

## Running TSUPREM 4: Tutorial 1

TSUPREM4 is a silicon process simulator. It is an outgrowth of the Stanford Suprem program written over a number of years. We will primarily use it for doing 1-D process simulations, but it is capable of much more; therefore, the manual is large and there are lots of options. Here is an oxidation/diffusion example.

### Setup for Graphics:

- Execute the statement:

**setenv TMAPLOT\_REPLOT CL/POSTSCRIPT**

so that your output into graphics can be in postscript form (actually eps , I think).

Depending on your window manager, you may also want to execute a command like:

**setenv TMA\_XLIB /usr/dt/lib (for the CDE window environment)**

Once you have a plot from TSUPREM4, after setting these environment variables you position the cursor over the plot itself, left-click and hold (the mouse) and hit the “d” key on the keyboard. This should generate a file tmaplot\_#.dplt which will be a postscript file.

Input file: 423\_auto.inp

```
comment compensated Si with auto-generated mesh
INITIALIZE BORON=5e16 PHOSPHORUS=1e16
DIFFUSION TEMPERAT=1050 TIME=5 DRYO2
DIFFUSION TEMPERAT=1050 TIME=60 F.O2=1.75 F.H2=2.5
DIFFUSION TEMPERAT=1050 TIME=5 DRYO2
SELECT Z=DOPING
PRINT.1D      LAYERS
SELECT Z=LOG10(PHOSPHORUS)
PLOT.1D  COLOR=2 RIGHT=1 Bottom=14 top=17
SELECT Z=LOG10(BORON)
PLOT.1D  ^AXES ^CLEAR COLOR=4
SELECT Z=LOG10(DOPING)
PLOT.1D  ^AXES ^CLEAR COLOR=1 line.typ=2
SELECT Z=LOG10(PHOSPHORUS)
PLOT.1D  COLOR=2 RIGHT=0.5 LEFT=0.1 Bottom=14 top=17
SELECT Z=LOG10(BORON)
PLOT.1D  ^AXES ^CLEAR COLOR=4
SELECT Z=LOG10(DOPING)
PLOT.1D  ^AXES ^CLEAR COLOR=1 line.typ=2
```

Type command:

tsuprem4 423\_auto.inp

Output file: 423\_auto.out

```
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```

22-Sep-2002 15:44:33

```
***** Advanced Application Module Availability
*****
Extended Defects : available for use
User-Specified Equation Interface : available for use
*****
*****
```

Entering source file 423\_auto.inp.

```
comment compensated Si with auto-generated mesh
INITIALIZE BORON=5e16 PHOSPHORUS=1e16
** Automatic X grid generation: lines at X=0 and X=1 micron.
** Automatic Y grid generation.
    2 lines in the x direction.
    36 lines in the y direction.
DIFFUSION TEMPERAT=1050 TIME=5 DRYO2
DIFFUSION TEMPERAT=1050 TIME=60 F.O2=1.75 F.H2=2.5
```

```

*** Partial pressures of oxidizing species:  H2O=0.833333  O2=0.166667
=> Oxidation rate based on partial pressure of H2O

```

```

DIFFUSION TEMPERAT=1050 TIME=5 DRYO2

```

```

SELECT Z=DOPING

```

```

PRINT.1D      LAYERS

```

```

** Printing along X.VALUE=0:

```

Num	Material	Top	Bottom	Thickness	Integral
1	oxide	-0.2874	0.2243	0.5117	-1.1695e+12
2	silicon	0.2243	0.2467	0.0225	4.2757e+09
3	silicon	0.2467	200.0000	199.7533	-7.9858e+14

