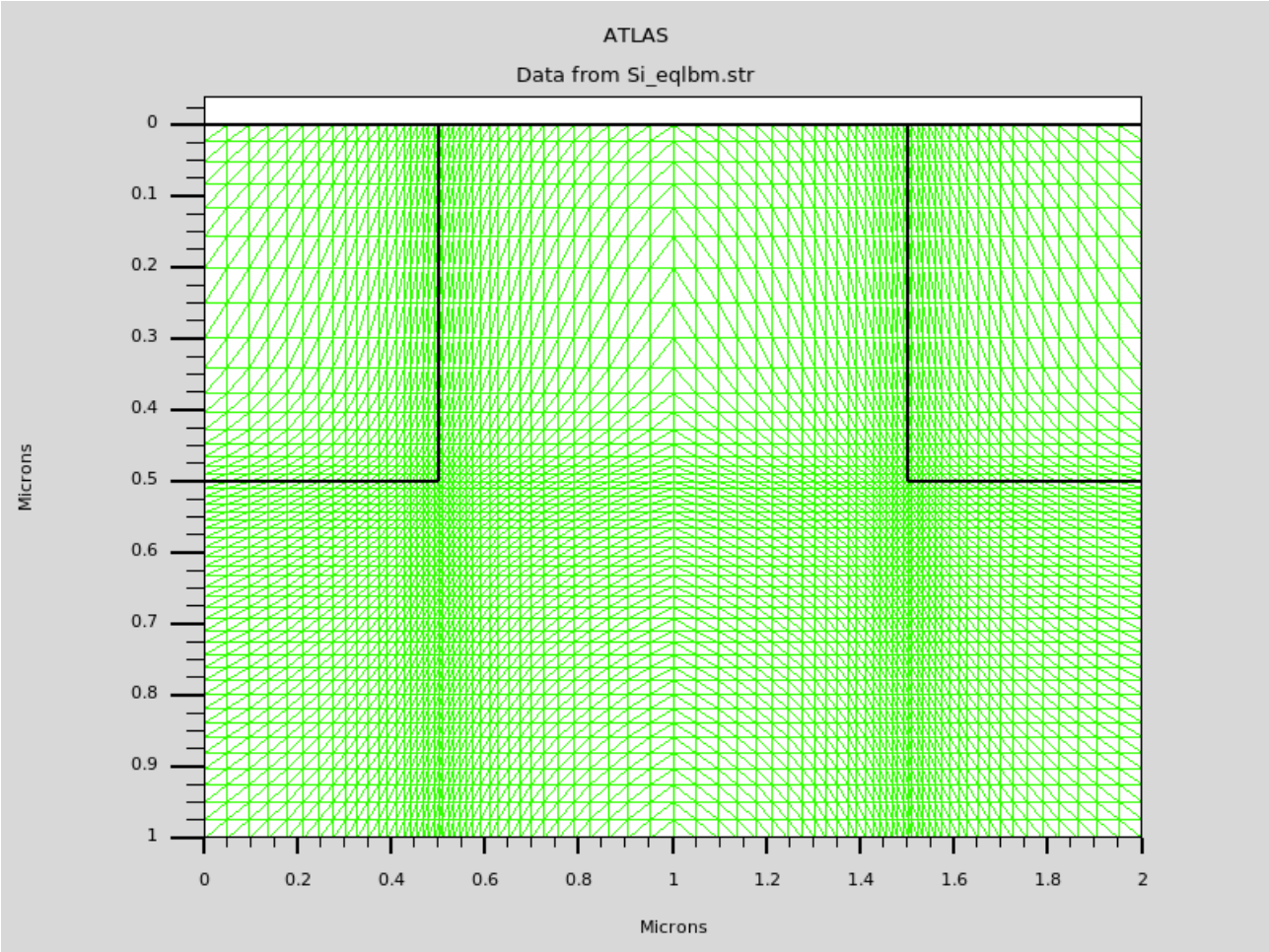
1.1 Code:

```
go atlas
#Length of the total device(um)
set L=2
#Thickness of the total device(um)
set T=1
#Length of the p-doped region(um)
set Lp=0.5
#Thickness of the p-doped region(um)
set Tp=0.5
#Length of the n-doped region(um)
set Ln=0.5
#Thickness of the n-doped region(um)
set Tn=0.5
#Distance between p-doped and n-doped region(um)
set Lpn=1 #0.5um, 1um, 1.5um

#Device width in z-direction(um)
mesh width = 100

# X-mesh
x.mesh loc=0.0 spac=0.05
x.mesh loc=$Lp spac=0.01
x.mesh loc=$Lp+$Lpn/2 spac=0.05
x.mesh loc=$Lp+$Lpn spac=0.01
x.mesh loc=$Lp+$Lpn+$Ln spac=0.05

# Y-mesh
y.mesh loc=0.0 spac=0.025
y.mesh loc=$Tp/2 spac=0.05
y.mesh loc=$Tp spac=0.01
y.mesh loc=$T spac=0.025

# Region
region num=1 x.min=0.0 x.max=$Lp+$Lpn+$Ln y.min=0.0 y.max=$T
user.material=Si
region num=2 x.min=0.0 x.max=$Lp y.min=0.0 y.max=$Tp
user.material=Si
region num=3 x.min=$Lp+$Lpn x.max=$Lp+$Lpn+$Ln y.min=0.0 y.max=$Tn
user.material=Si

# Electrode
```

```
elec num=1 name=anode x.min=0.0 x.max=$Lp y.min=0.0 y.max=0.0
elec num=2 name=cathode x.min=$Lp+$Lpn x.max=$Lp+$Lpn+$Ln
y.min=0.0 y.max=0.0

# Doping (n-Si: 1e15, 1e16, 1e17)
doping region=1 uniform n.type conc=1e17
doping region=2 uniform p.type conc=1e19
doping region=3 uniform n.type conc=1e19

# Material
material material=Si user.default=silicon

# Models
model srh drift.diff print

# Output
output band.param con.band val.band

# Method
method newton

# Initial solution
solve init

solve vanode=-10
log outf=Si_eqlbm.log
# Apply 0V,0.5,-1 bias and solve
#solve vanode=0 vstep=0.05  vfinal=2  name=anode

# Save
save outf=Si_eqlbm.str
# Extract and visualize the band diagram and electric field
tonyplot Si_eqlbm.str

#tonyplot Si_eqlbm.log

quit
```

