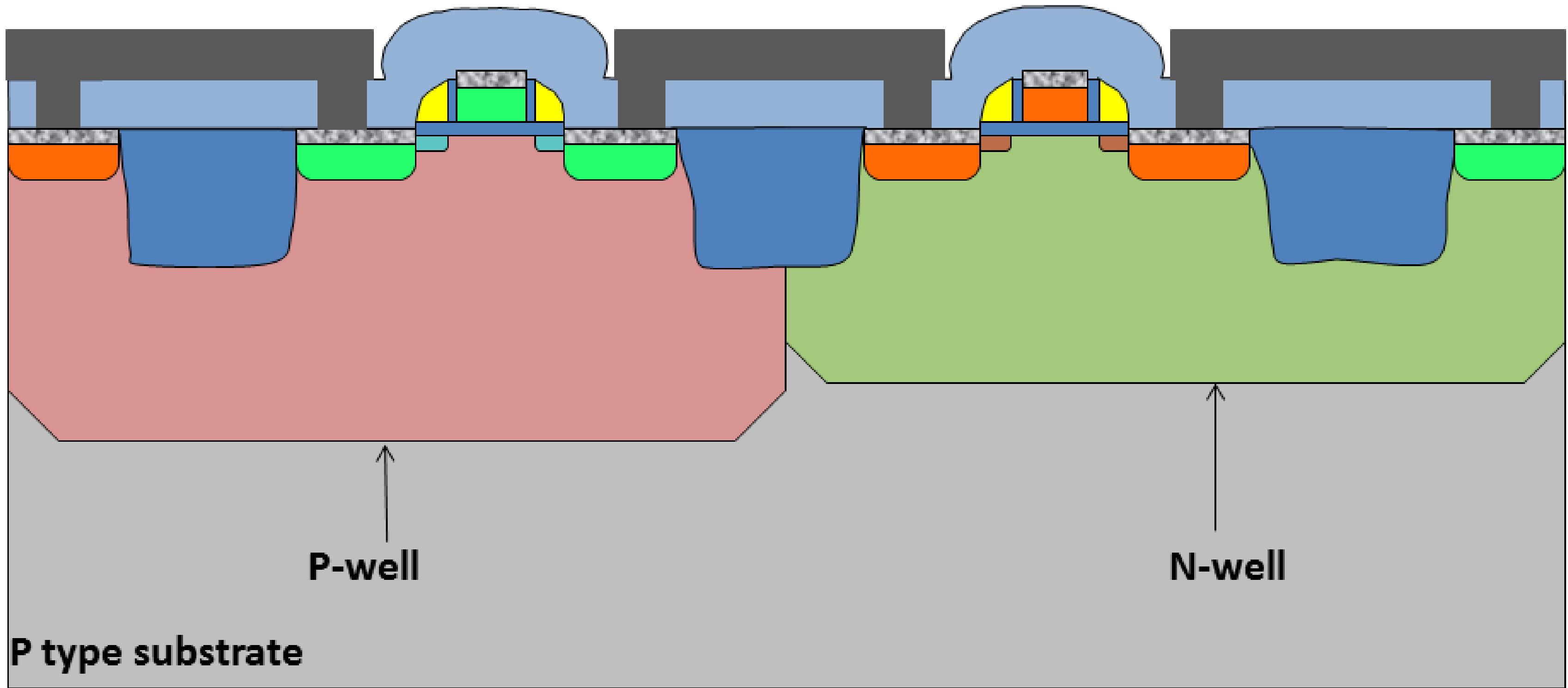
Manufacturing Process and Fabrication of 100nm CMOS Devices



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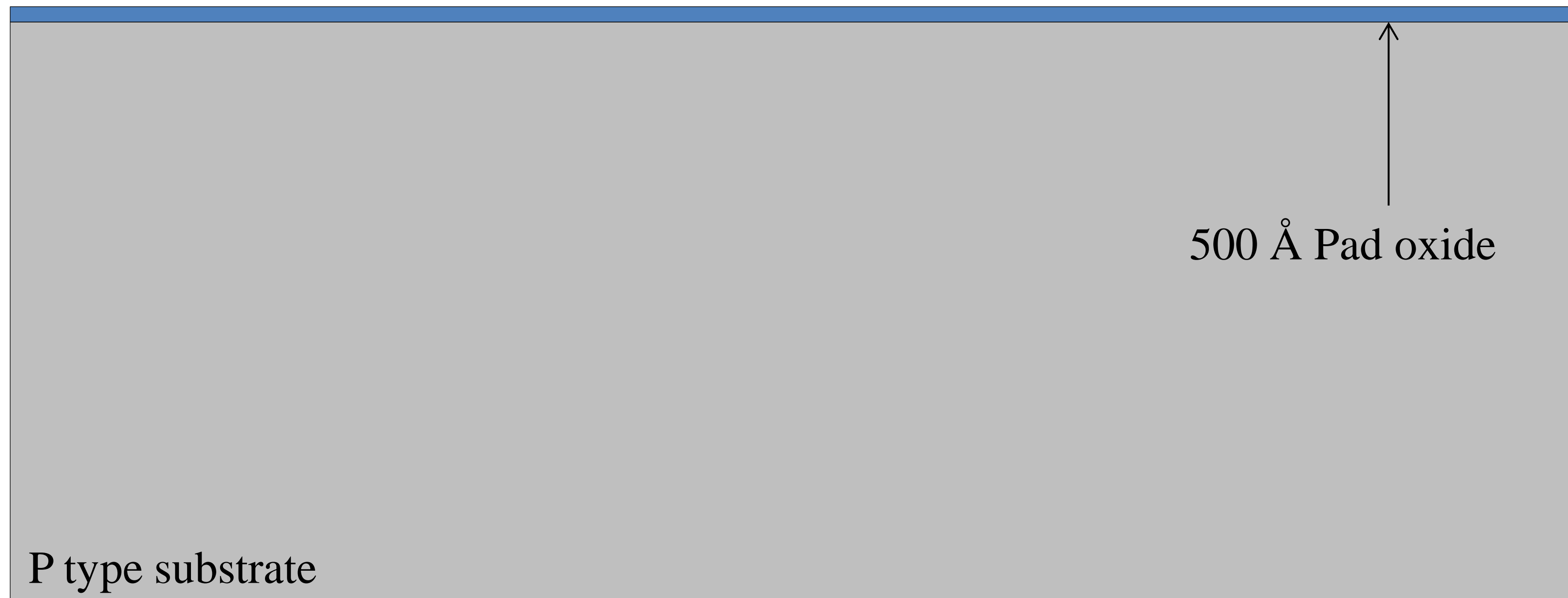
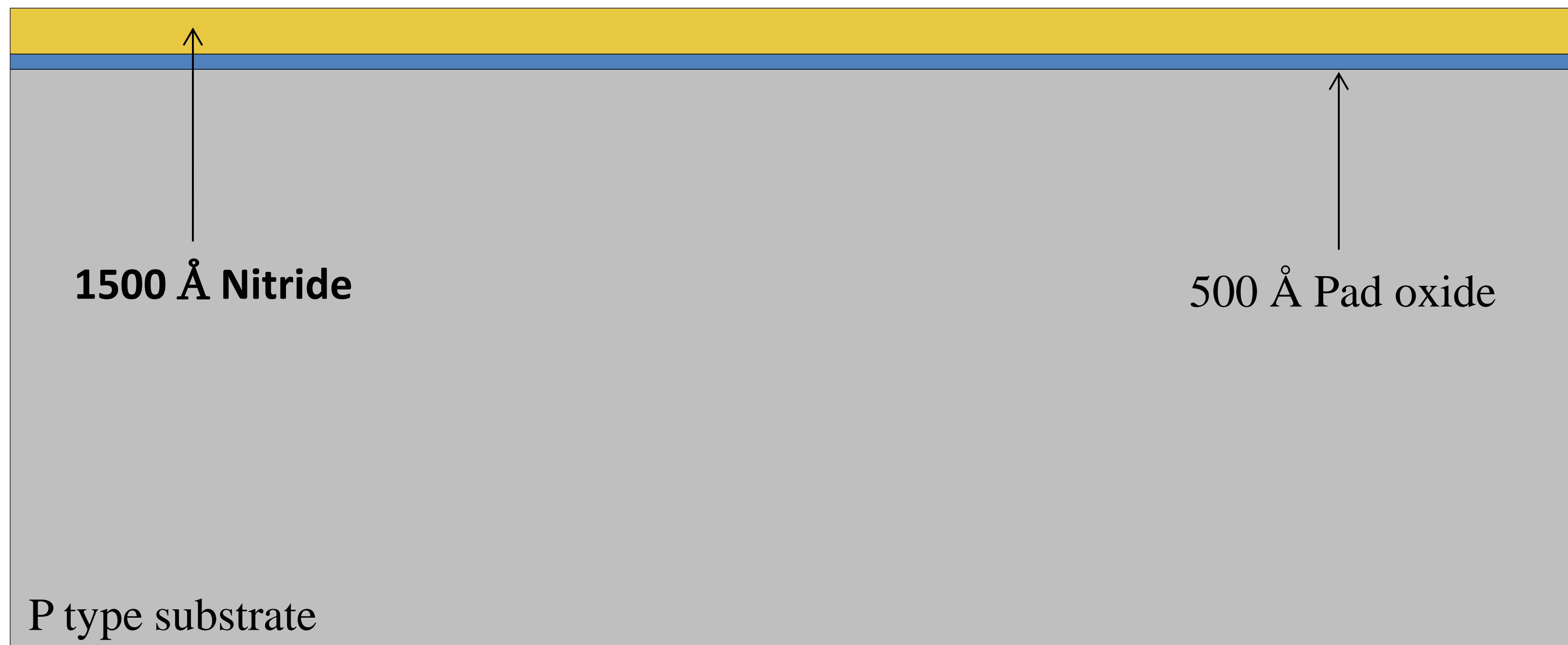
1 – Dry Oxide: Pad Oxide Growth

Bruce TUBE 04, Recipe #250
Target Oxide Thickness: 500 Å
Metrology: SpectraMap- 81 pt Oxide on Silicon



