RIT POLY GATE PMOS PROCESS VER-2 FOR MICROSCOPHOTOMETER

- 10 Micrometer Design Rules
- 7 Design Layers - p+ Implant, Active, Poly, CC, metal one, via, metal two
- 7 Photolithography Layers
- n+ Poly Gate
- p+ Implant for multiplexer
STARTING WAFER N-TYPE, 5 OHM-CM

Verify Type
Four Point Probe to Verify Resistivity
RCA CLEAN
GROW 5000 Å OXIDE

5,000 Å SiO2

Push at 900 C in N2
Ramp to 1100 C in dry O2
Start Soak at 1090 C
Time = 48 min. in wet O2
Ramp down to 1000 C in N2
Pull at 1000 C in N2
Measure Xox
COAT WITH PHOTORESIST

1 µm Photoresist

5,000 Å SiO2

Shipley System 8 Resist
HMDS 5000 rpm, 60 sec
Resist 5000 rpm, 60 sec
90 °C, 1 min Hotplate
EXPOSE AND DEVELOP LEVEL 1 P+IMPLANT

0.6 sec Integrate Mode
150 mj/cm²
Develop in MF 321, 1 min
Inspect, Pass?
ETCH OXIDE

Buffered HF
6 min
Rinse and Spin Dry
Measure $X_{ox} < 100$?
IMPLANT P+ DIODES AND MULTIPLEXER SELECT

Dose = 2 E 15 cm-2
Energy = 100 KeV
BF2+ Species
STRIP RESIST and RCA CLEAN

Ash 300 w, 30 min
RCA Clean
Is Resist Removed?
COAT WITH PHOTORESIST

Shipley System 8 Resist
HMDS 5000 rpm, 60 sec
Resist 5000 rpm, 60 sec
90 °C, 1 min Hotplate
EXPOSE AND DEVELOP LEVEL 2 ACTIVE

0.6 sec Integrate Mode
150 mj/cm²
Develop in MF 321, 1 min
Inspect, pass?
Etch in Buffered HF
Time = 6 min.
Measure Xox is it < 100 Å?
STRIP RESIST and RCA CLEAN

Ash 300 w, 30 min
RCA Clean
Resist Removed?
GROW 700 Å GATE OXIDE

Push at 900 C in N2
Ramp to 1100 C in dry O2
Start soak at 1090 C
Time = 8 min. in dry O2
Ramp down to 1000 C in N2
Pull at 1000 C in N2
Measure Xox
DEPOSIT POLY

LPCVD Polysilicon
6000 Å
610 C for 78 min, 330 mTorr
Measure Poly over 700 Å Oxide
SPIN-ON N-TYPE DOPANT

1) Spin coat with Emulsitone N-250
   3000 rpm, 30 sec
   Bake 200 C, 15 min

2) Push at 900 C in N2
   Ramp to 1000 C in N2
   Start soak at 990 C
   Time = 15 min. in N2
   Pull at 1000 C in N2

3) Etch Phosphorous Doped Glass in BHF wet etch, 2 min.
   Rinse and spin Dry

4) Four Point Probe
COAT WITH PHOTORESIST

Shipley System 8 Resist
HMDS 5000 rpm, 60 sec
Resist 5000 rpm, 60 sec
90 °C, 1 min Hotplate
EXPOSE AND DEVELOP LEVEL 3 POLY

0.6 sec Integrate Mode
150 mj/cm²
Develop in MF 321, 1 min
Inspect, Pass?
ETCH POLY

SF6 42.5 sccm
O2 at 7.5 sccm
400 mTorr
40 watts
1 min 10 sec
STRIP RESIST, RCA CLEAN

O2
300 w, 30 min
Resist Removed?
D/S IMPLANT

BF2
100 KeV
2E15
ANNEAL AND LTO

1) LTO, 8000A, 100 min.
   400 C, SiH4 40 sccm
   O2 48 sccm, 245 mTorr

2) Push at 900 C in N2
   Ramp to 1100 C in N2
   Start soak at 1090 C
   Time = 60 min. in N2
   Pull at 1000 C in N2
LPCVD OF LTO (LOW TEMPERATURE OXIDE)

The placement of the wafers in the boat and the placement of the boat in the furnace and the temperature of the furnace all affect the deposition rate. Rates from 35 A/min to 100 A/min have been observed with basically the same LPCVD recipe. 80 A/min was obtained by simply spacing the dummy wafers and the device wafers in every other slot in the boat. Starting in the 5th slot place 5 dummy wafers in every other slot followed by 5 device wafers and two dummies all spaced every other slot. Place the boat such that the 1st device wafer is slightly closer to the door so that all device wafers are forward with respect to the center of the furnace. 5 or 10 degrees hotter will also give a higher deposition rate. For thick layers do the deposition in two runs and switch the order to give more uniform deposition. Flats up and all wafers pretty much vertical also helps uniformity. These films are not as dense as thermal oxide. They etch faster in BHF and KOH etches.
COAT WITH PHOTORESIST