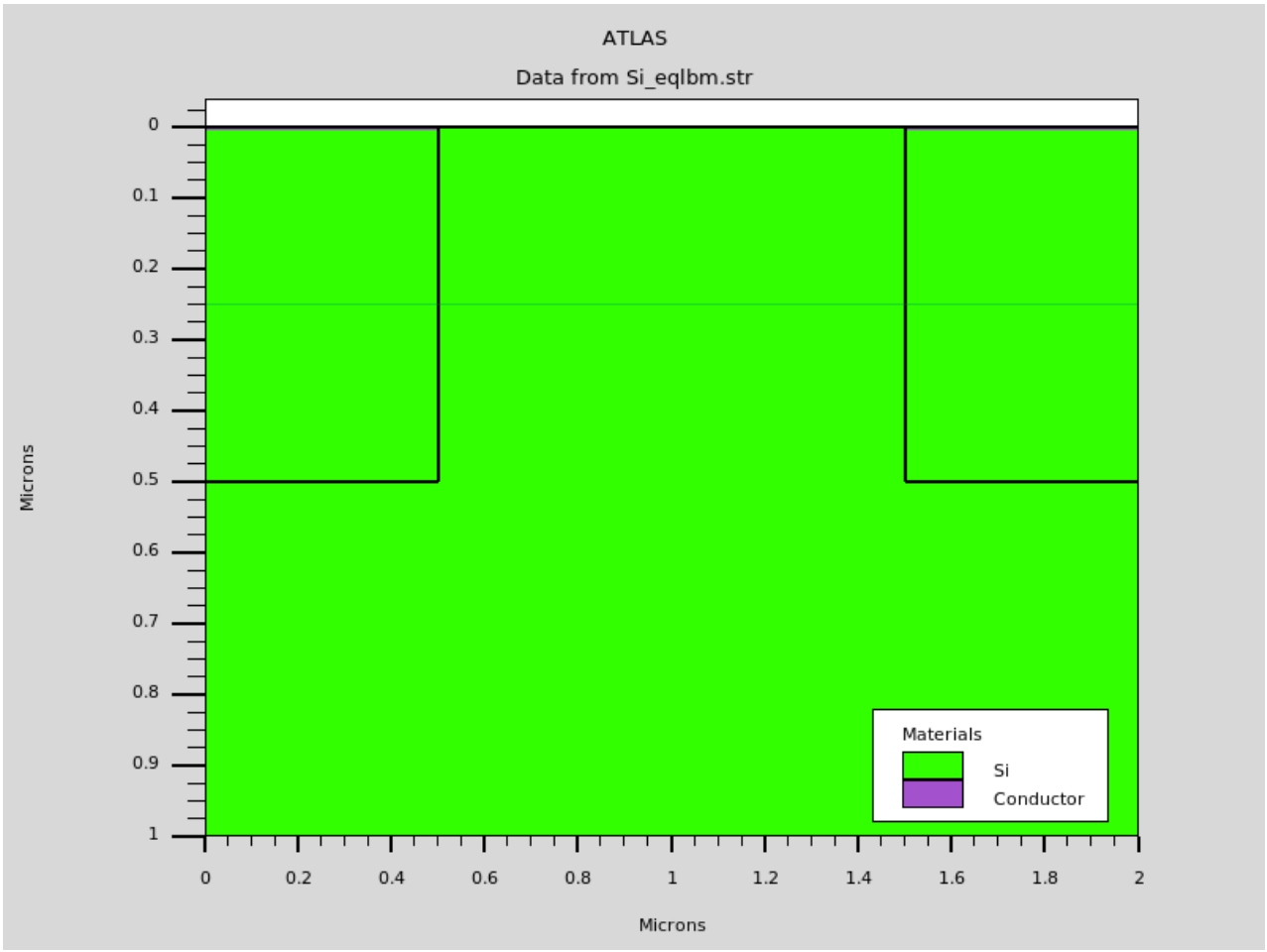
2 Show the meshing, band diagram and electric field

