

USING TSUPREM-IV

INTRODUCTION

TSUPREM-4 is a computer program that allows the user to simulate the various processing steps used in the manufacture of Si ICs. The processing steps simulated are: inert ambient dopant drive-in; thermal oxidation of Si and silicon-nitride; ion implantation, epitaxial growth of Si; and low temperature deposition or etching of various materials. TSUPREM-4 simulates the changes in a semiconductor structure as a result of the various processing steps used in its manufacture. The primary results of interest are the thicknesses of the various layers and the distribution of impurities within those layers.

TSUPREM-4 is currently installed on the several workstations (hedge.stanford.edu, myth.stanford.edu and bramble.stanford.edu). These workstations share a common file server. To have access to the workstations, you must have an account on *Leland* (or *SUNet ID*). If you don't already have one, you may open an account for yourself as long as you are a registered student at Stanford.

You can request an *SUNet ID* (or *Leland* account) on the web at <https://sunetid.stanford.edu>. Follow the on-screen instructions step by step to have your account opened. Note: it may take 24 hours before your account is activated, so be sure to do this well in advance of the homework due date(s).

Initializing TSUPREM-IV on your *Leland* Account

Once you have established an account on *leland*, you may log into any of the workstation computers. The first time you log in, you need to complete the following steps before you can actually run SUPREM-IV:

1. Use a text editor (vi or emacs) to add the following lines to the end of your `.cshrc` file:

```
# Initialization command to run TSUPREM-IV
source /afs/ir/class/ee/synopsys/tcad/tcad.cshrc
```

Note that the filenames are case sensitive.

2. These commands will take effect the next time you log in. You can also type
`source .cshrc`
to have them take effect immediately.

Running TSUPREM-IV from a *myth* Workstation (Open Cluster in Gates B08)

1. Once you log in, you must invoke a terminal window to use TSUPREM-IV.
2. You can now run TSUPREM-IV by issuing the command on the terminal window:

```
tsuprem4 <your_input_filename>
```

Running TSUPREM-IV from a Remote Workstation running X11

If you access the workstations from a remote workstation running X11 (X-Windows), you need to have the environment variable DISPLAY set correctly. To do this, you need to follow these steps:

1. Determine the correct DISPLAY variable for your local machine by typing

```
printenv DISPLAY
```

on your local machine. (If you get "unix:0.0" or "unix:1.0", do not use the word "unix" for step 2. Instead, replace it with the name of your machine, which you can obtain with the command hostname.)

2. Allow X connections from the *hedge* machine to your local machine. For example, if you are going to run TSUPREM-IV on *hedge05*, type this on your local machine:

```
xhost hedge05.stanford.edu
```

3. Specify to the remote machine what your local display is:

```
setenv DISPLAY <local_machine_name>
```

where *<local_machine_name>* is the DISPLAY name given by the printenv command in step 1 (e.g., sensei:0.0).

4. You can now run TSUPREM-IV by issuing the command:

```
tsuprem4 <your_input_filename>
```

Running TSUPREM-IV from Remote Computers (Using VNC on Windows)

To access the workstations remotely from your own computers using VNC, users must download and install the VNC Free Edition Viewer for Windows, available online at the RealVNC website (<http://www.realvnc.com/>).

1. Connect to a UNIX host using a (secure) terminal emulator like SecureCRT, available online from the ESS website (<http://ess.stanford.edu/>).



2. If VNC has not been used before a password must be created to control access to the remote display. First, create the VNC application directory if it does not already exist:

```
mkdir ~/.vnc
```

Then, set the password using the **vncpasswd** command; this password is not very secure, so it should not be the same as any password associated with a SUNet ID.

3. Once a password has been set, launch the VNC server application using the **vncserver** command. Depending upon how many remote displays are already present on the current system, several warning messages may be displayed before vncserver reports that it has created a new X11 desktop; take note of the host name and display number so reported:

```
New 'X' desktop is hedge01.Stanford.EDU:3
```

4. Set the **DISPLAY** environment variable to reflect the new display using the following command:

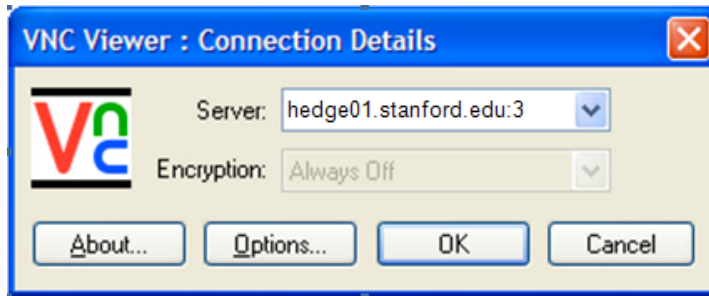
```
setenv DISPLAY localhost:n
```

n should be replaced with the number of the display reported by vncserver.