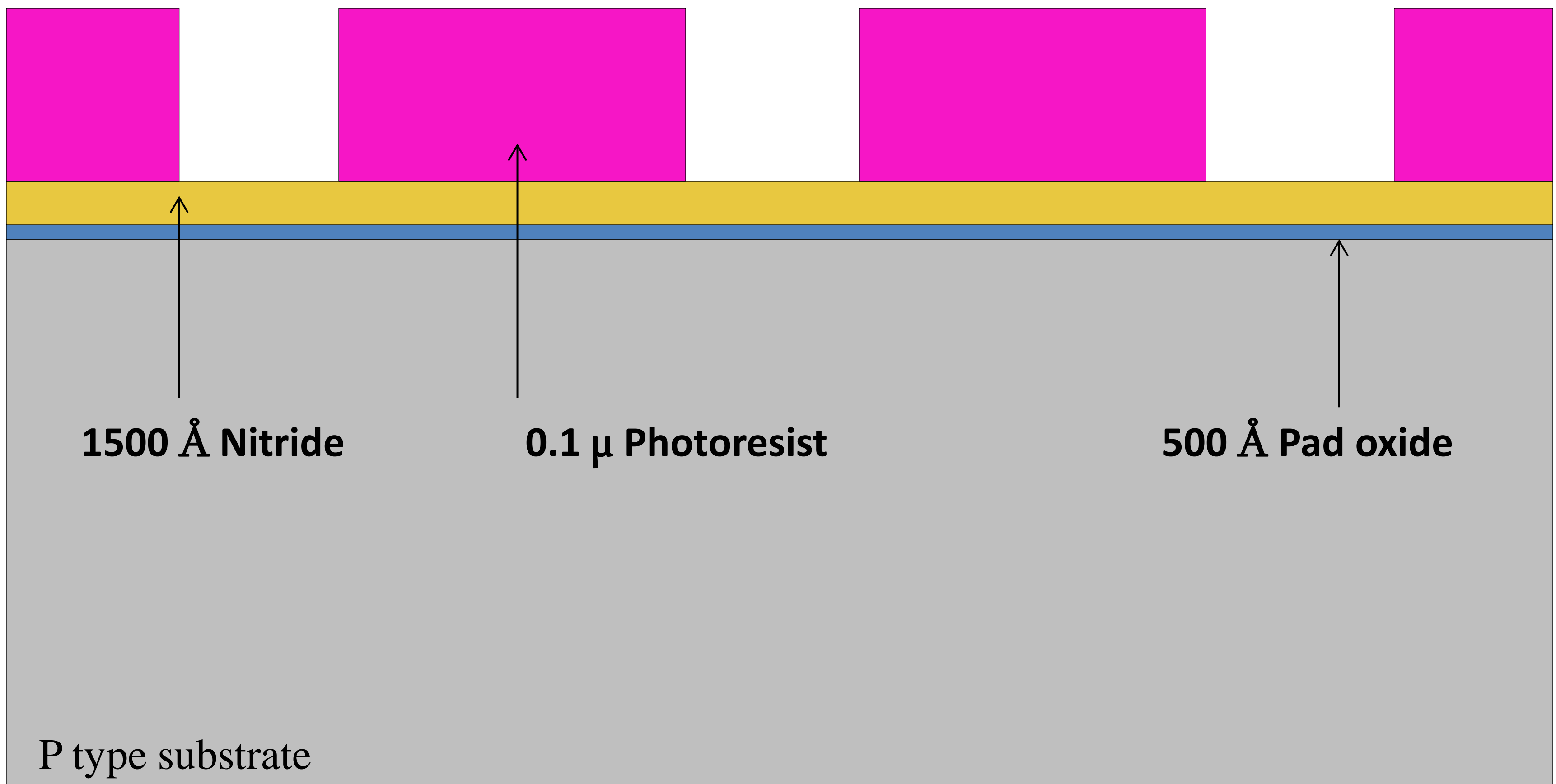
2 – LPCVD Nitride Deposition

Lower LPCVD Tube, Recipe # FACTORY NITRIDE 810
Target Thickness: 1500 Å
Metrology: SpectraMap – 81 pt Nitride on Oxide



3 – Photo Level-1 (STI)

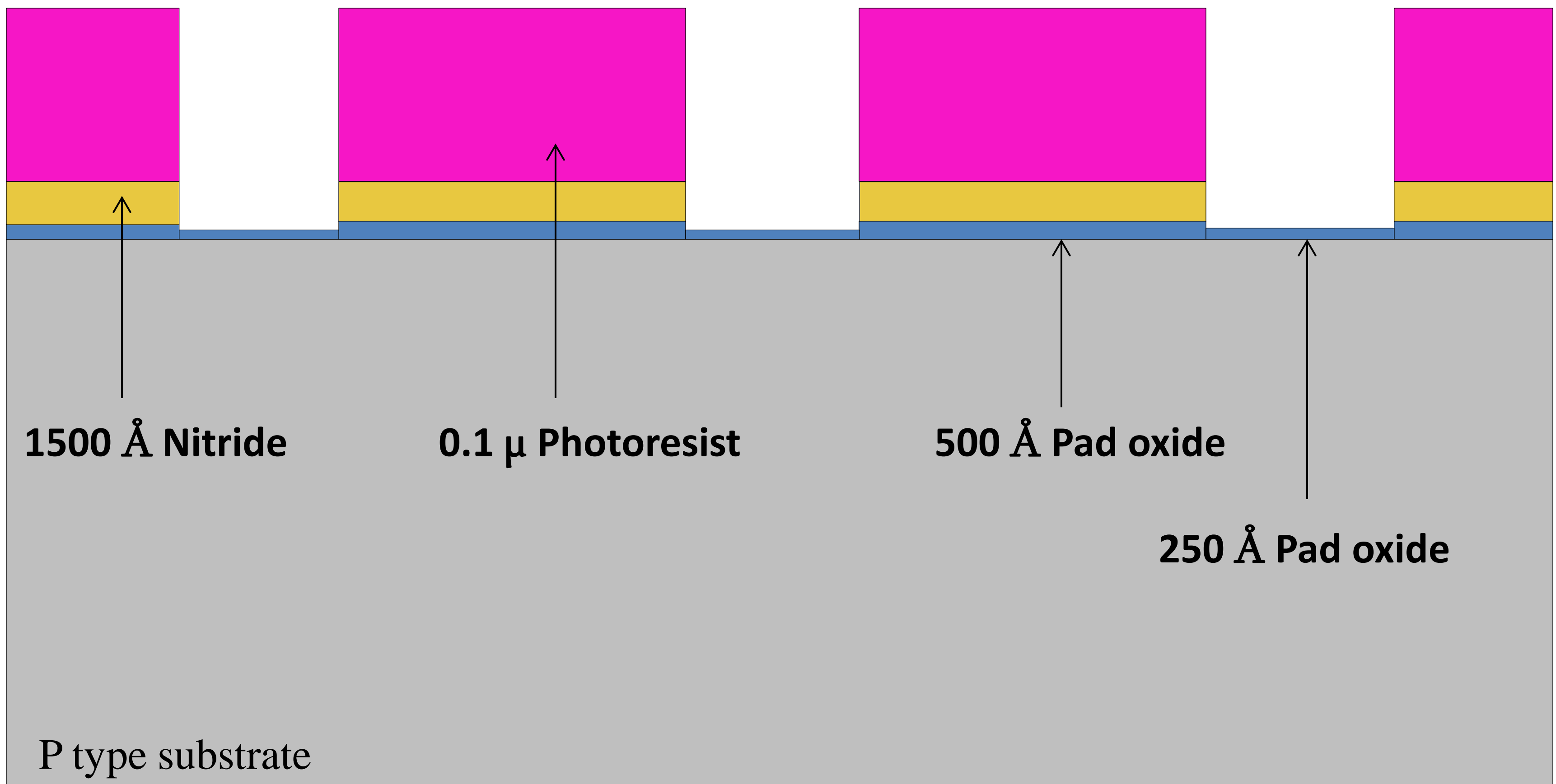
SSI Track: Recipe: COAT.rcp, DEVELOP.rcp
ASML Stepper: Mask- ADV STI
Jobname: factory-adv-cmos



4 – Nitride etch (Plasma etch)

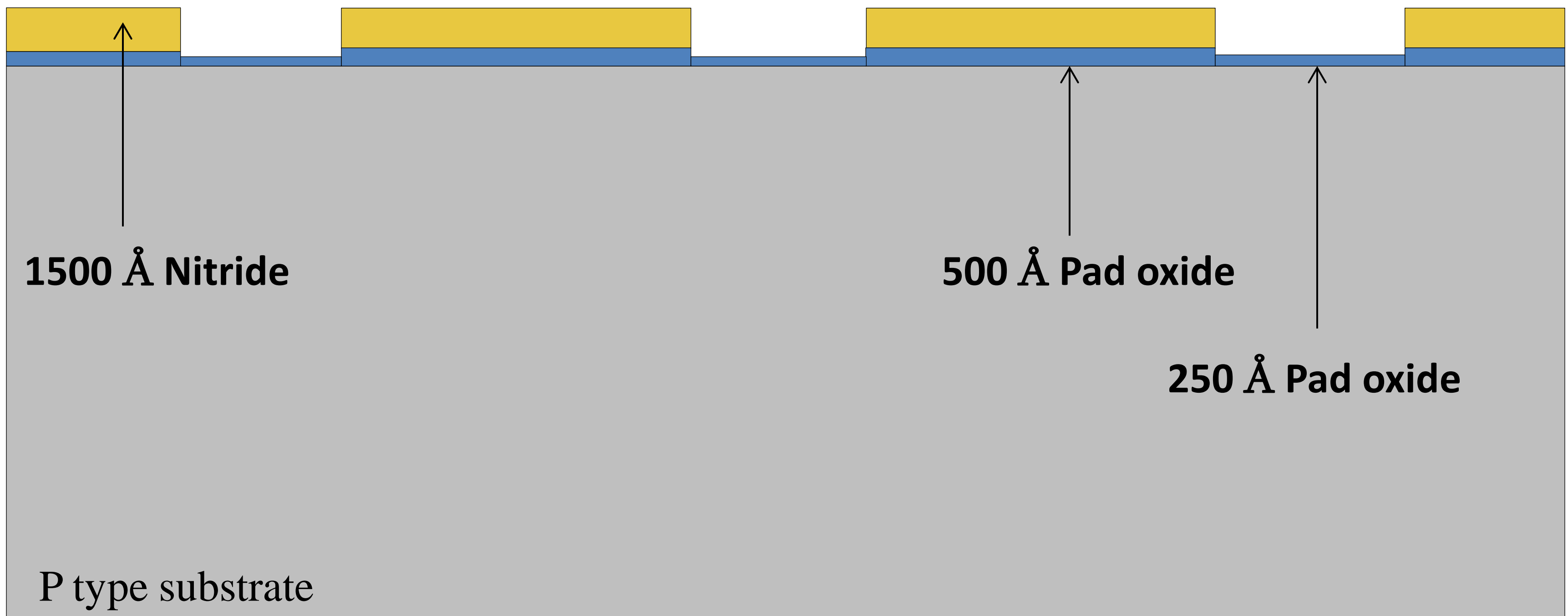
LAM 490: Recipe FNIT1500.rcp

Metrology: NanoSpec (Recipe 7: Thin Oxide on Silicon)

