PROBLEM SET #2

Issued: Thursday, Feb 4, 2010

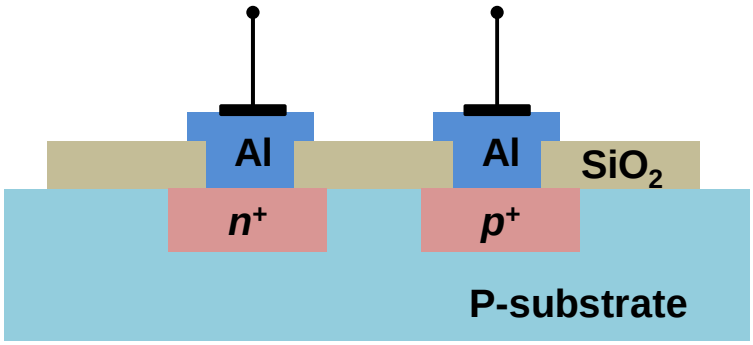
Due: Thursday, Feb. 11, 2010, 7:00 p.m. in the EE 143 homework box in 240 Cory

I. Process Flow/Layout to Cross-Section

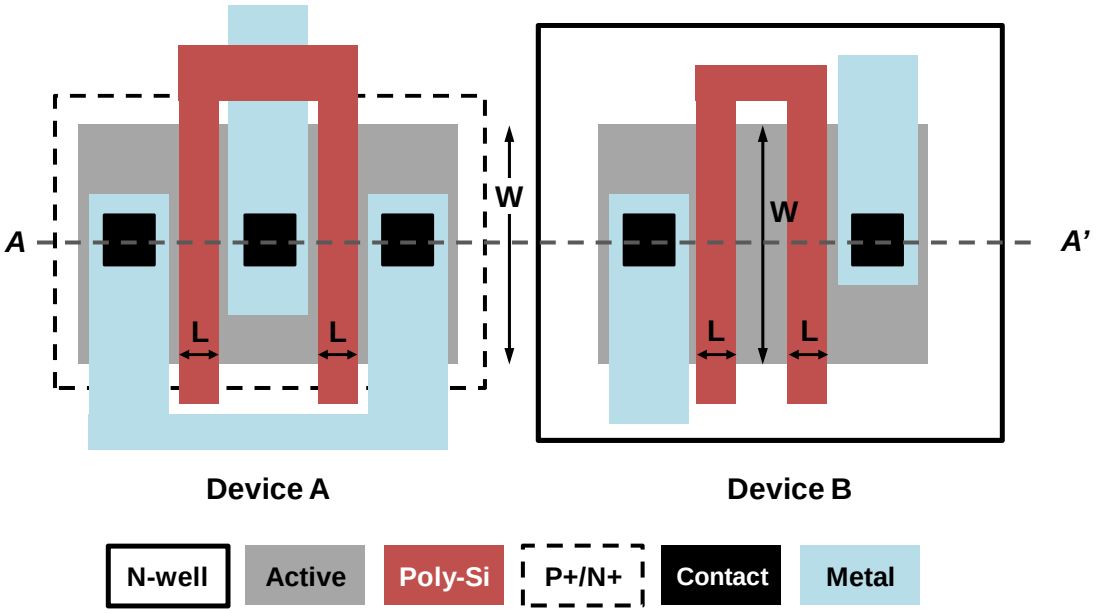
1. Consider the cross-section of a device shown below:

   a. What kind of device is this?

   b. Generate a possible process flowchart for fabrication of this structure. Use a form like the cross-sections in Figure 1.6 in Jaeger's textbook.



2. Consider the following layout of two MOSFET devices and the corresponding process flow:

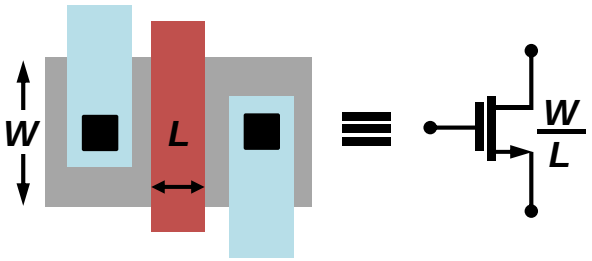


The process flow

1) Silicon oxidation: target = 300nm
2) Lithography: Mask I (N-well)
3) Etch SiO_2
4) Remove PR
5) N-well diffusion: P (n-type)
6) Etch SiO_2
7) Silicon oxidation: target = 100nm
8) LPCVD Si_3N_4: target = 500nm
9) Lithography: Mask II (Active)
10) Etch Si_3N_4
11) Etch SiO_2
12) Field isolation implant: B+ (p-type)
13) Remove PR
14) Grow 1μm of SiO_2 thermally (LOCOS oxidation)
15) Etch Si_3N_4
16) Etch SiO_2
17) Dry oxidation for gate oxide: target = 100nm
18) LPCVD situ phosphorous-doped gate polysilicon: target = 350nm
19) Lithography: Mask III (Poly)
20) Dry etch polysilicon
21) Remove PR
22) Lithography: Mask IV (n+ implant)(dark field)
23) D/S ion implantation: P (n-type)
24) Remove PR
25) Lithography: Mask V (p+ implant)(clear field)
26) D/S ion implantation: B (p-type)
27) Remove PR
28) Anneal at 1050°C to activate dopants and drive-in diffusion
29) LPCVD PSG: target = 1 μm and reflow at 950°C
30) Lithography: Mask VI (contact)
31) Etch SiO_2 down to S/D regions
32) Remove PR
33) Deposit Al: sputtering target = 1 μm
34) Lithography: Mask VII (metal)
35) Dry etch Al

a. Plot the cross-sections along *AA'* plane through step 6), 14), 21), 26) and 35).

b. A MOSFET device can be represented by a circuit symbol view, e.g., a NMOS device layout can be depicted as:



Draw the circuit schematics implemented by each device layout in A and B. Then, for each of A and B, equate the circuit to an equivalent single device and redraw the layout so that it realizes the corresponding single device.