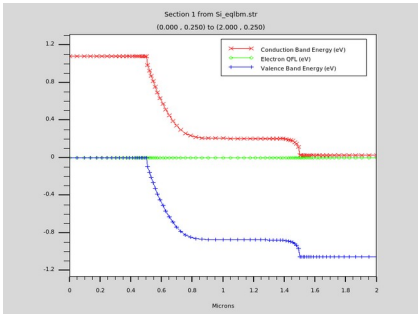
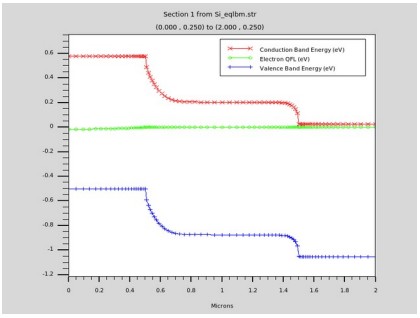
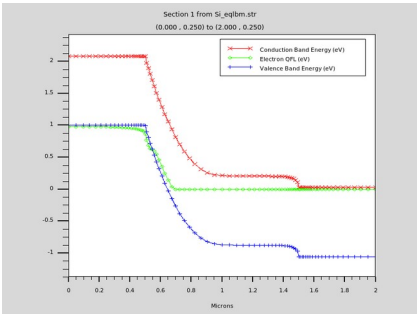
2.1 Meshing

