Lecture 5-2 MEMS Layout Software

● **CAD software**

Functions:

1. **Simulator:**

   Matlab (Analog hardware), Spice (IC), IntelliCAD (MEMS/bulk, surface), Ledit EDA (IC/MEMS, spice extension), MEMSCAP (MEMS/bulk, surface), MEMCAD (now Coventerware, MEMS/bulk, surface), CAD-ACE+MEMS (Fluid, stress, electrostatics), ANSYS (FE), NASTRAN (FE), ABQUS(FE), Phoenics (CFD), CFX4 (CFD), Fluent (CFD), …etc.

   Purpose: IC circuit simulation, MEMS simulation, Mechanical Problem simulation.

2. **Layout software:**

   Magic (IC), Vem (IC), Ledit (IC/MEMS), AutoCAD (ME/Architect), …etc.

   Purpose: Layout drawing, DRC (Design Rule Check), Extraction, Cross Section Viewer.

● **Advantage to use LEDIT (Tanner Research)**

1. **PC based portable system vs. Unix work station**
2. **Easy to use**
3. **Provides shapes other than rectangles (circles, polygons, inclined lines, Manhattan geometry (90˚), Non-Manhattan geometry (45˚, arbitrary), …etc).**
4. **No problem to transfer TDB file to CIF[1] or GDSII[2] format files for pattern generator. (can also read CIF or GDSII files)**
5. **Cross Section Viewer**

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[1] CIF: Caltech Intermediate Form (ASCII code)
[2] GDS: Cadence Design Systems, Calma Inc. (Binary code)

- **Installation**

    1. **System: 2 M RAM, MS-DOS 5.0, 256 k RAM EGA Monitor, 1.5 M Hard disk, mouse, floppy disk driver**
    2. **Copy all files into subdirectory in hard disk, run ledit.exe**
    3. **Student version limitation:**
        a. **640 k RAM, file size 50-60 k.**
        b. **Can read, write, edit .tdb format.**
        c. **Can not generate, read, write, edit .cif, .gds file. Compatible with 5.x version**
        d. **Support EDA resolution**
        e. **DOS system template**

- **Basic templates**

    1. **Menu bar**
    2. **Mouse buttons**
    3. **Work area**
    4. **Locator**
    5. **File name**
    6. **Cell name**
    7. **Layer name**
    8. **Layer Palette**
    9. **Drawing Tools**
    10. **Status Bar**

- **Basic operations**

    1. **example: draw a red rectangle**
    2. **The layout area: max +- 2^{29}=536,870,912**
    3. **setup file**
    4. **Pan, auto pan**
    5. **zoom**
    6. **home, end**
    7. **Drawing tools: arrow, rectangle, polygon, wire, circle, port**

8. Select operations
9. Layer hiding
10. Move/Edit
11. cut (under edit or ^x)
12. copy (^c)
13. arrange commands: rotate, flip, cut, merge
14. Status (memory monitor)
15. Save file

● **Advanced operations:**

*Special***: DCR (Design Rule Checker), Circuit Extractor, Cross-Section Viewer, generate layers**

● **Command overview:**

1. *L-Edit***: About L-Edit, Status**

2. *File***: New, Open, Save, Save as, Close, Replace setup, Info, choose printer, Page set up, Print/Plot, push to dos, Quit**

3. *Edit***: Undo, Cut, Copy, Paste, Clear, Duplicate, Select All, Unselect All, Find Object (after DRC), Find Next Object, Find prev. Object, Edit Object, Group, Ungroup.**

4. *View***: show/hide all insides (for Instance cell), cell outline/icon view, hide/show arrays/ports/location/grid/origin, home view, exchange view, Mouse zoom, Zoom in/out/select, pan left/right/up/down.**

5. *cell***: Info, new, open, revert cell, close as, rename, instance, copy, fabricate, flatten**

6. *Arrange***: rotate, flip, cut, merge**

7. *setup***: Palette, environment, layers, wires, special layers, derived layers, technology, grid, selection,**

cif(no), gdsII(no), SPR Block(no), Padframes(no), Pad Routes(no).

● **An example of layout design--cantilever beam by using CMOS process from MOSIS/SCNA => thermally driven micro mixer.**

References:

1. CMOS Layout Design-UsingL-EDIT, Uyemura, 楊忠煌譯, 高立出版社, 1998., chapter 1, 2, 6, 7, 8, 9, 10.

2. Micromachine Devices, Vol. 3, #6 and #12, 1998