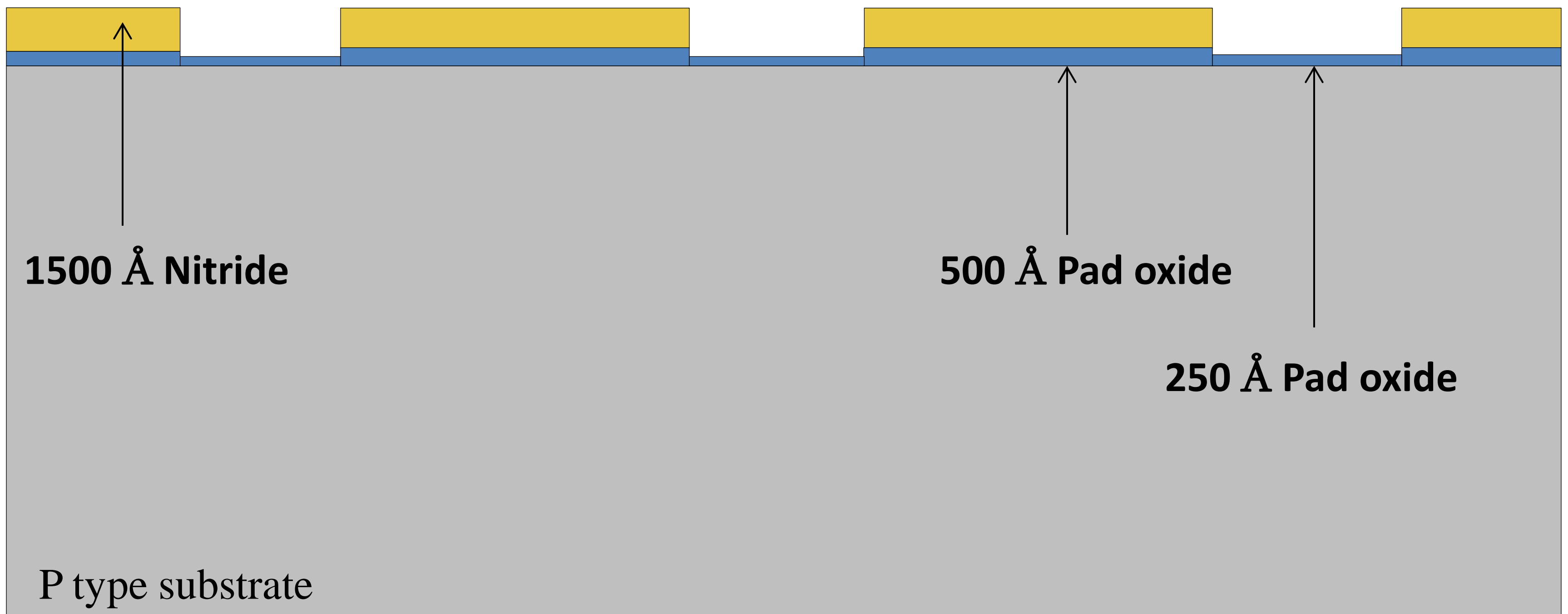


5 – Photoresist Strip

GaSonics Asher: FF (O2 Plasma)
Metrology: Visual/ Inspection Microscope

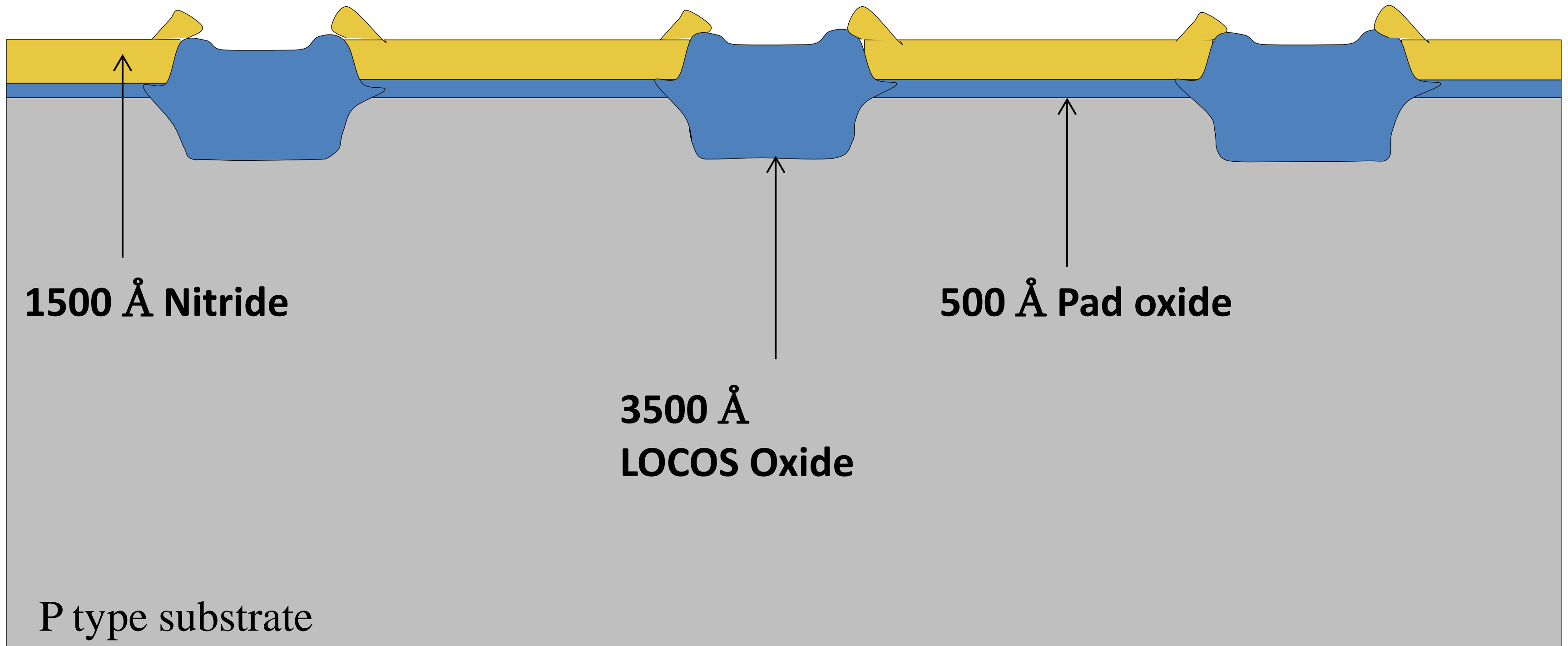


6 – RCA Clean



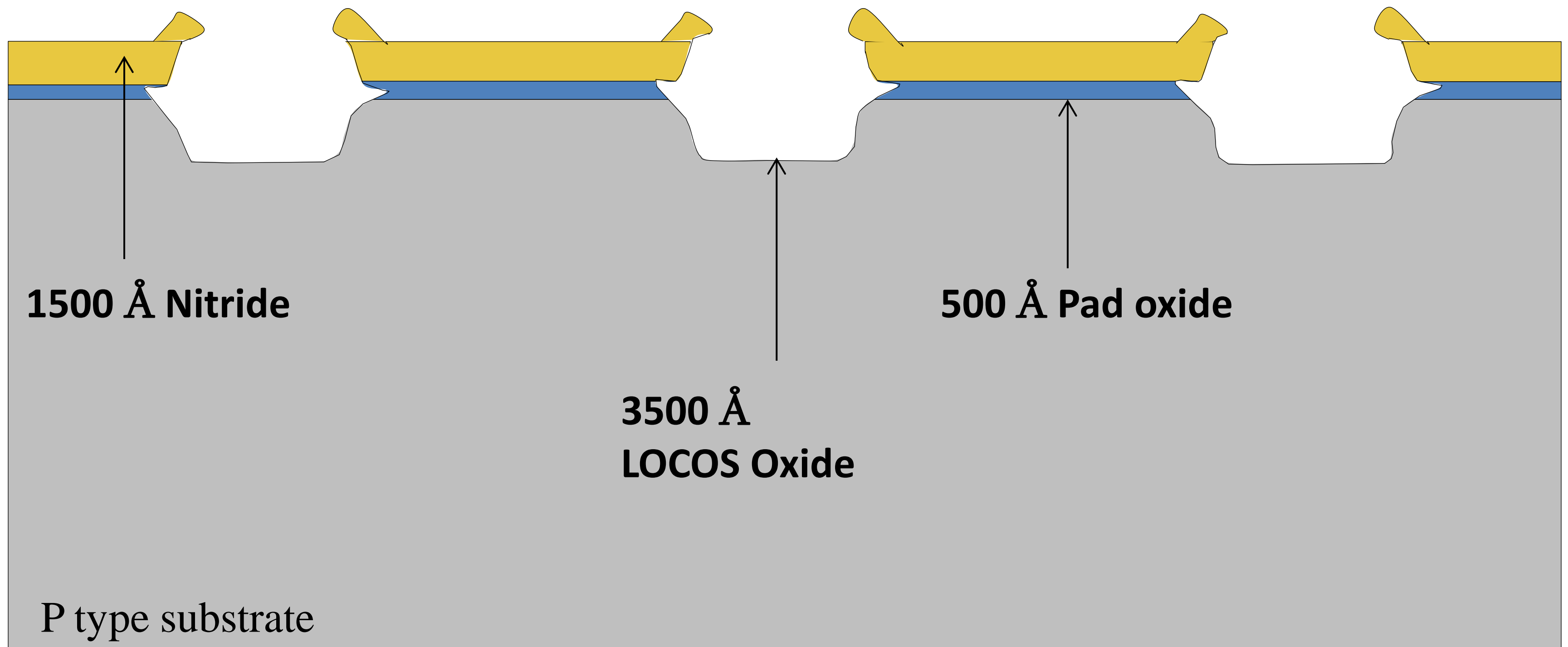
7 – Wet oxide (LOCOS)

Bruce TUBE 01, Recipe #336
Target Oxide Thickness: 3500 Å
Metrology: NanoSpec (Field Area)



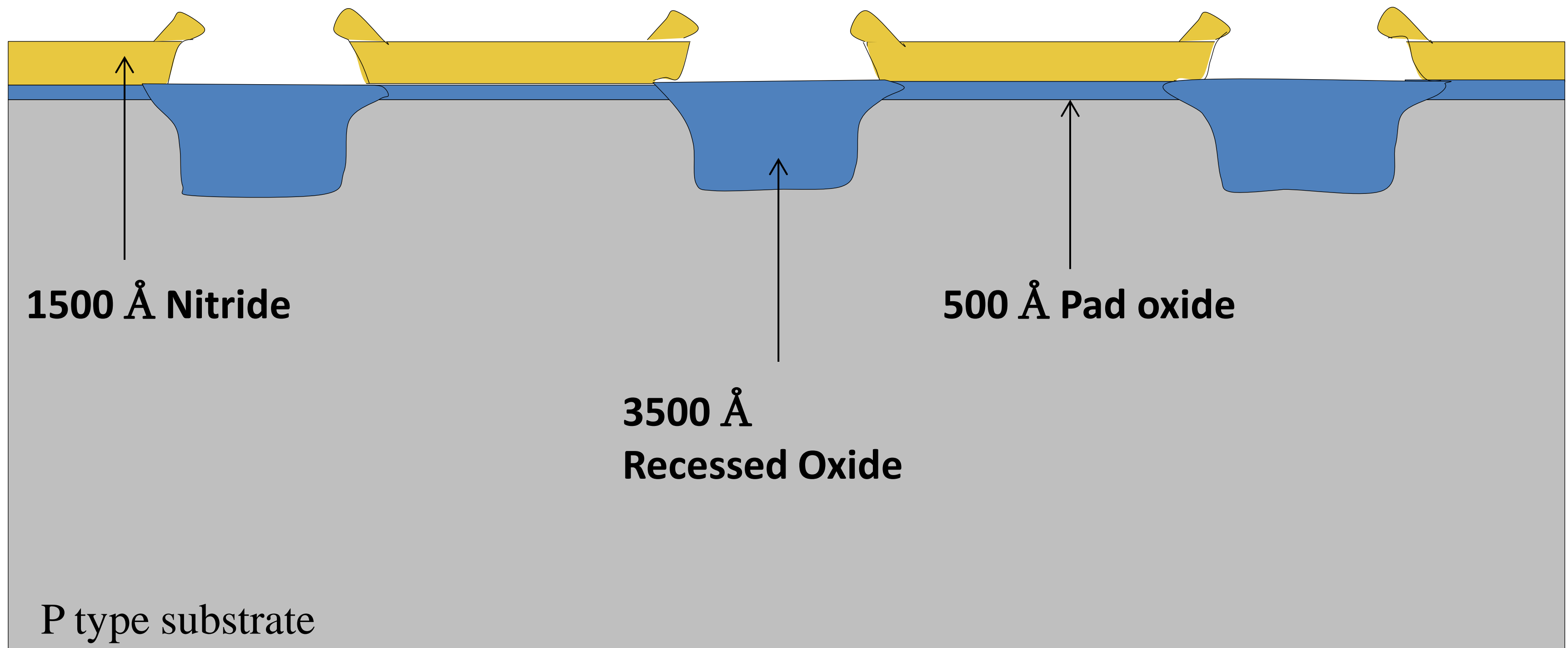
8 – Oxide Etch

10:1 Buffered HF BOE Etch for 6 min 30 sec
(Etch rate: 586 Å/min)
Rinse in DI water, SRD
Metrology: NanoSpec (Field Area)