```

SELECT Z=LOG10(PHOSPHORUS)

```

```

PLOT.1D  COLOR=2 RIGHT=1 Bottom=14 top=17

```

```

** Plotting along X.VALUE=0.

```

```

** Plotting to device: "x" (specified by DEFPDEV environment variable)

```

```

SELECT Z=LOG10(BORON)

```

```

PLOT.1D  ^AXES ^CLEAR COLOR=4

```

```

** Plotting along X.VALUE=0.

```

```

SELECT Z=LOG10(DOPING)

```

```

PLOT.1D  ^AXES ^CLEAR COLOR=1 line.typ=2

```

```

** Plotting along X.VALUE=0.

```

```

SELECT Z=LOG10(PHOSPHORUS)

```

```

PLOT.1D  COLOR=2 RIGHT=0.5 LEFT=0.1 Bottom=14 top=17

```

```

** Plotting along X.VALUE=0.

```

```

SELECT Z=LOG10(BORON)

```

```

PLOT.1D  ^AXES ^CLEAR COLOR=4

```

```

** Plotting along X.VALUE=0.

```

```

SELECT Z=LOG10(DOPING)

```

```

PLOT.1D  ^AXES ^CLEAR COLOR=1 line.typ=2

```

```

** Plotting along X.VALUE=0.

```

```

Exiting source file 423_auto.inp.

```

```

*** END TSUPREM-4 ***

```

-  
Use Mesh Statement for Better Resolution of Variation: 423\_mesh.inp

```

MESH LY.SURF=0.9 DY.SURF=1e-3 LY.BOT=5

```

```

INITIALIZE BORON=5e16 PHOSPHORUS=1e16

```

```

DIFFUSION TEMPERAT=1050 TIME=5 DRYO2

```

```

DIFFUSION TEMPERAT=1050 TIME=60 F.O2=1.75 F.H2=2.5

```

```

DIFFUSION TEMPERAT=1050 TIME=5 DRYO2

```

```

SELECT Z=DOPING

```

```
PRINT.1D      LAYERS
SELECT Z=LOG10(PHOSPHORUS)
PLOT.1D  COLOR=2 RIGHT=1 Bottom=14 top=17
SELECT Z=LOG10(BORON)
PLOT.1D  ^AXES ^CLEAR COLOR=4
SELECT Z=LOG10(DOPING)
PLOT.1D  ^AXES ^CLEAR COLOR=1 line.typ=2
SELECT Z=LOG10(PHOSPHORUS)
PLOT.1D  COLOR=2 RIGHT=0.5 LEFT=0.1 Bottom=14 top=17
SELECT Z=LOG10(BORON)
PLOT.1D  ^AXES ^CLEAR COLOR=4
SELECT Z=LOG10(DOPING)
PLOT.1D  ^AXES ^CLEAR COLOR=1 line.typ=2
```

Produces Output: 423\_mesh.out

```
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```

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```
***** Advanced Application Module Availability
*****
Extended Defects : available for use
User-Specified Equation Interface : available for use
*****
*****
```

Entering source file 423\_mesh.inp.

```
MESH LY.SURF=0.9 DY.SURF=1e-3 LY.BOT=5
INITIALIZE BORON=5e16 PHOSPHORUS=1e16
** Automatic X grid generation: lines at X=0 and X=1 micron.
** Automatic Y grid generation.
   2 lines in the x direction.
   939 lines in the y direction.
DIFFUSION TEMPERAT=1050 TIME=5 DRYO2
DIFFUSION TEMPERAT=1050 TIME=60 F.O2=1.75 F.H2=2.5
```

```

*** Partial pressures of oxidizing species:  H2O=0.833333  O2=0.166667
=> Oxidation rate based on partial pressure of H2O

```

```

DIFFUSION TEMPERAT=1050 TIME=5 DRYO2

```

```

SELECT Z=DOPING

```

```

PRINT.1D      LAYERS

```

```

** Printing along X.VALUE=0:

```

Num	Material	Top	Bottom	Thickness	Integral
1	oxide	-0.2788	0.2175	0.4963	-1.1943e+12
2	silicon	0.2175	0.2521	0.0346	1.5456e+10
3	silicon	0.2521	5.0000	4.7479	-1.8618e+13

```

SELECT Z=LOG10(PHOSPHORUS)

```

```

PLOT.1D  COLOR=2 RIGHT=1 Bottom=14 top=17

```

```

** Plotting along X.VALUE=0.

```

```

** Plotting to device: "x" (specified by DEFPDEV environment variable)

```

```

SELECT Z=LOG10(BORON)

```

```

PLOT.1D  ^AXES ^CLEAR COLOR=4

```

```

** Plotting along X.VALUE=0.

```

```

SELECT Z=LOG10(DOPING)

```

```

PLOT.1D  ^AXES ^CLEAR COLOR=1 line.typ=2

```

```

** Plotting along X.VALUE=0.

```

```

SELECT Z=LOG10(PHOSPHORUS)

```

```

PLOT.1D  COLOR=2 RIGHT=0.5 LEFT=0.1 Bottom=14 top=17

```

```

** Plotting along X.VALUE=0.

```

```

SELECT Z=LOG10(BORON)

```

```

PLOT.1D  ^AXES ^CLEAR COLOR=4

```

```

** Plotting along X.VALUE=0.

```

```

SELECT Z=LOG10(DOPING)

```

```

PLOT.1D  ^AXES ^CLEAR COLOR=1 line.typ=2

```

```

** Plotting along X.VALUE=0.

```

```

Exiting source file 423_mesh.inp.

```

```

*** END TSUPREM-4 ***

```