



Fraunhofer

IISB

FRAUNHOFER INSTITUTE FOR INTEGRATED SYSTEMS AND DEVICE TECHNOLOGY IISB

Dr. *Li*TiTHO

The image displays the Dr.LiTHO software interface, which is used for lithography simulation and metrology. The interface includes a file explorer on the left showing a project named 'SRAM'. The main window displays a Python script named 'imaging.py' with the following code:

```
34 illuminator = drlitho.drimage.  
35 sourcetransformer = drlitho.d  
36 hints = drlitho.drimage.Sour  
37  
38 illuminator.wavelength.setMic  
39 illuminator.dose = 20.0  
40 illuminator.chiefAngle = 0.0  
41 illuminator.chiefAngleAzimuth  
42  
43 source = drlitho.drimage.Sour  
44 source.sigmaInner = 0.8  
45 source.sigmaOuter = 0.98  
46 source.intensity = 1.0  
47 source.phase.setDeg(0.0)  
48 polarization = drlitho.drimage  
49 #polarization = drlitho.drimage  
50 #polarization = drlitho.drimage
```

The interface also shows a 'Namespace' panel on the left and a 'Terminal' window with the following commands and output:

```
In [1]: %run imaging.py  
Mask spectrum computation  
  
Image computation  
  
In [3]: print projector.defocus  
.....:  
>print (projector.defocus)  
0.0  
  
In [4]:
```

The 'Aerial Image Metrology' window displays a 2D intensity map of the mask pattern, with a color scale ranging from 0.32 to 0.60. The x and y axes are in micrometers (um), ranging from -0.15 to 0.15. A red horizontal line is drawn across the image at y = -0.1. The 'Settings' panel shows the following parameters:

Parameter	Value
View Mode	Image
Threshold	0.5
Show CDs	<input type="checkbox"/>
Show ILS	<input type="checkbox"/>
ILS Distance	0.003 um
Z layer	0 (0 um)
Image Aspect	Real

The 'Cut' panel shows the following parameters:

Parameter	X	Y
Start	-0.17	-0.1
End	0.17	-0.1
Threshold	0.5	

The 'Aerial Image Metrology' window also displays a 3D topography plot of the mask pattern, showing the height of the mask features. The plot is color-coded, with red representing the highest points and blue representing the lowest points. The plot shows a central vertical channel with a width of approximately 0.1 um, and a series of rectangular features on either side. The features are approximately 0.1 um wide and 0.1 um high. The plot is shown in a perspective view, with the x and y axes in micrometers (um).

The 'Aerial Image Metrology' window also displays a 3D topography plot of the mask pattern, showing the height of the mask features. The plot is color-coded, with red representing the highest points and blue representing the lowest points. The plot shows a central vertical channel with a width of approximately 0.1 um, and a series of rectangular features on either side. The features are approximately 0.1 um wide and 0.1 um high. The plot is shown in a perspective view, with the x and y axes in micrometers (um).

General Description

Dr.LiTHO is a comprehensive simulation environment for photolithography developed at Fraunhofer IISB. Its main focus is on development and research applications.

Features

- Rigorous electromagnetic field solver. Computation of mask diffraction spectra.
- Fast imaging simulator including polarization effects, Zernike and Jones pupils and illumination settings.
- Models and algorithms for the simulation of EUV masks including mask defects.
- Photoresist processing module including diffusion and chemical reaction kinetics upon PEB and development.
- Process evaluation tools for aerial image and photoresist profile analysis.
- Optimization toolbox for OPC and SMO including global and multi-objective optimizers.
- Interfaces for the modeling of other exposure techniques such as contact and proximity printing and interference lithography.

Advantages

Dr.LiTHO covers a wide range of photolithographic techniques and can be used to speed up process development and analysis.

- Prediction of the performance of photolithography systems for specific tasks.
- Early identification of critical structures and process parameters.

- Optimization of mask layouts and illumination settings.

Benefits

- Less test exposures and faster process development.
- Full access to the (simulated) light distribution, therefore independent analysis of optical and photoresist performance.
- Increased understanding of processes by controlled variation of process parameters.

Usability

Dr.LiTHO is available under Windows and several Linux distributions. The scripting language *Python* is used as a frontend language.

Dr.LiTHO comes with a collection of tutorial scripts and a large scripting library for various applications.

Dr.LiTHO includes graphical user interfaces for data visualization and for the installation and update of its modules.

Lithography Simulation



Contact: Fraunhofer IISB (Institute for Integrated Systems and Device Technology)
Schottkystr. 10, 91058 Erlangen, Germany
dr.litho@iisb.fraunhofer.de
www.drliitho.com