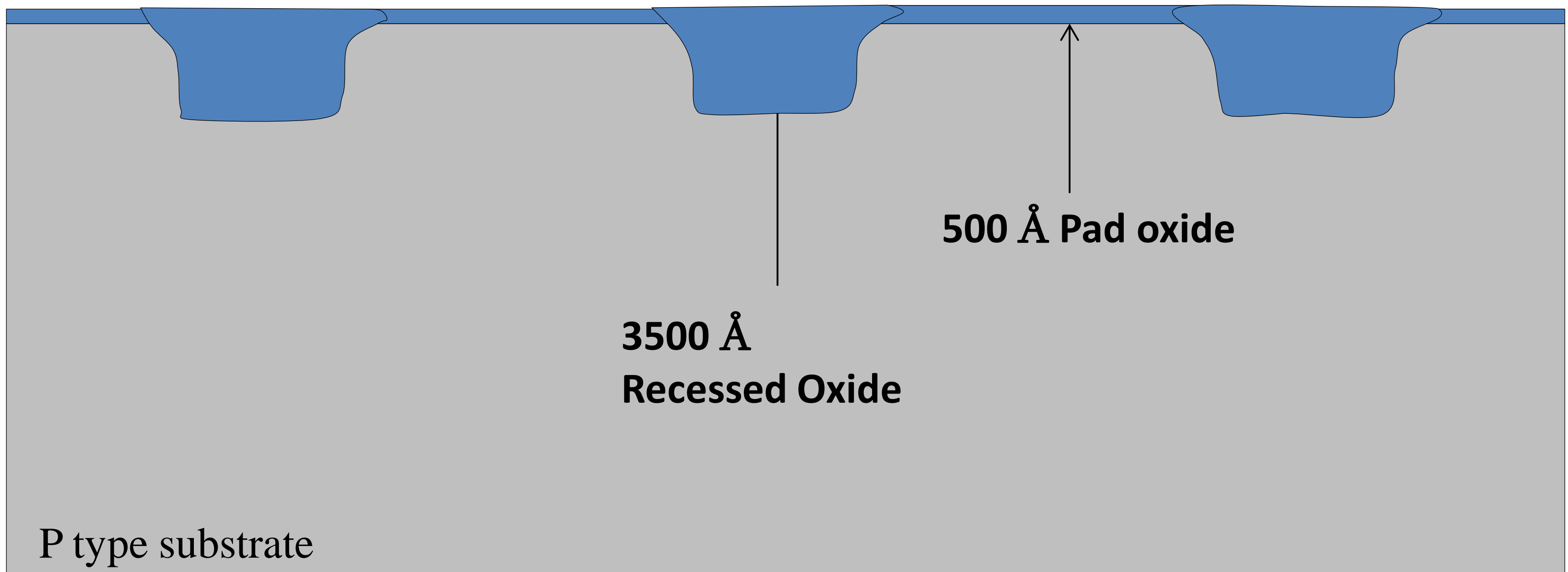
9 – Wet Oxide

Bruce TUBE 01, Recipe #336
Target Oxide Thickness: 3500 Å
Metrology: NanoSpec (Field Area)



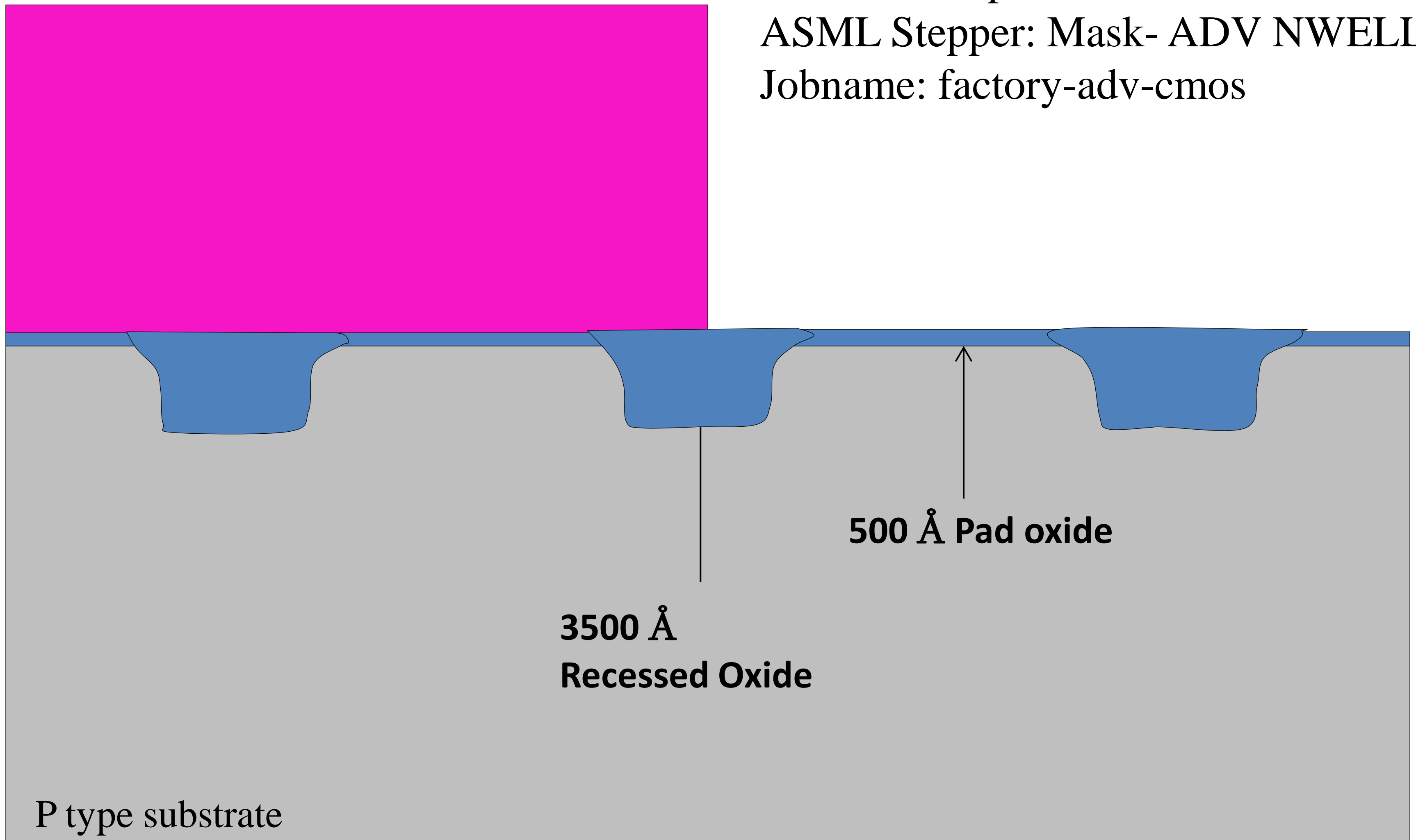
10 – Etch Nitride

Hot Phosphoric Acid at 165 °C for 45 min
(Etch rate: 80 Å/min) (Stir every 10 minutes for uniform etch)
Metrology: NanoSpec (Active Area)

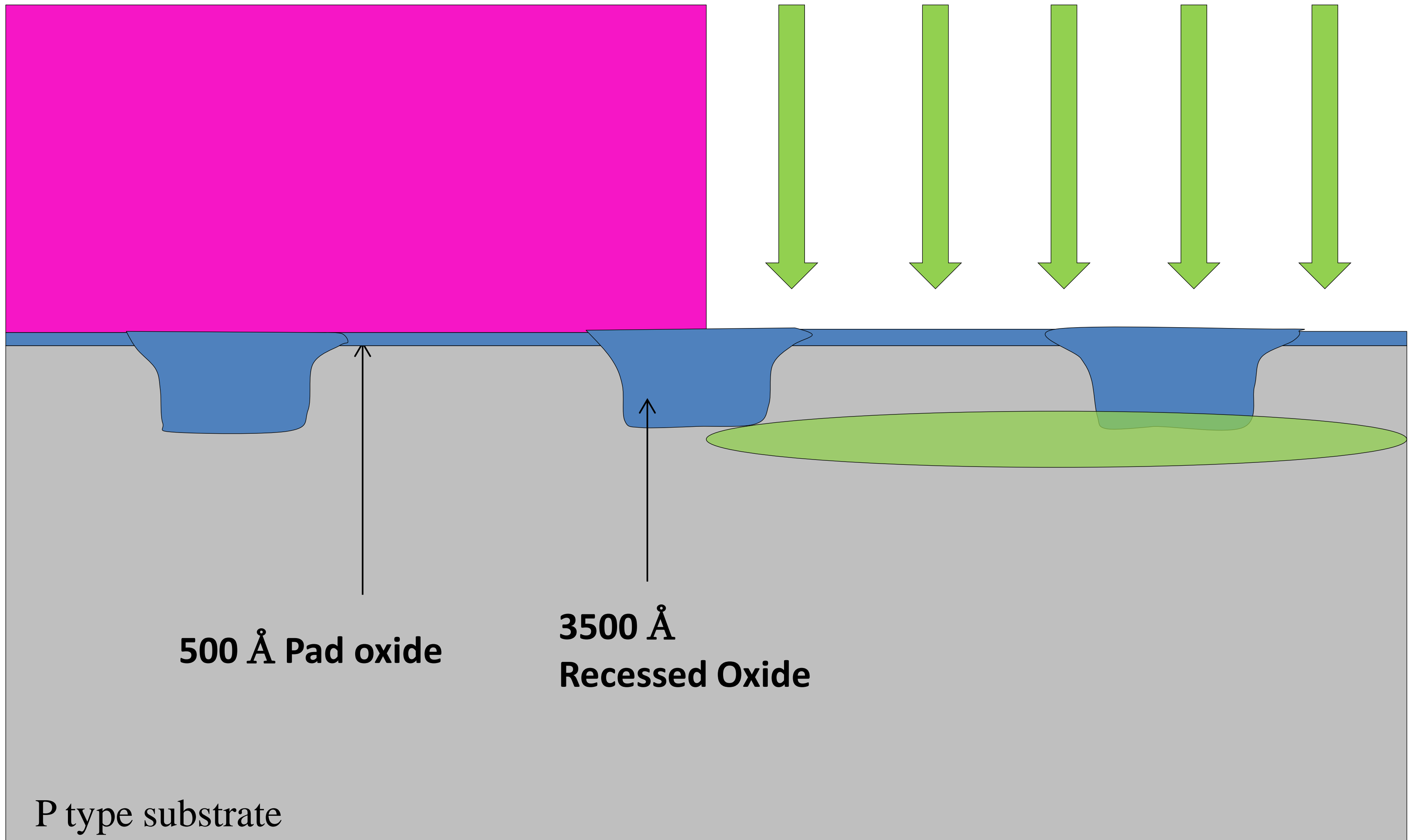


11 – N-well Photo (Level 2)

SSI Track: Recipe: COATMTL.rcp,
DEVMTL.rcp
ASML Stepper: Mask- ADV NWELL
Jobname: factory-adv-cmos

