

Variable sizing map for a microprocessor layout to compensate for long range loading effects. The map was obtained by convolving the original density distribution with a dual Gaussian kernel.

Mask Process Correction for process loading and proximity effects

Calibre® MPCpro is a focused solution for mask making. The mask making process is exposed to systematic errors induced by the ebeam lithography and etching processes. Through variable sizing of the pattern the Calibre MPCpro tool corrects process effects like fogging, development and etch loading and e-beam proximity effects. Build on the experience of the well established Calibre OPCpro tool for optical process correction, MPCpro addresses the specific needs of the mask manufacturing.

Shrinking feature sizes and the complexity of nanometer designs drive tighter and tighter specifications for controlling the critical dimensions – mean to target as well as the distribution across the mask. As previously in the wafer lithography domain the equipment and process control capabilities alone can not achieve the required accuracy and hence technologists are looking to data dependent corrections that will compensate the process effects to the required tolerances.

MPCpro is part of the Calibre mask data preparation suite of tools, and is fully integrated with the Calibre design to silicon platform. It includes the density based long range correction functions for area based sizing, density measurement and kernel convolution and a rules based correction module – OPCbias. MPCpro provides highly scalable processing while maintaining the highest data quality required for low tolerance mask fabrication.

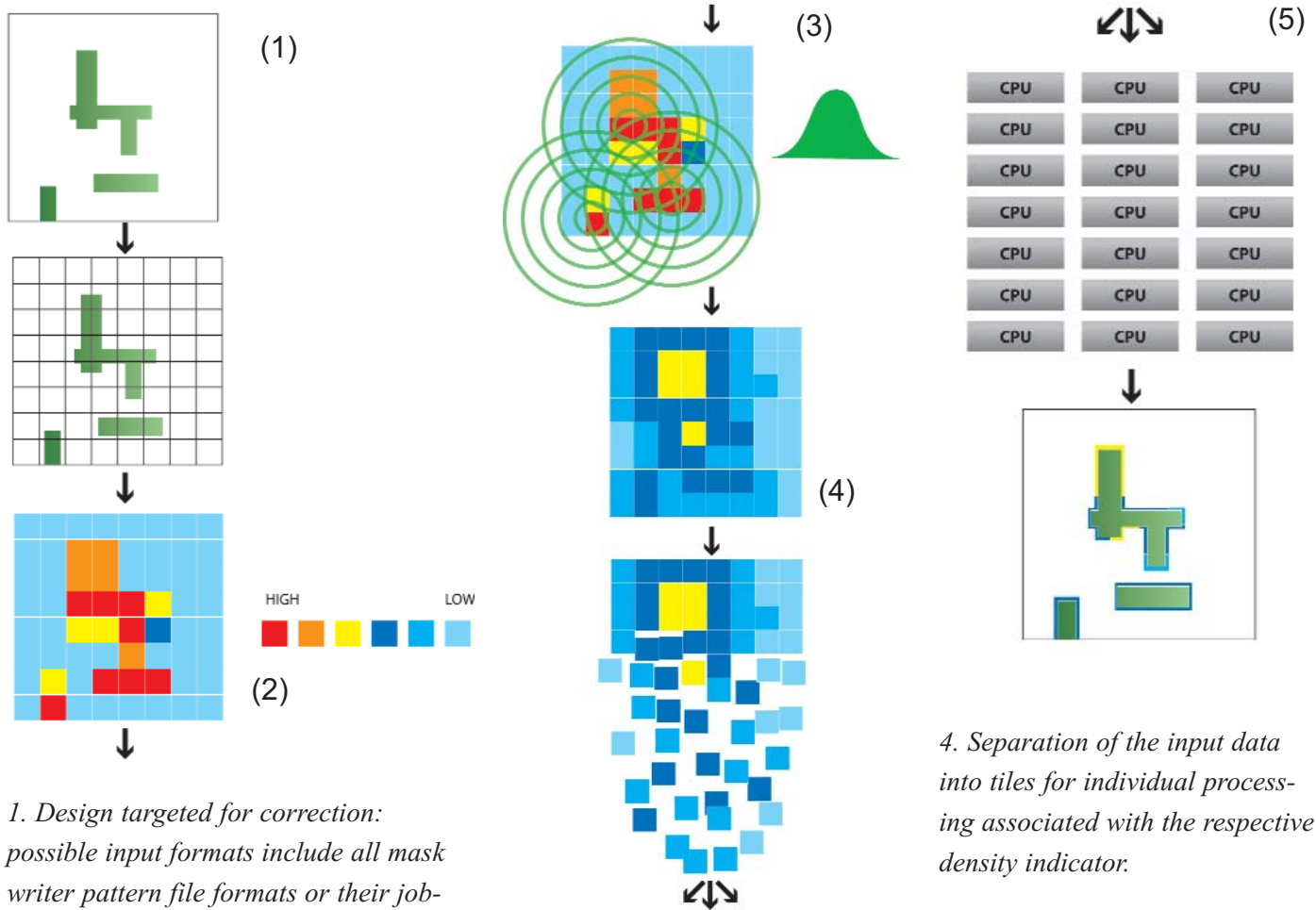
Key Product Benefits

- Provides high performance mask process correction - flexible, accurate and scalable - while maintaining optimum data quality and short mask writing time
- Corrects systematic errors and proximity effects resulting from the use of electron beam lithography in the mask making process:
 - Fogging effects
 - Process loading effects
 - E-beam proximity effects
- Integrated with Calibre design-to-silicon platform

Family of Calibre MDP Tools and Formatting Capabilities

- FRACTUREm (MEBES)
- FRACTUREj (JEOL)
- FRACTUREt (Toshiba/NuFlare)
- FRACTUREh (Hitachi)
- FRACTUREc (Micronic)
- MDPverify
- MDPview
- MDPmerge
- MRC for mask rule checking
- MPCpro for mask process correction

Processing sequence of density-based compensation in Calibre MPCpro



1. Design targeted for correction: possible input formats include all mask writer pattern file formats or their job-deck representations, as well as GDSII and OASIS formats.

2. A density map of the mask writer data or design file is generated with a user specified tile size.

3. Calculate for each square the density impact from all other squares = convolve the density matrix with a user-specified point-spread function. This generates an “effective” density matrix.

4. Separation of the input data into tiles for individual processing associated with the respective density indicator.

5. Apply selective corrective processing for each density category via distributed tile-based processing.

Visit the Calibre mask data preparation website at

http://www.mentor.com/products/ic_nanometer_design/mask_syn/calibre_mdp/index.cfm

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