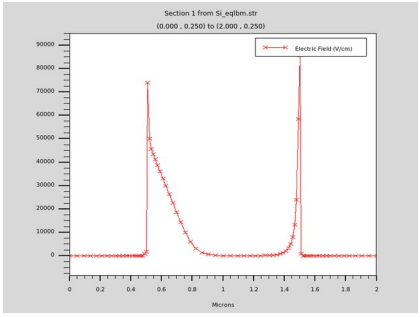
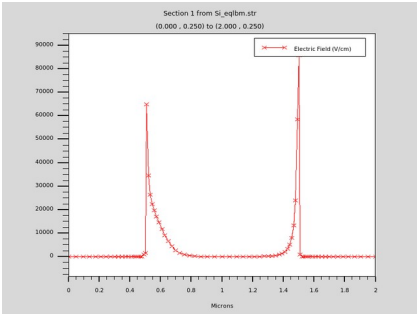
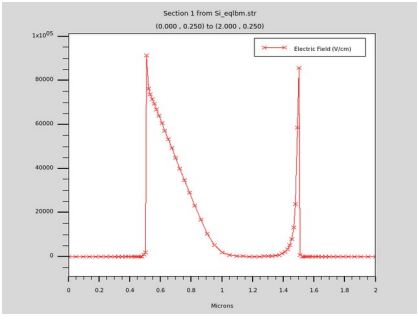


2.2 Band diagram and electric field for L=1um, n-Si=1e16 /cm3

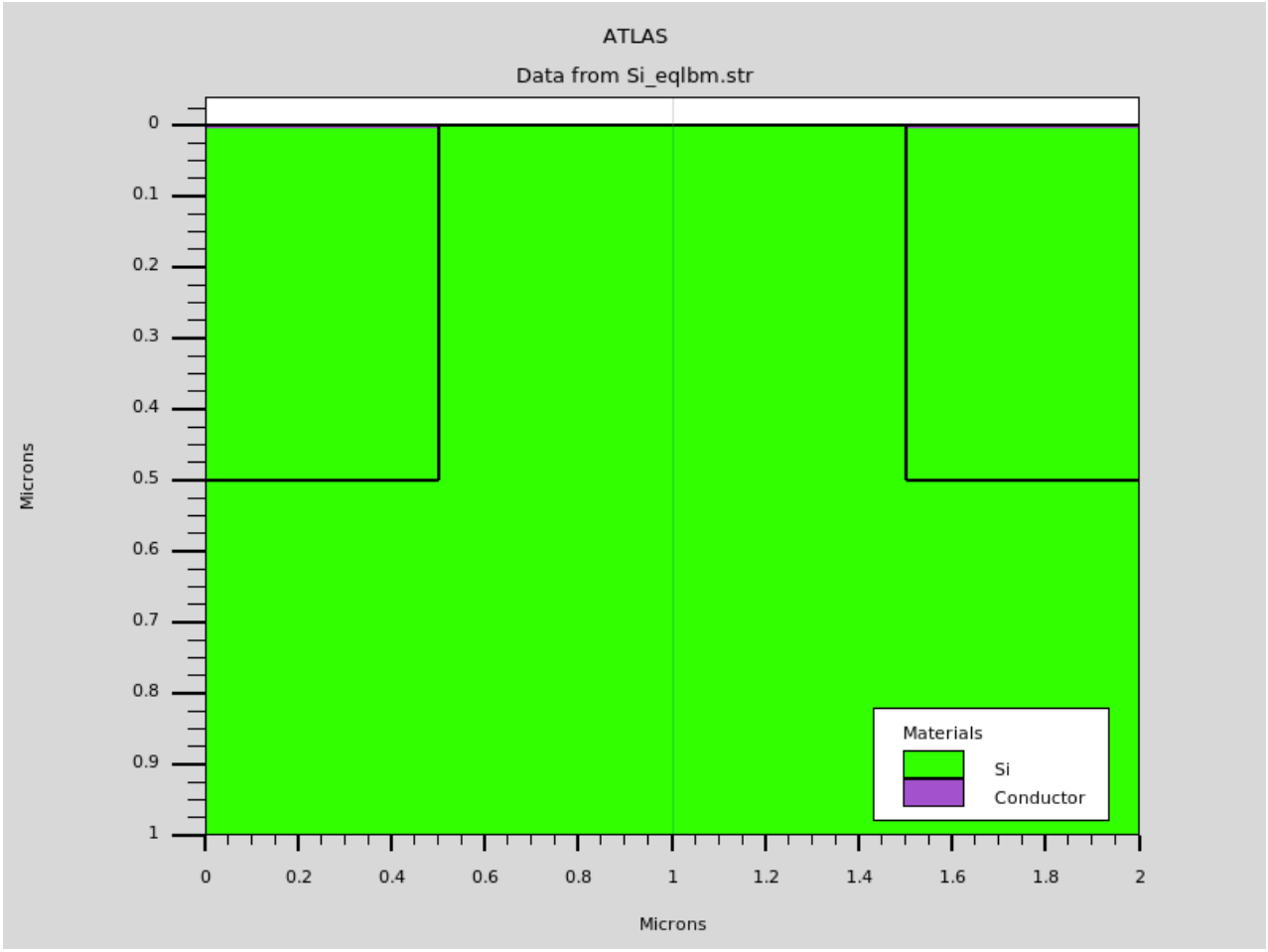
Band Diagram and Electric Field of A-A’