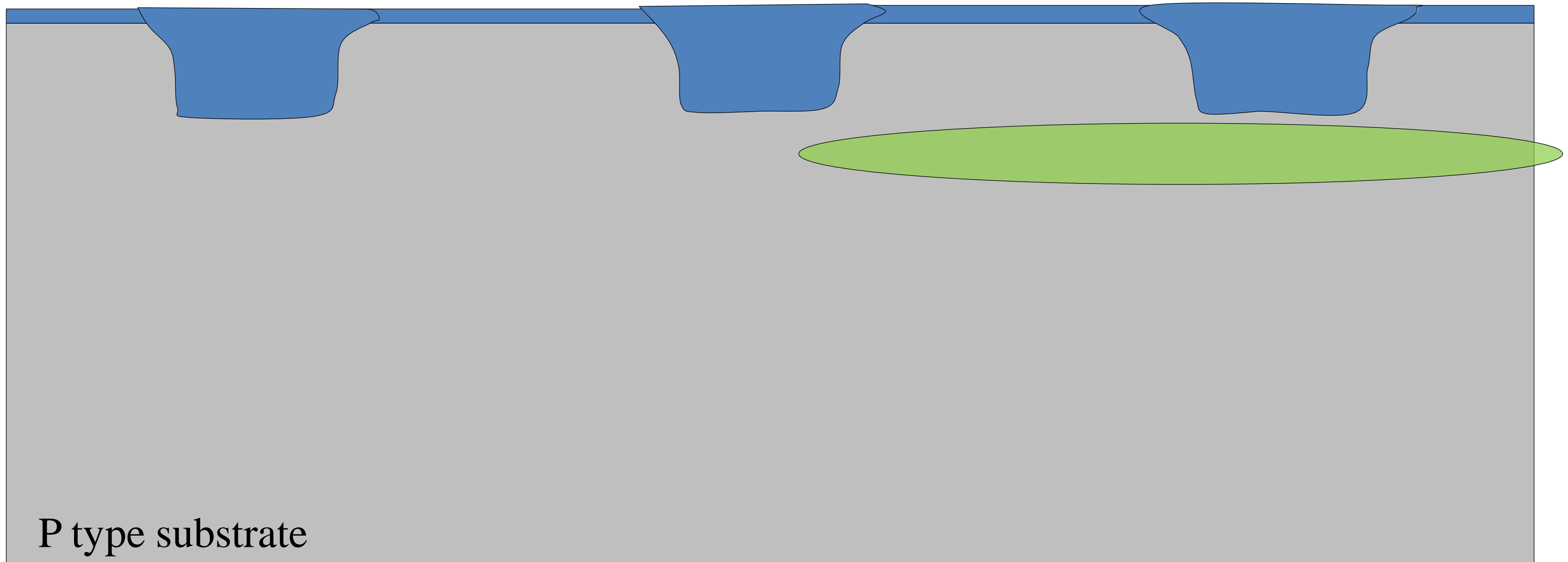


12 – N-well Implant



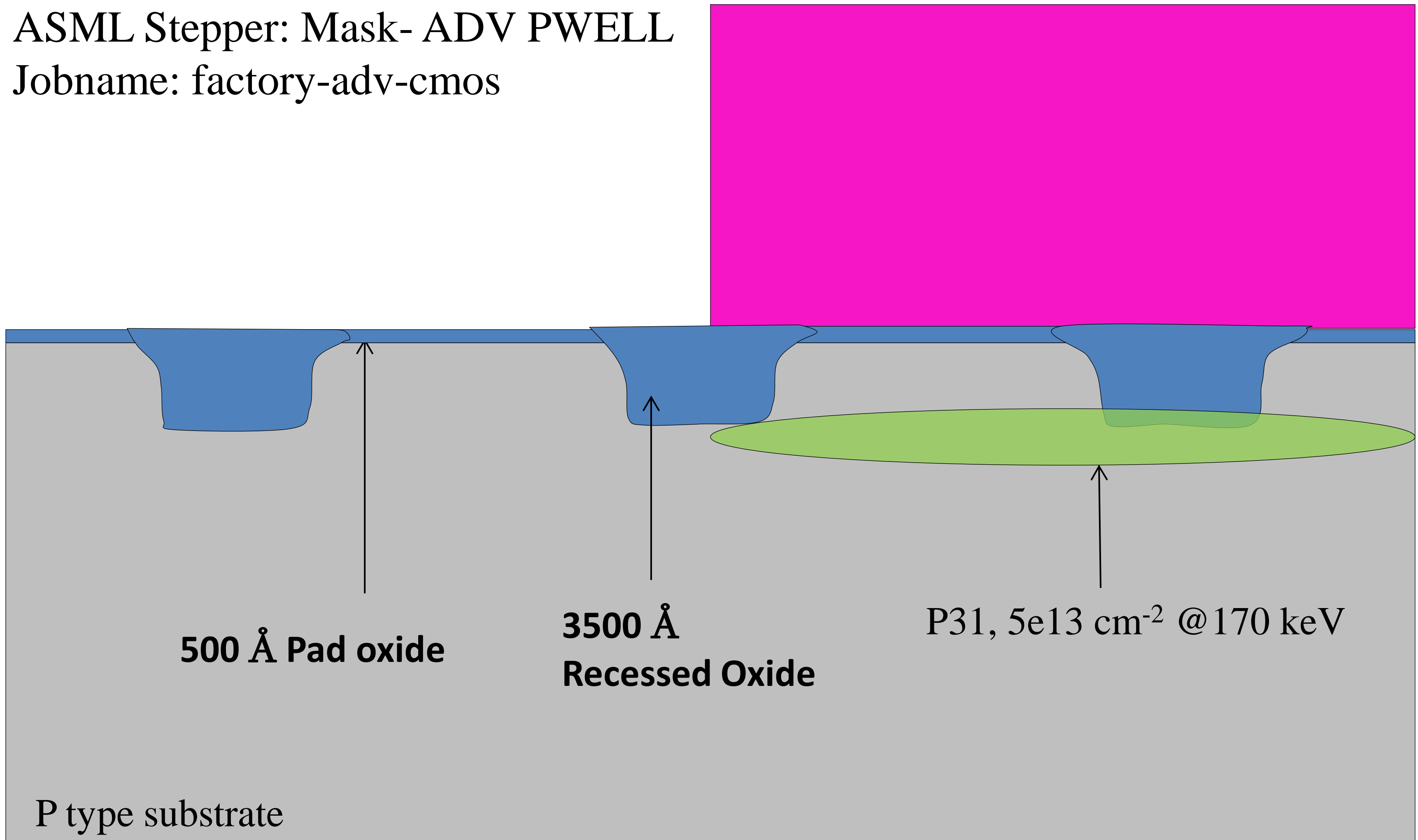
13 – Photoresist Strip

GaSonics Asher: FF (O_2 Plasma)
Metrology: Visual/ Inspection Microscope

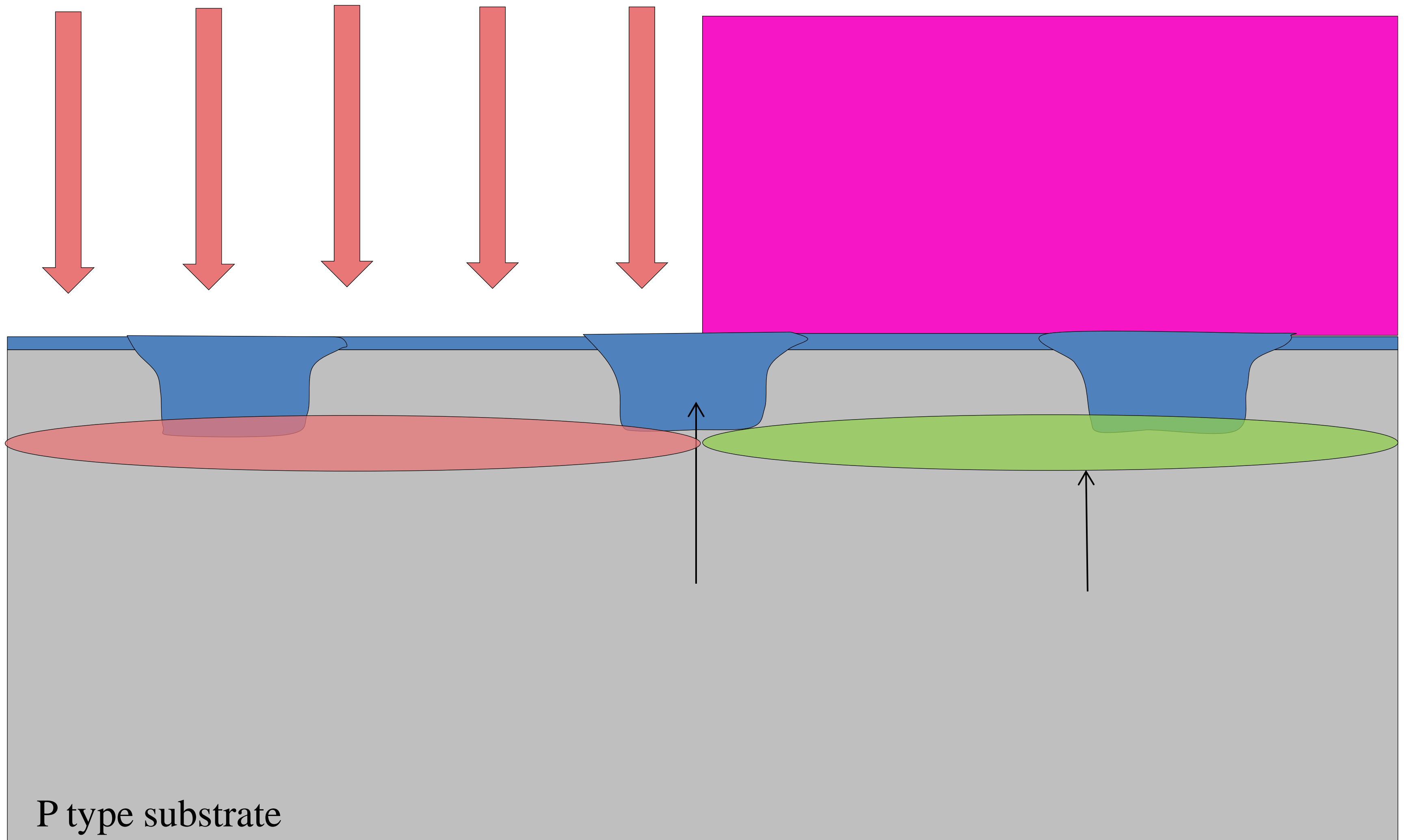


14 – P-well Photo (Level – 3)

SSI Track: Recipe: COATMTL.rcp, DEVMTL.rcp
ASML Stepper: Mask- ADV PWELL
Jobname: factory-adv-cmos

