EECS 243 – Advanced IC Processing and Layout

Fall 2000 | **Office Hours** | **Prof. A. R. Neureuther,**
Tu, Th 3:30-5 | **M, Tu,Th, (F) 11am** | **510 Cory Hall, 2-4590**
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Homework Assignment # 1, Solution

1.1 Simple Process Flow. http://www-inst.eecs.berkeley.edu/~ee40/SIMPLer/index.html
This was your chance to be creative in setting up a process flow and masks of your own. The inputs to Simpler are limited so you did not need to make too many detailed decisions. However, you likely found that you had to take what you got in feature sidewall angles, step coverage , etc. The regular SIMPL version is available on the instructional computing machines and it gives more control over profile shapes and can even request and external rigorous simulation with SAMPLE2D. The regular SIMPL is recommended for project work.

1.2 Berkeley Microlab baseline CMOS Process.
http://www-microlab.eecs.berkeley.edu:8080/baseline/index.html
The process on the web has several errors and the data here is taken from figures in the memo describing the baseline process. The BMB-CMOS is a single N-well (no P-well just p-substrate) process that uses LOCOS isolation for the active regions and a boron field implant in the p-substrate. The devices do not have LDD's, there is no TiN interconnect strap, but there is a capacitor for analog circuits. The masks are NWEL, ACTV, PFLD (complement of NWEL), POLY, CAP, NSD, PSD, CON1, MET1, CON2 (VIA), and MET2. The NSD and PSD are similar to the complement of NWEL and NWEL but also include SELECT areas for n+ to N-well and p+ to p-substrate ohmic connections. All masks align to the previous mask except for PFLD and POLY that align to ACTV and except for CON1, NSD and PSD that align to POLY. The designer lays out 8 layers plus identifies the well and substrate contacts (SELECT).

1.3 LAVA Remote Simulation. http://cuervo.eecs.berkeley.edu/Volcano/
The general trends with feature size are:

1) The peak intensity can exceed the clear field intensity for features larger than about 0.6 λ/NA but then decreases rapidly almost in a square law manner from the clear field value.
2) The contrast is near unity for features about 0.8 λ/NA, then decreases rapidly beyond 0.6 λ/NA, and goes to zero around 0.3 λ/NA.
3) The maximum slope at the feature edge does not degrade as much as the peak intensity or contrast and a resist that responded to edge slope would likely show superior feature size independence.

The general trends with feature type are:

1) The crossover point for equal intensities is about 0.3 of the clear field.
2) Isolated lines and dense (line equal space) patterns have very similar intensity distributions a 0.8 λ/NA.
3) For small feature sizes the dense (line equal space) pattern degrades the most but isolated (positive resist) line and space also degrade. There is a larger difference between dense and the line or space pattern.