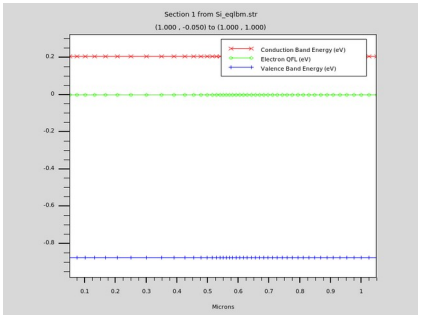
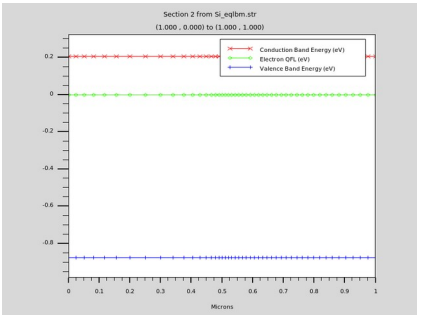
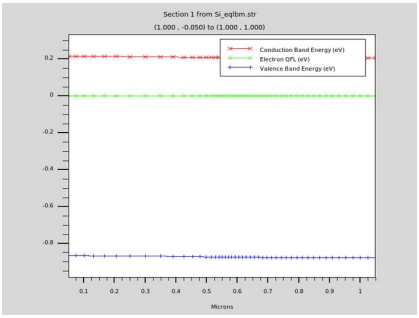
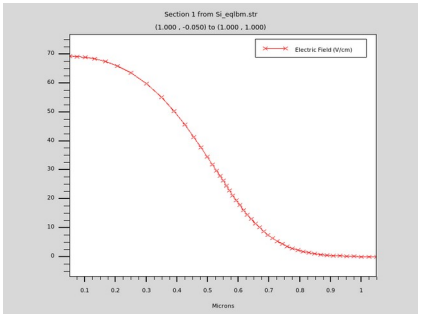
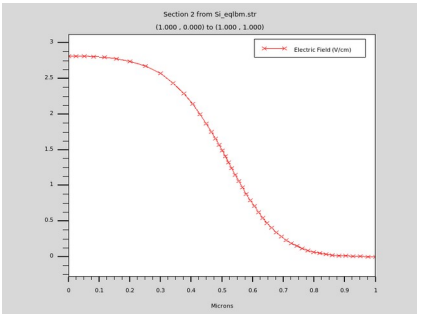
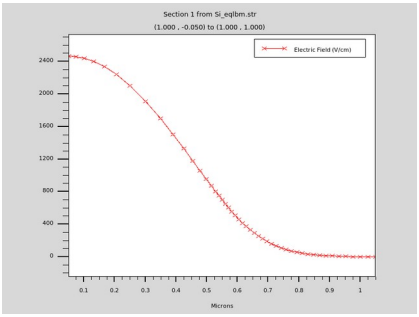