1 µm Photoresist

Shipley System 8 Resist
HMDS 5000 rpm, 60 sec
Resist 5000 rpm, 60 sec
90 °C, 1 min Hotplate
EXPOSE AND DEVELOP LEVEL 4 CONTACT CUT

0.6 sec Integrate Mode
150 mj/cm²
Develop in MF 321, 1 min
Inspect, Pass?
ETCH CONTACT CUT

1 µm Photoresist

BHF
10 min
Rinse, Spin Dry
Inspect, Pass?
ASH RESIST, RCA CLEAN

300 w
30 min
Resist Removed?
SPUTTER ALUMINUM

DC ENI Source
CVC601 7000 A
30 min at 5mTorr
2000 w
DEPOSITION OF ALUMINUM

Follow Procedure for CVC-601 for power up, loading substrates, etc. Then to sputter with ENI RPG-50 power supply:

Check that power cable from the ENI RPG-50 is connected to the correct target, cooling water on
Turn on ENI RPG-50, breaker switch
Close Throttle Valve (panel 13) and turn off the high vacuum gage
Turn on Rotostrate (panel 9 and power switch on panel 16)
Set Praini Guage to 10 scale (panel 6)
Put the shutter over the target (panel 23), Turn off high vacuum gage
Turn on Argon slowley, set flow = zero and turn up slowly to 19.5 sccm to get 5 mTorr on Prani gage
Press Run Mode button and set pre sputter time to 120s (=2 min), by turning the knob.
Press Run Mode button again and set power to desired value (example: 2000 watts)
With Correct Power and Time Showing, Press On/Off button, (Record ex: V=449, A=2.15, W=2000)
Wait for the timer to time out at end of presputter.
Press Run Mode button and set sputter time to desired value (example 2400 sec =30 min), set power
Move shutter to uncover the target (check the gear assembly behind the pannel)
Press On/Off button, (Record example: V=449, A=2.15, W=2000)
Wait for the timer to time out and end of sputter, then turn off ENI RPG-50
Turn down Argon flow, turn off Argon flow, turn off Argon MFC
Open Throttle Valve
Turn off Rotostrate (panel 9 and power switch on panel 16)
Turn off praini gage
Turn off water cooling
Press Stop on pannel #1
Press Vent on pannel #1

Date    Time      Power     Thickness
9-13-96  20 min, 2000 watts, 5000 Å
9-18-96  30 min, 2000 watts, 7000 Å
10-1-96  50 min, 2000 watts, 12,000 Å
about 240 Å/min
COAT WITH PHOTORESIST

Shipley System 8 Resist
HMDS 5000 rpm, 60 sec
Resist 5000 rpm, 60 sec
90 °C, 1 min Hotplate
EXPOSE AND DEVELOP LEVEL 5 METAL ONE

0.6 sec Integrate Mode
150 mj/cm²
Develop in MF 321, 1 min
Inspect, Pass?
ETCH ALUMINUM

50 C
1-3 min
Inspect, Pass?
ASH RESIST

300 w
30 min
Resist Removed?
LTO, 8000A, 100 min.
400 C, SiH4 40 sccm
O2 48 sccm, 245 mTorr
COAT WITH PHOTORESIST

Shipley System 8 Resist
HMDS 5000 rpm, 60 sec
Resist 5000 rpm, 60 sec
90 °C, 1 min Hotplate
EXPOSE AND DEVELOP LEVEL 6 VIA

0.6 sec Integrate Mode
150 mj/cm²
Develop in MF 321, 1 min
Inspect, Pass?
ETCH VIA

1 µm Photoresist

BHF with Glycerin Mixture
5 min
Rinse, Spin Dry
Inspect, Pass
ASH RESIST

300 w
30 min
Resist Removed?
SPUTTER ALUMINUM

DC ENI Source
CVC601 7000 A
30 min at 5mTorr
2000 w
COAT WITH PHOTORESIST

Shipley System 8 Resist
HMDS 5000 rpm, 60 sec
Resist 5000 rpm, 60 sec
90 °C, 1 min Hotplate
EXPOSE AND DEVELOP LEVEL 7 METAL TWO

0.6 sec Integrate Mode
150 mj/cm²
Develop in MF 321, 1 min
Inspect, Pass?
ETCH METAL TWO

50 C
1-3 min
Inspect, Pass?
ASH RESIST

Resist Removed?

300 w
30 min

p+ p+
SINTER, 425 °C, N₂/H₂

Before Sinter

After Sinter

Reduce Contact Resistance

Native Oxide

Hydrogen, neutral region

Silicon DiOxide Interface

Silicon Crystal

Reduce Surface States

Oxygen

+ charge region silicon atom that lost an electron
TEST

Ids-Vds Family
Sub-Vt
Diode vs Light System