

Simulation Standard

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Hints, Tips and Solutions

How Can I Re-Use Individual Monte-Carlo 3D Implant Profiles ?

It is often the case that a design of experiments (DOE) is required to optimize the performance of a particular device. Sometimes this simply means tweaking the implant dose for threshold voltage or other minor adjustments, but in other cases it can mean tweaking such things as high energy deep well implants.

When using very high energy implants, on large structures the task of repeating Monte-Carlo simulations can take many hours, even when utilizing a high number of parallel threads. If the structure has not physically changed, a very useful feature is the ability to reload previously simulated individual 3D monte-carlo implant profiles, as this only takes a few seconds rather than several hours. The implant dose and damage can also be scaled by a factor, if that particular implant dose was part of the optimization procedure.

In Victory Process, the parameter “reuse” can be invoked on any individual implant statement. The location of the stored individual implant data is also specified on the implant statement. If the user wanted to store the implant data in a sub-directory called “my_implants”, then the parameter `reuse.folder=“./my_implants”` would be used. As a side note, the directory specified for implant data storage must exist prior to the implant statement.

Another useful parameter that can be invoked, once the first implant simulation is complete, is the ability to request that the previous implant dose and damage profile be scaled by a user definable factor. Let us say it was required that the dose and damage be scaled by a factor of 1.5 from the first implantation simulation, then the additional parameter `“reuse.scale=1.5”` could also be added.

Another available feature is the ability to save a structure file, with only the present implant profile stored, such that the contribution from only that implant can be assessed separately. This can be achieved by using the “`export=<filename>`” parameter.

Putting this all together, lets look at an example. The user wants to invoke this reuse feature for a 1MeV Monte-Carlo implant of phosphorus at 7 degrees tilt and 27 degrees of wafer rotation and a dose of $1e12/cm^2$. If it is decided that the required number of simulated ions for a smooth profile is 40,000 and the implant profile is to be saved in a structure file called “phos_2.str”, then the complete implant statement for the second run would be:

```
implant phosphorus dose=1e12 \  
energy=1000 tilt=7 rotation=27 \  
n.ion=40000 bca reuse \  
reuse.folder="my_implants" \  
reuse.scale=1.5 export=phos_2
```

What happens when the simulator reaches the above implant line is that Victory Process will check to see if that particular Monte-Carlo implant has been simulated previously. If it has not, the Monte-Carlo implant simulation will proceed as normal (making sure the “reuse.scale” parameter is set to 1 for the first run and the exported structure file set to a different name, such as “phos_1” for example). However, if Victory Process detects that this simulation has already been stored in the specified directory, it will simply re-load this previously stored result, which usually only takes a few seconds. The stored result in the above example will also have the dose and damage distribution, scaled by a factor of 1.5 as the user requested.

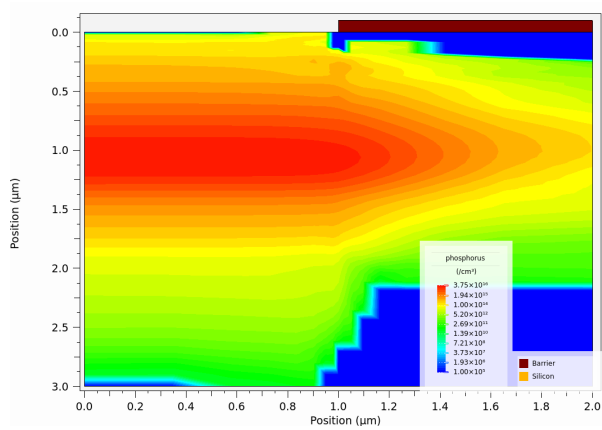


Figure 1.

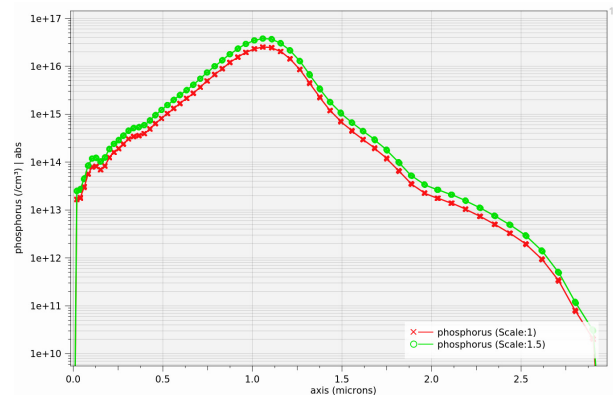


Figure 2.

In this example, the doping distribution 2D cut line is shown in Fig 1 and the 1D cut lines for the two runs are overlayed in Fig 2, showing how the second run has the dose multiplied by a factor of 1.5 in this case.

As can be imagined, this feature can save many hours of simulation time for repeated DOE simulations of the same structure.