Band Diagram at 0V	Band Diagram at 0.5V	Band Diagram at -1V
		

Electric Field at 0V	Electric Field at 0.5V	Electric Field at -1V
		

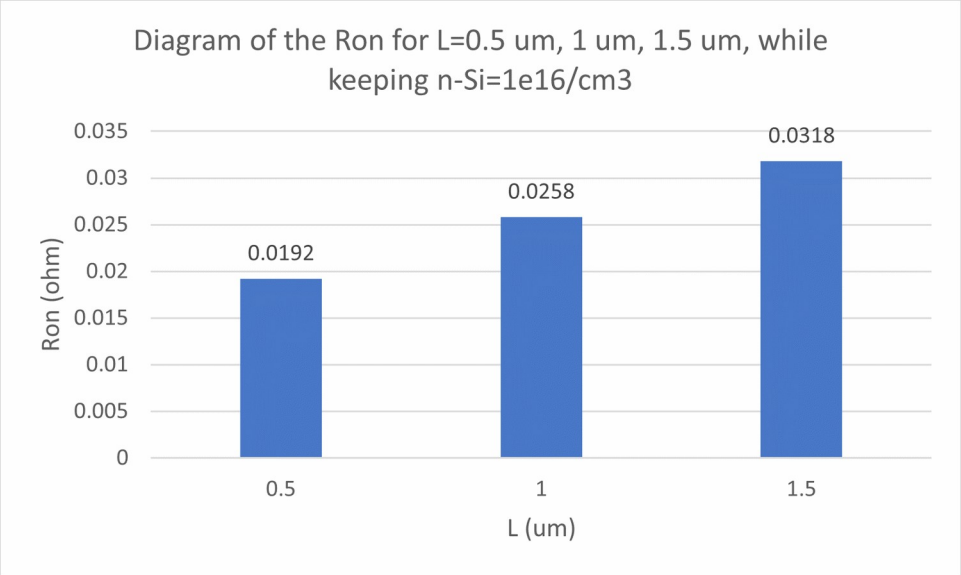
Band Diagram and Electric Field of B-B’

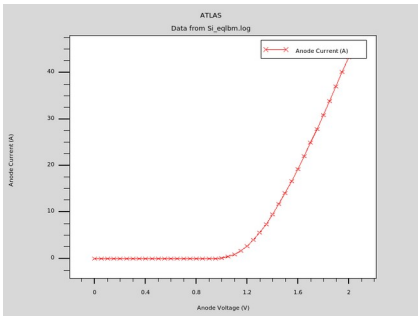
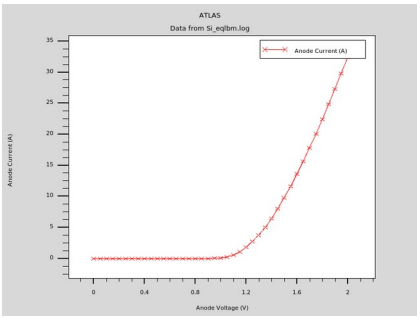
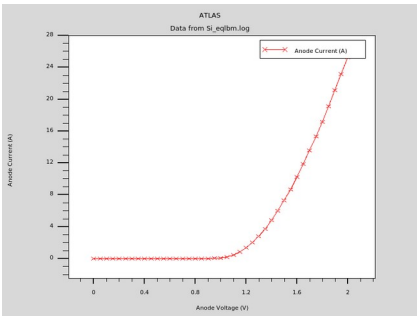


Band Diagram at 0V	Band Diagram at 0.5V	Band Diagram at -1V
		
Electric Field at 0V	**Electric Field at 0.5V**	**Electric Field at -1V**
		

3. Ron for changing Length

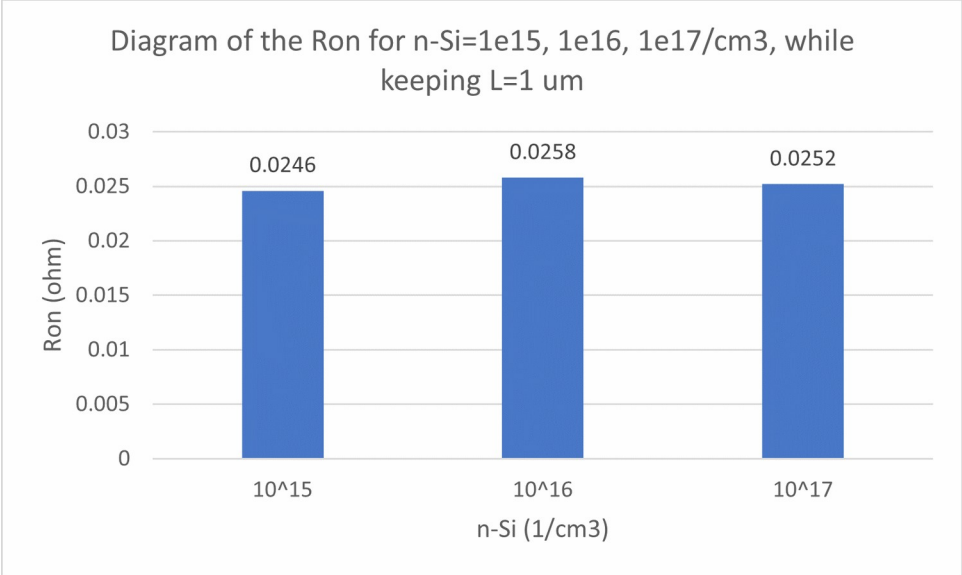
Ron for L=0.5, 1, 1.5 um, while keeping n-Si = 1e16/cm3 at -10 V