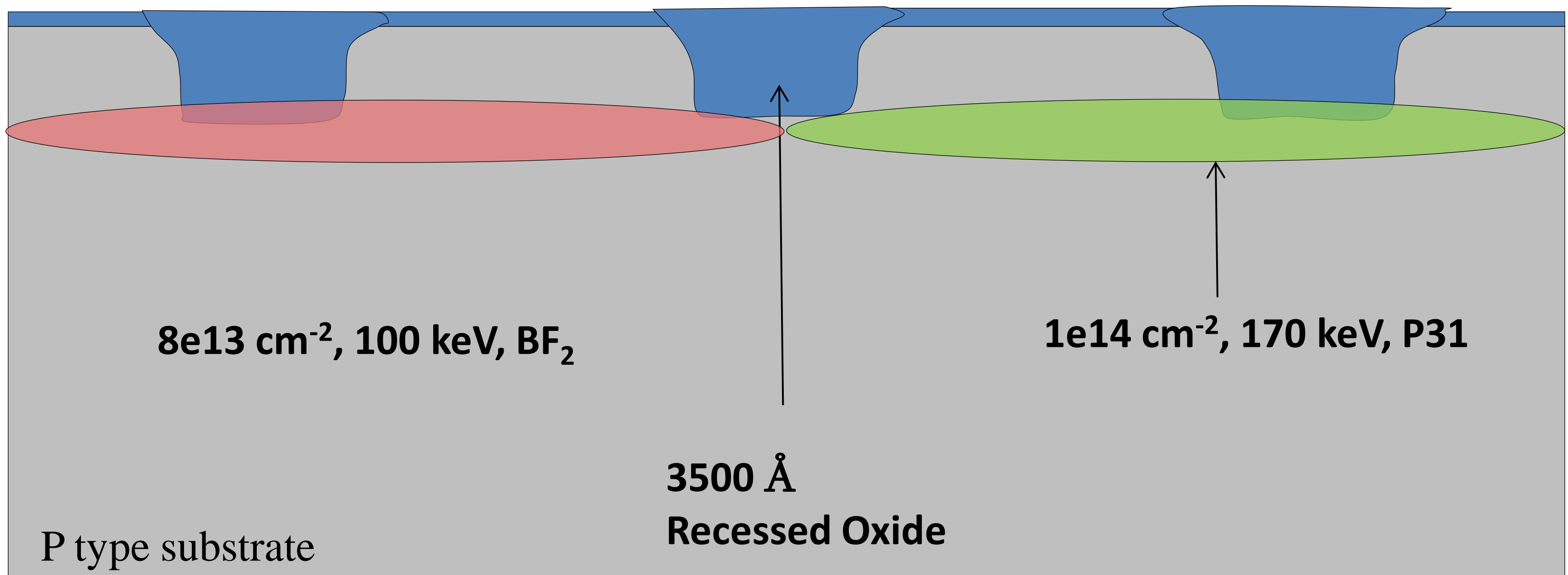


15 – P-well Implant



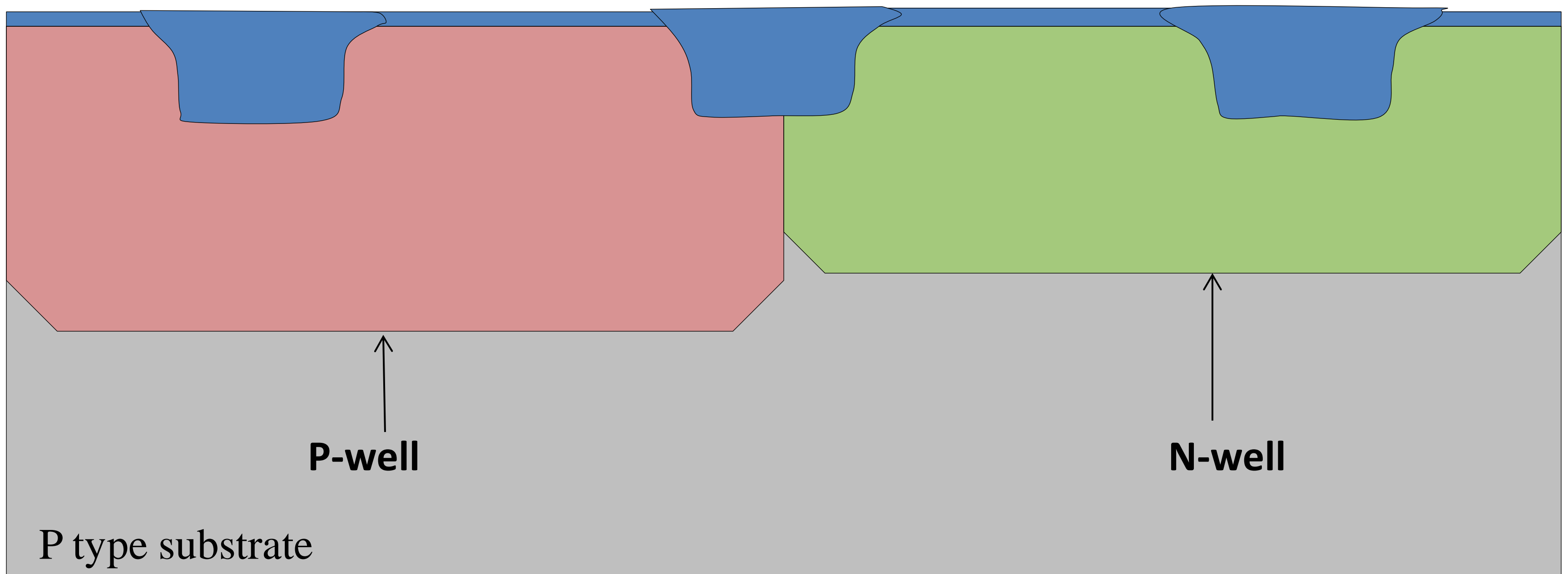
16 – Photoresist Strip

GaSonics Asher: FF (O_2 Plasma)
Metrology: Visual/ Inspection Microscope

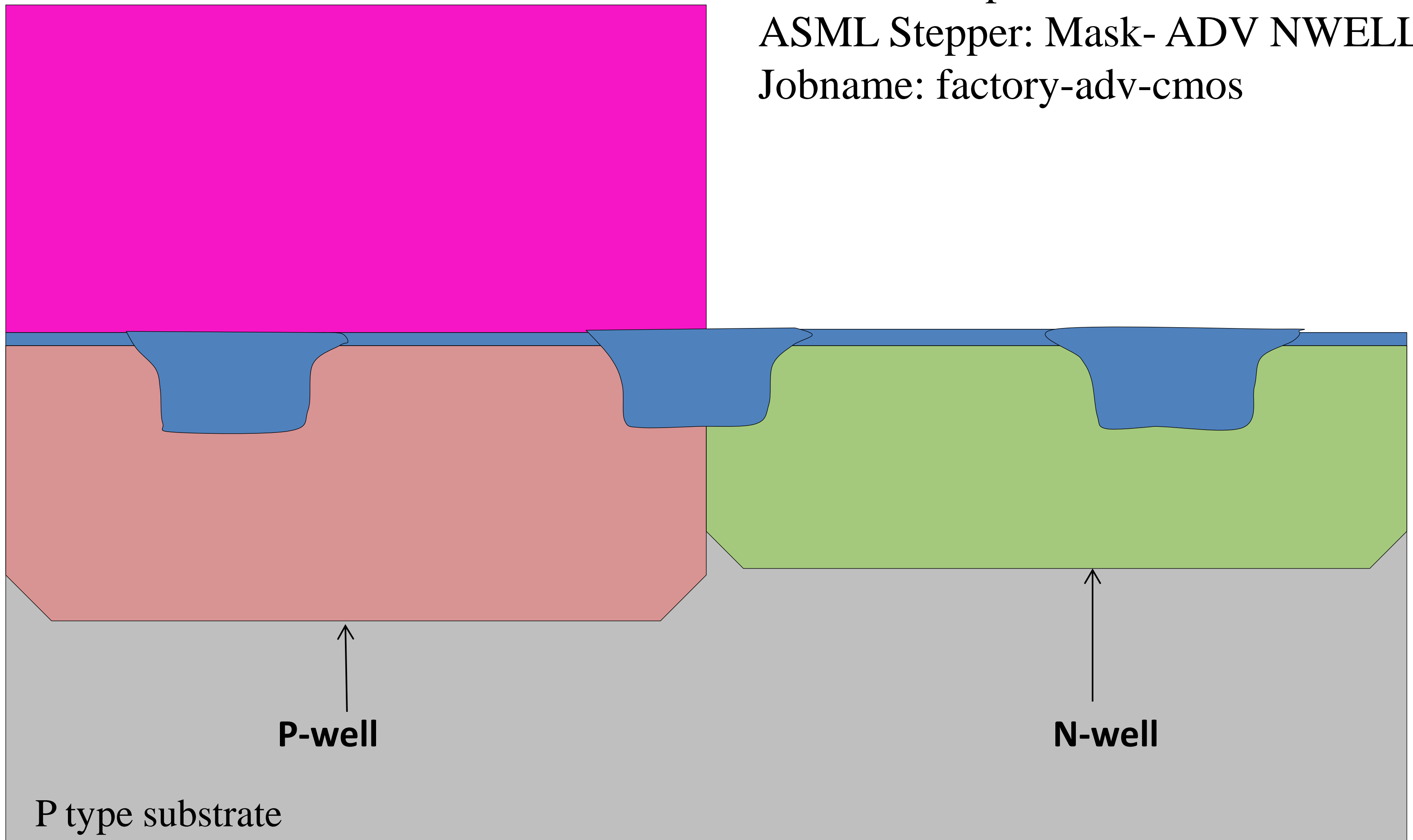


17 – Well Drive-in

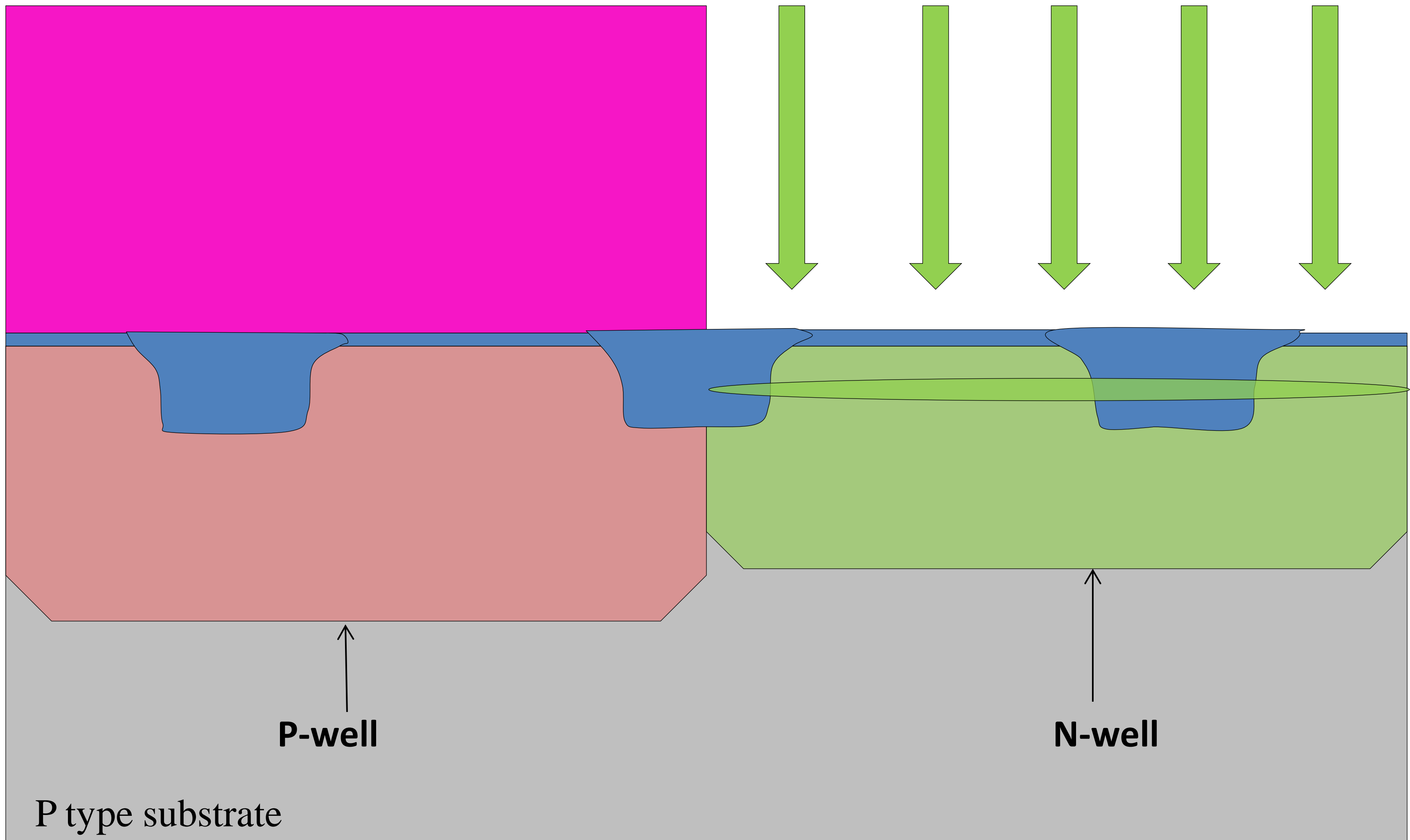
Bruce TUBE 01, Recipe #11
Soak Time 4hrs @ 1000 °C, N2 ambient