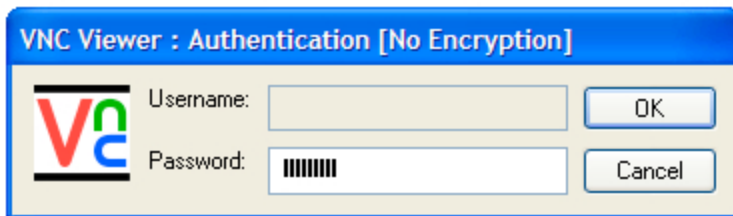
5. Launch the **VNC Viewer** application on the local computer.



VNC Viewer will display a dialog box requesting the server to which the viewer should connect. Enter the host name and display number as they appeared in the notification message displayed by vncserver.



Provide a VNC password when required.



6. A window should open displaying the remote desktop. Remote applications with a graphical user-interface will automatically use this window for local display.
7. You can now run TSUPREM-IV by issuing the command:

```
tsuprem4 <your_input_filename>
```

8. To end the remote display session, quit all running applications and close the VNC Viewer application. Then, terminate the vncserver application using the following command:

```
vncserver -kill :n
```

n should be replaced with the number of the display originally reported by vncserver. Finally, type **exit** to end the remote terminal session and quit the terminal emulator.

Please note that when using VNC software it is advisable to use the original terminal session to launch other applications or issue shell commands. If the session is idle for an extended period of time the remote host may automatically disconnect, causing the vncserver process and other running applications to quit unexpectedly.

Running TSUPREM-IV from Remote Computers (Using Apple X11 on Mac OSX)

Apple X11 requires Mac OS X 10.3 (Panther) or later. It is included with recent versions of the operating system and can be specified as an option when installing OS X, or else installed at a later time using a separate package located on the OS X installation

media (i.e., the OS X DVD or Install Disc 3). It is also available for download at the Apple website. (http://support.apple.com/downloads/X11_for_Mac_OS_X_1_0)

1. Verify that Apple X11 is installed and launch the X11 application (located in the Utilities subfolder of the Applications folder).



X11

An **xterm** window should open by default. If no terminal window opens, start one by selecting **Terminal** from the **File** menu or pressing **command-N**.



2. At the **\$** prompt, run the OpenSSH client using the **ssh** command. This command takes a single argument specifying the user's SUNet ID and the target host, and requires a single option, **-Y**, specifying that ssh should additionally arrange for an X-windows connection; for example:

```
ssh -Y sunetid@hedge.stanford.edu
```

If you are using OS X 10.3, it may be necessary to use **-X** instead of **-Y**:

```
ssh -X sunetid@hedge.stanford.edu
```

3. After entering a password the remote machine will present a standard UNIX prompt. Remote applications with a graphical user-interface will automatically use the local display.
4. You can now run TSUPREM-IV by issuing the command:

```
tsuprem4 <your_input_filename>
```

5. To end the remote display session, quit all running UNIX applications, type **exit** to close the ssh connection, and quit the X11 application.

Plotting TSUPREM-IV Output

By default, TSUPREM-IV will plot to your window system if you are running X. In order to plot to a PostScript printer, you must first specify to TSUPREM-IV to direct the plot output to a PostScript file. Once the PostScript file is created, you can then send that file to a printer. This is done by the following:

1. On the plot line in your TSUPREM-IV input file, append the `device=ps` option as follows:

```
option device=ps <all your other options>
```

2. The plot output will now be saved in a file called `plotfile.ps`. To print this out, use the `lpr` command:

```
lpr -P<printer_name> plotfile.ps
```

You should rename the `plotfile.ps` file as soon as it is generated since TSUPREM-IV will overwrite it without warning in subsequent runs.

SUPREM-IV PDF Documentation and Examples

A PDF version of the `tsuprem4` documentation (containing example decks) can be found in `/afs/ir/class/ee/synopsys/tcad/A_2007.12/taurus-tsuprem4_2007.12.0/manual_pdf` and can be read using the Acrobat reader (`acroread`).