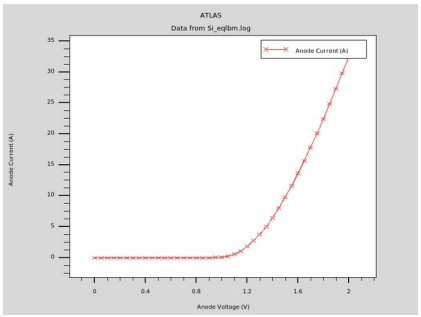
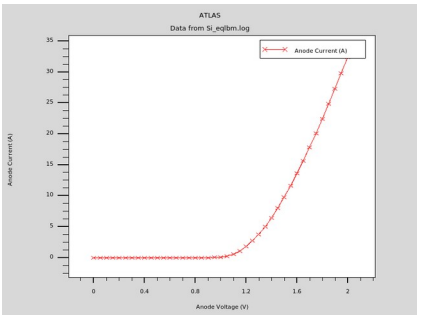
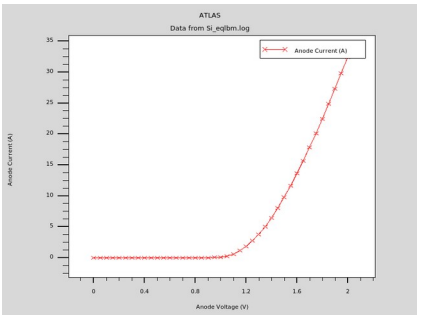


Ron for L=0.5 um	Ron for L=1 um	Ron for L=1.5 um
		

4. Ron for changing n-Si

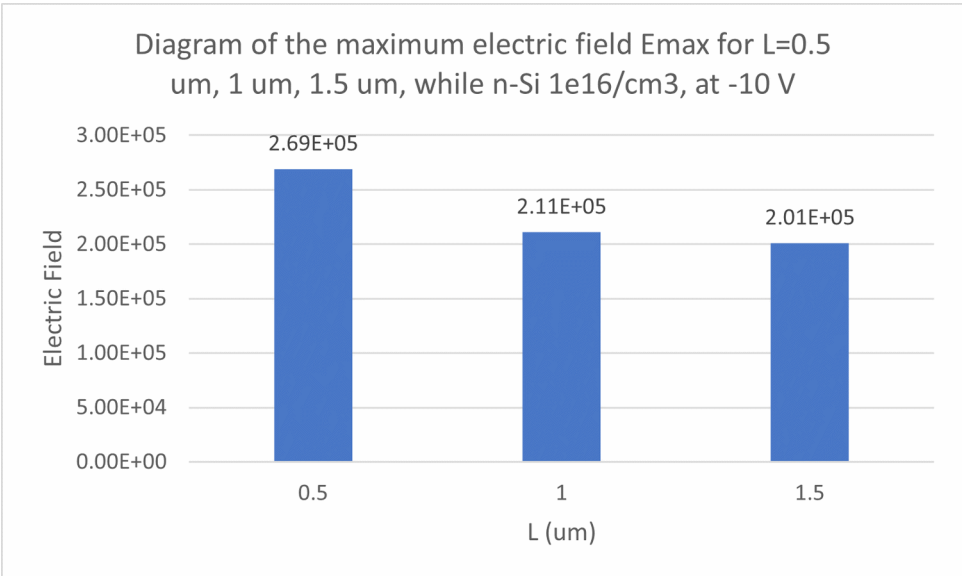
Ron for n-Si= 1e15 , 1e16 , 1e17 /cm3, while keeping L = 1um at -10 V