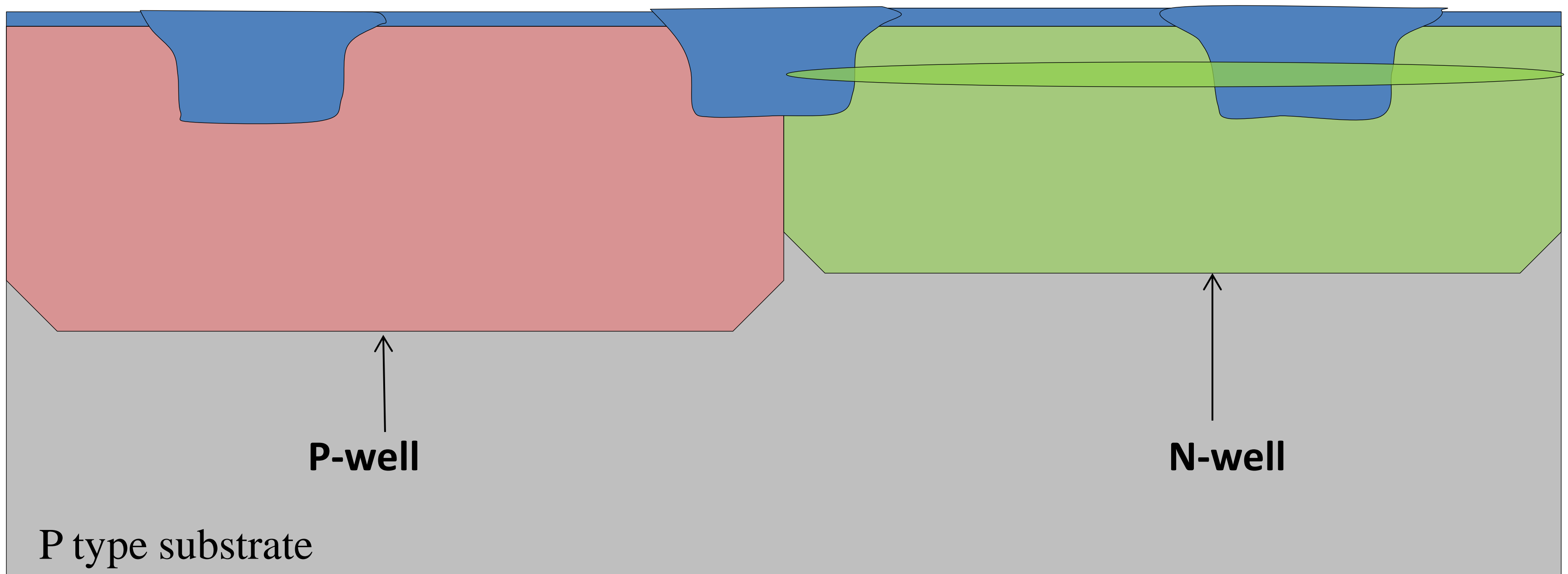
18 – N-well Retrograde Photo (Level-4)



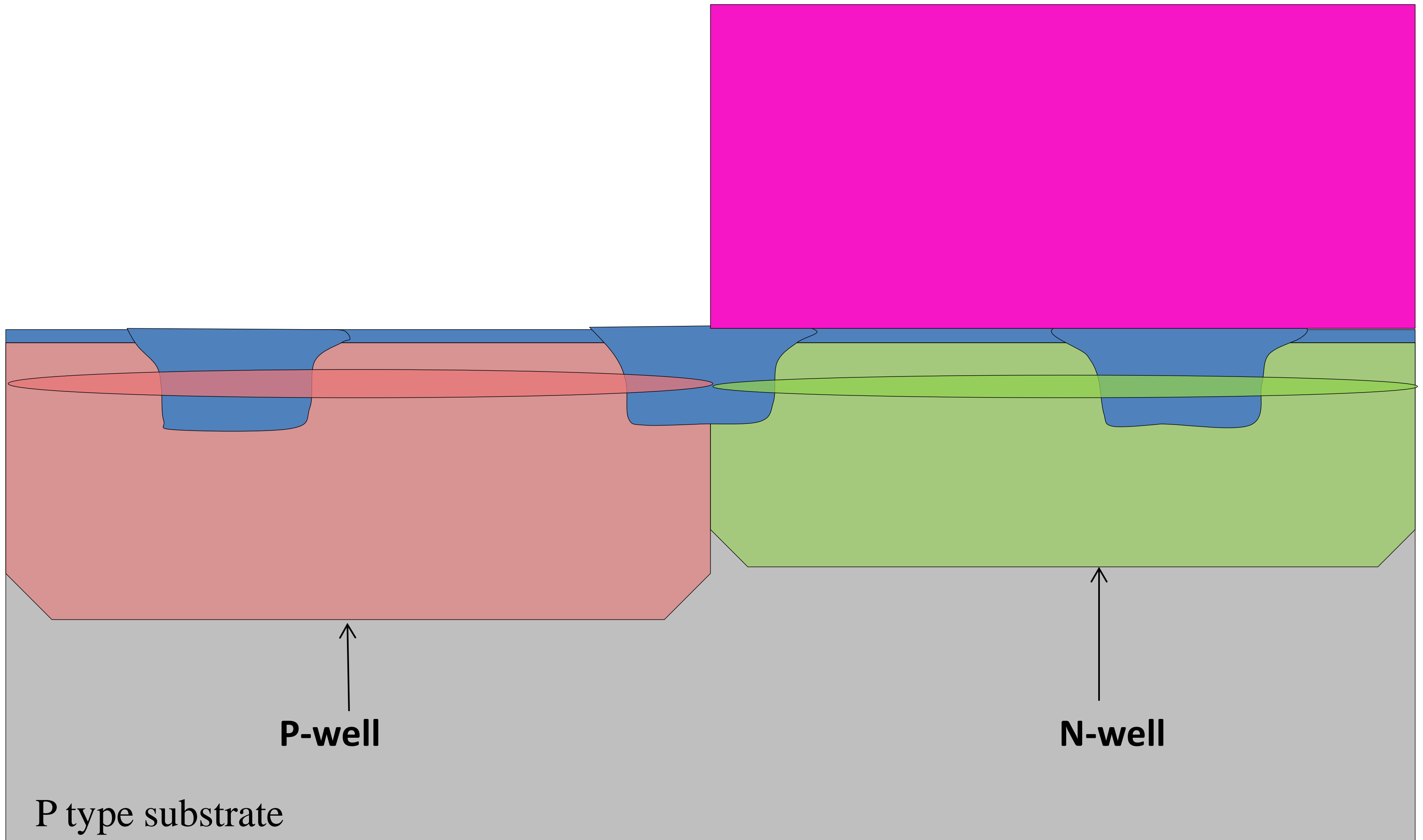
19 – N-well Retrograde Implant



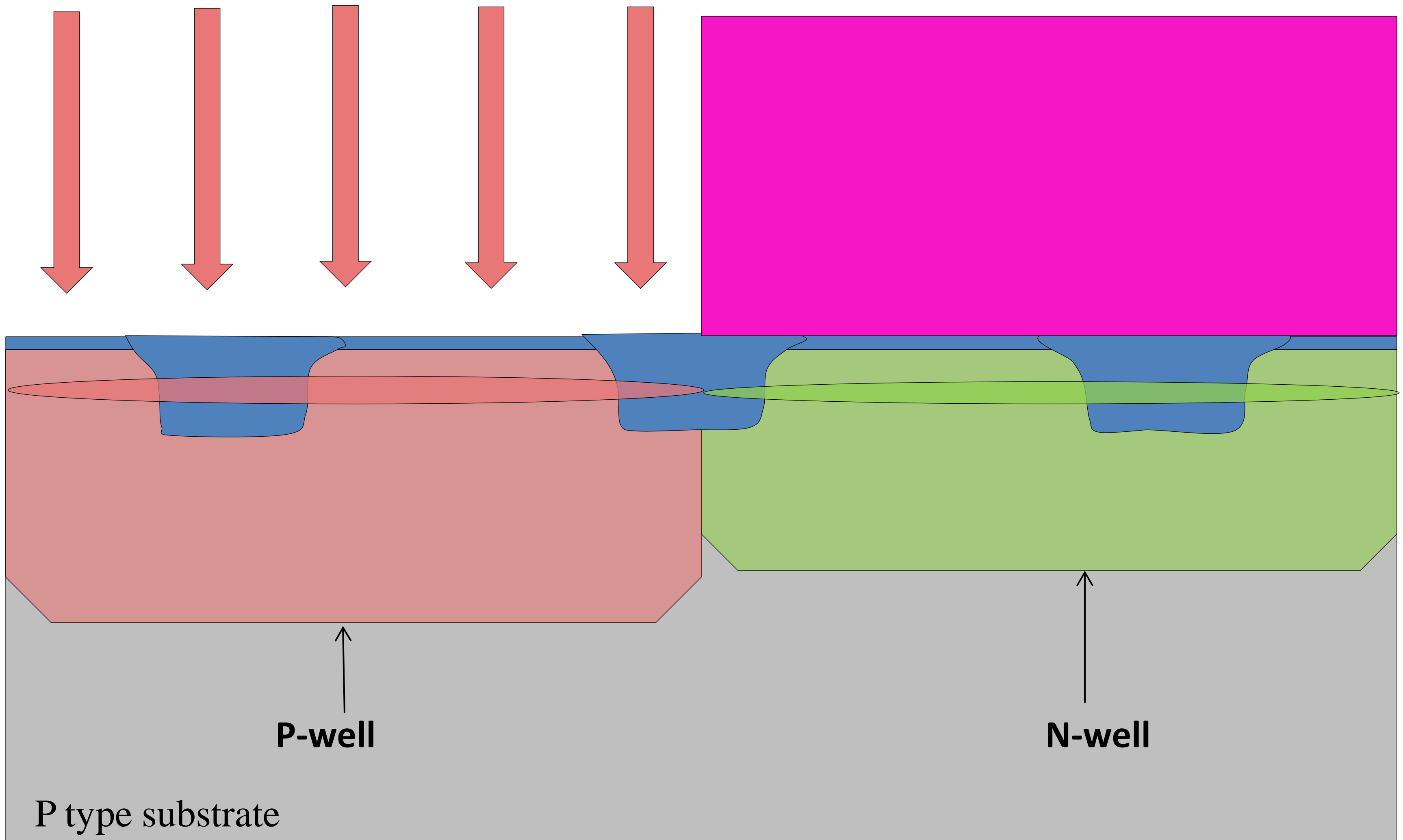
20 – Resist Strip



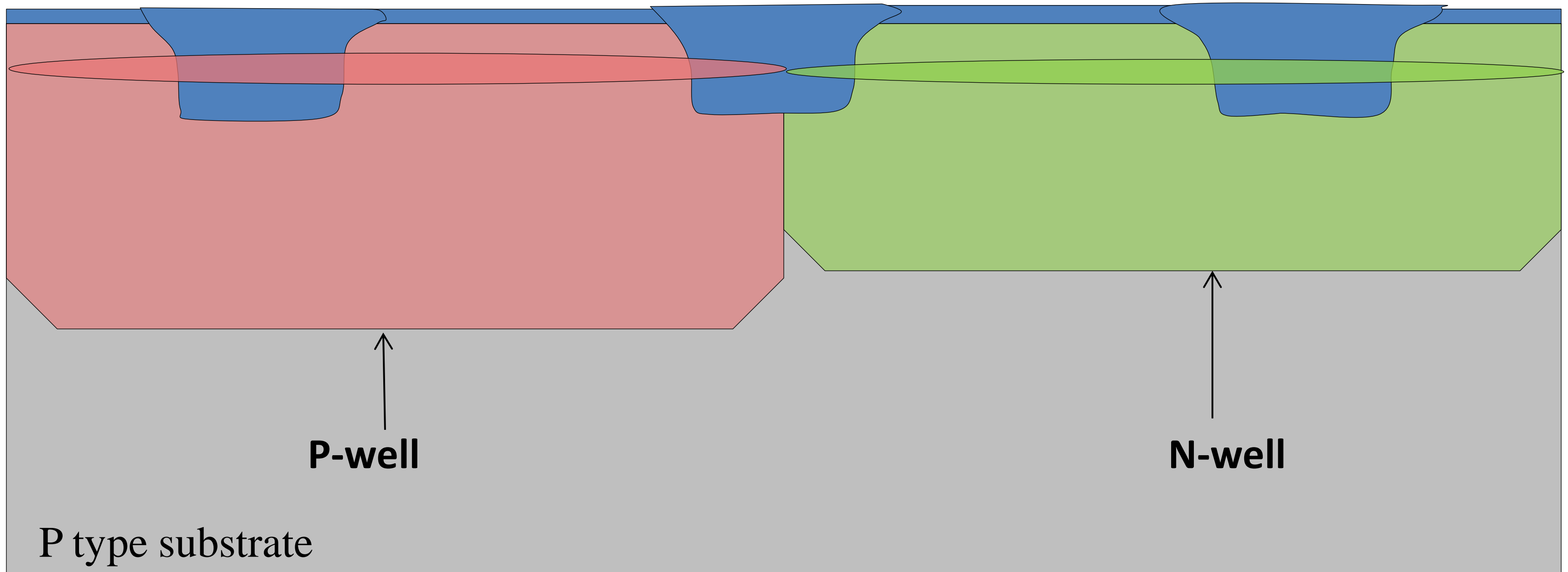
21 – P-well Retrograde Photo (Level-5)