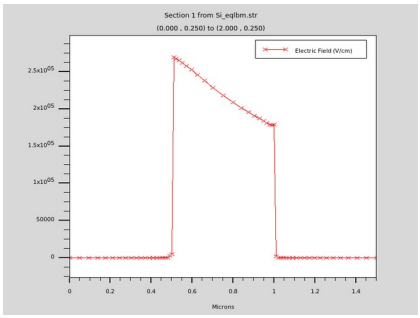
Ron for n-Si = 1e15/cm3	Ron for n-Si = 1e16/cm3	Ron for n-Si = 1e17/cm3
		

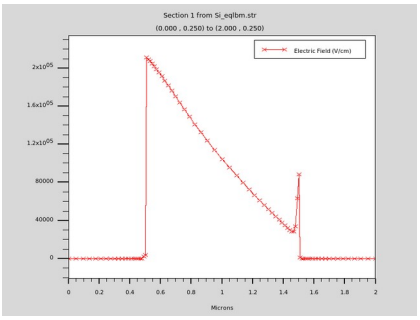
5. Max Electric Field for changing Length

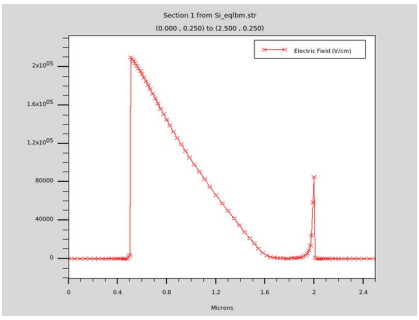
Electric Field for L=0.5, 1 1.5 um, while n-Si = 1e16 /cm3 at -10 V



Electric Field for L=0.5 um	Electric Field for L=1 um	Electric Field for L=1.5 um

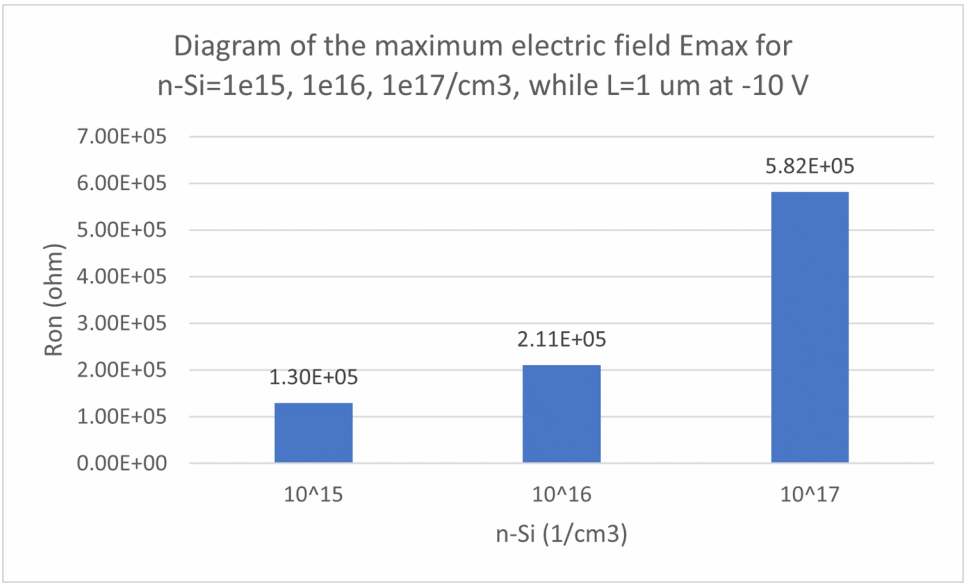






6. Max Electric Field for changing n-Si

Electric Field for n-Si= 1e15 , 1e16 , 1e17 /cm3, while L = 1um at -10 V



Electric Field for n-Si = 1e15/cm3	Electric Field for n-Si = 1e16/cm3	Electric Field for n-Si = 1e17/cm3