22 – P-well Retrograde Impant

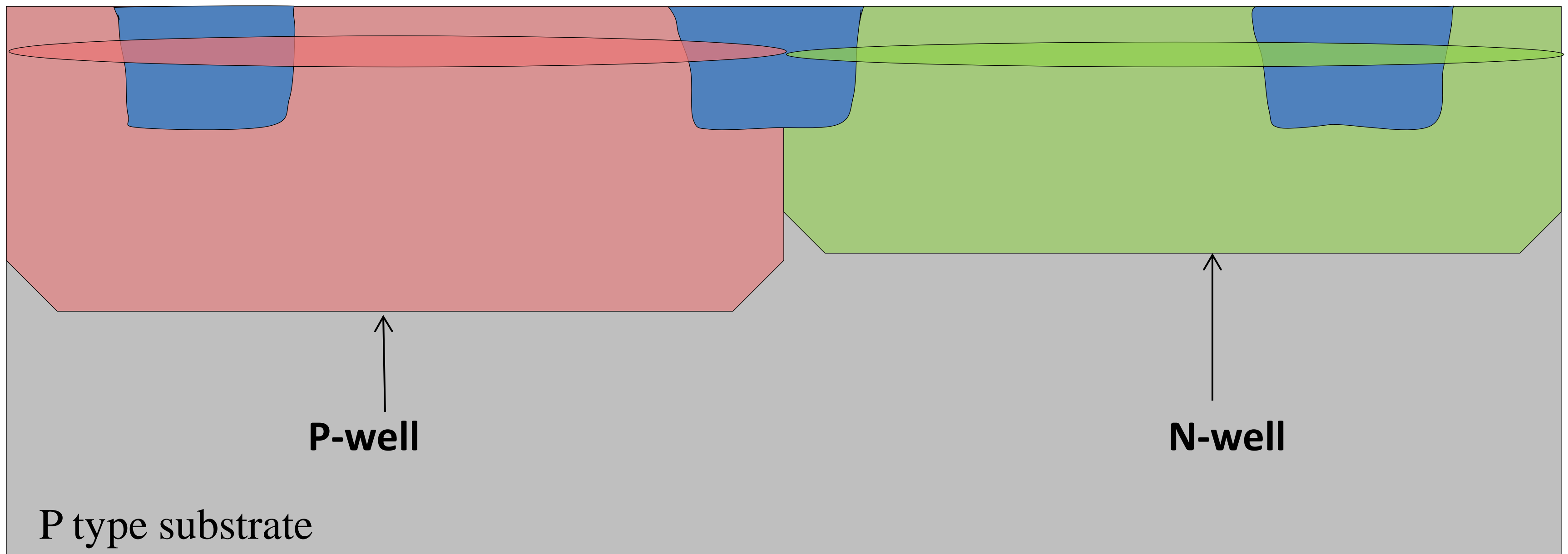


23 – Resist Strip

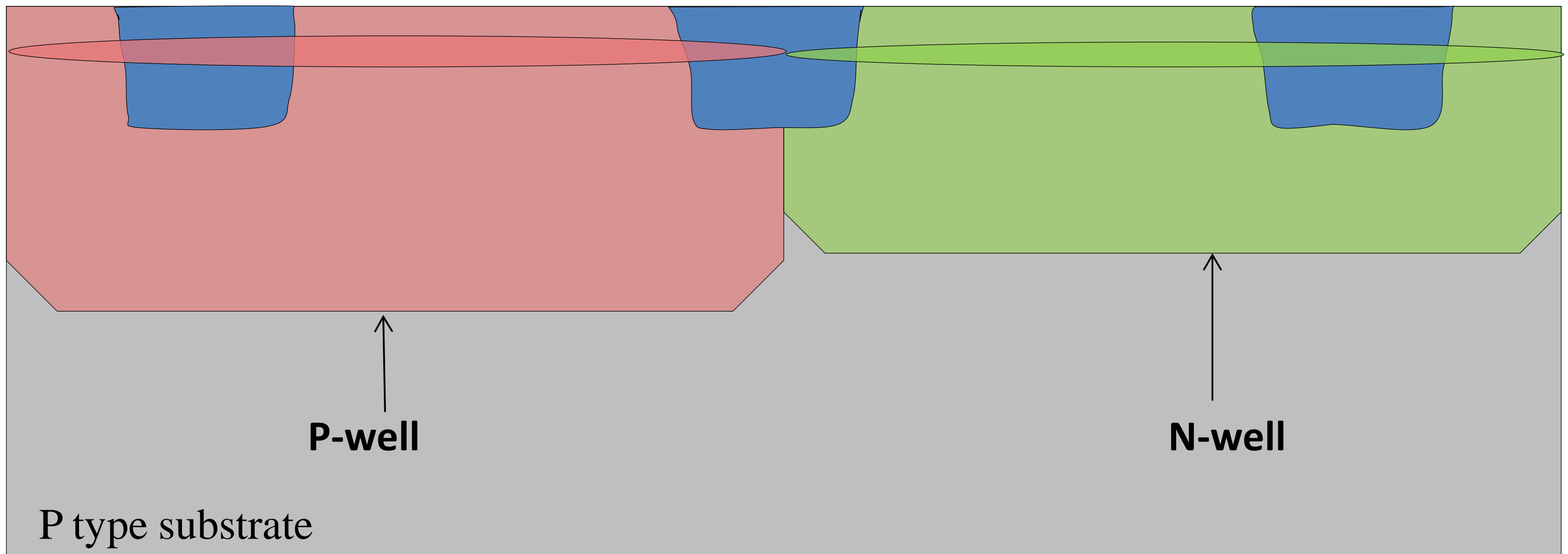


24 – Pad Oxide Etch

10:1 Buffered HF BOE, Etch for 1 min
(Etch rate: 586 Å/min)
Rinse in DI water, SRD
Metrology: NanoSpec (Active Area)

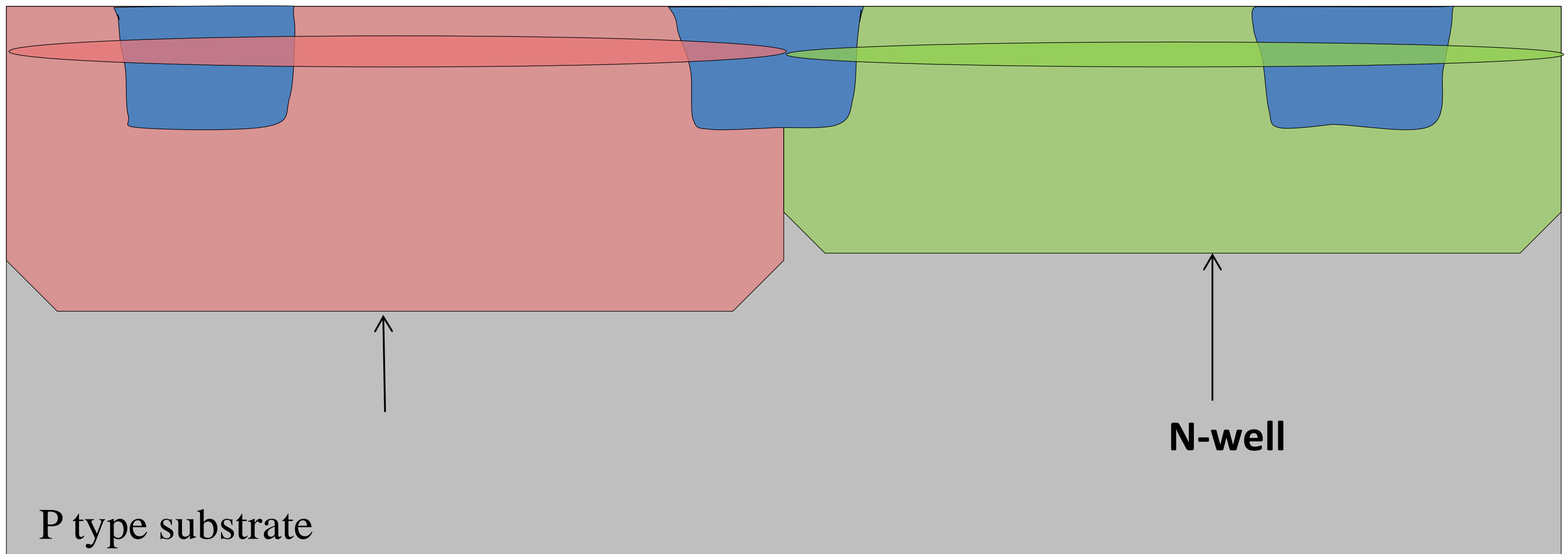


25 - RCA Clean



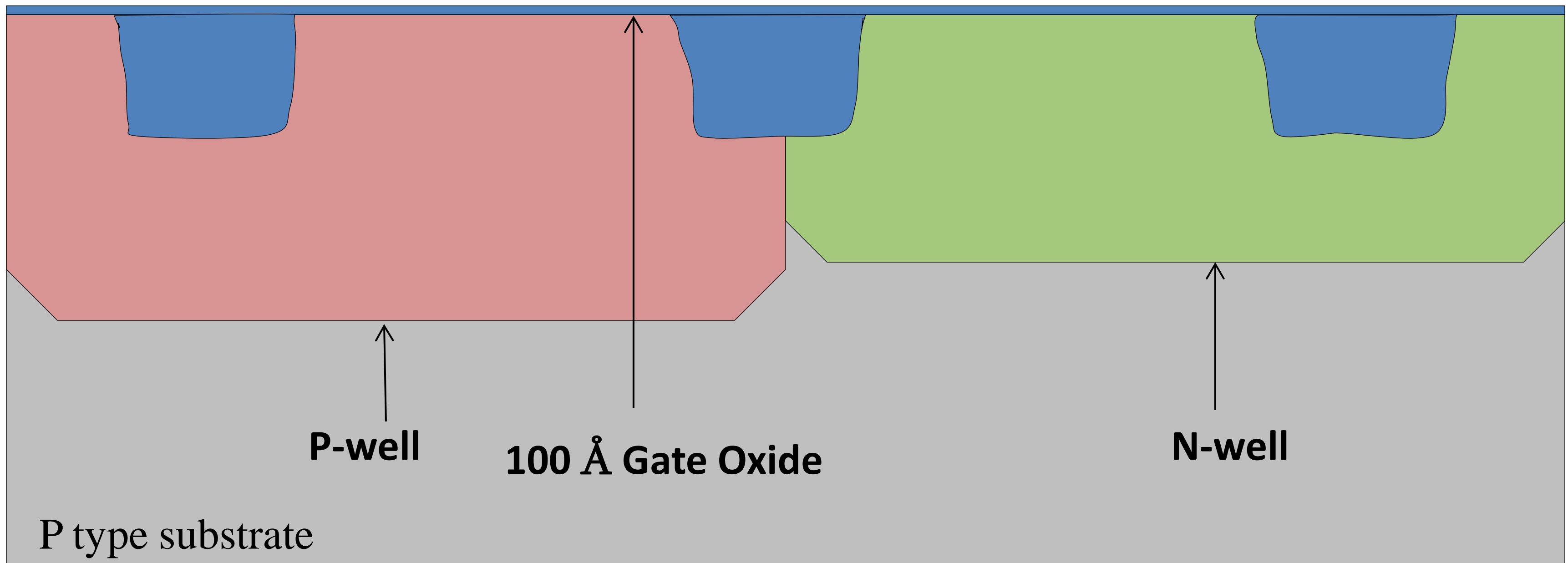
26 – Native Oxide Etch

50:1 HF, Etch for 1 min
Rinse in DI water, SRD
Metrology: NanoSpec (Active Area)



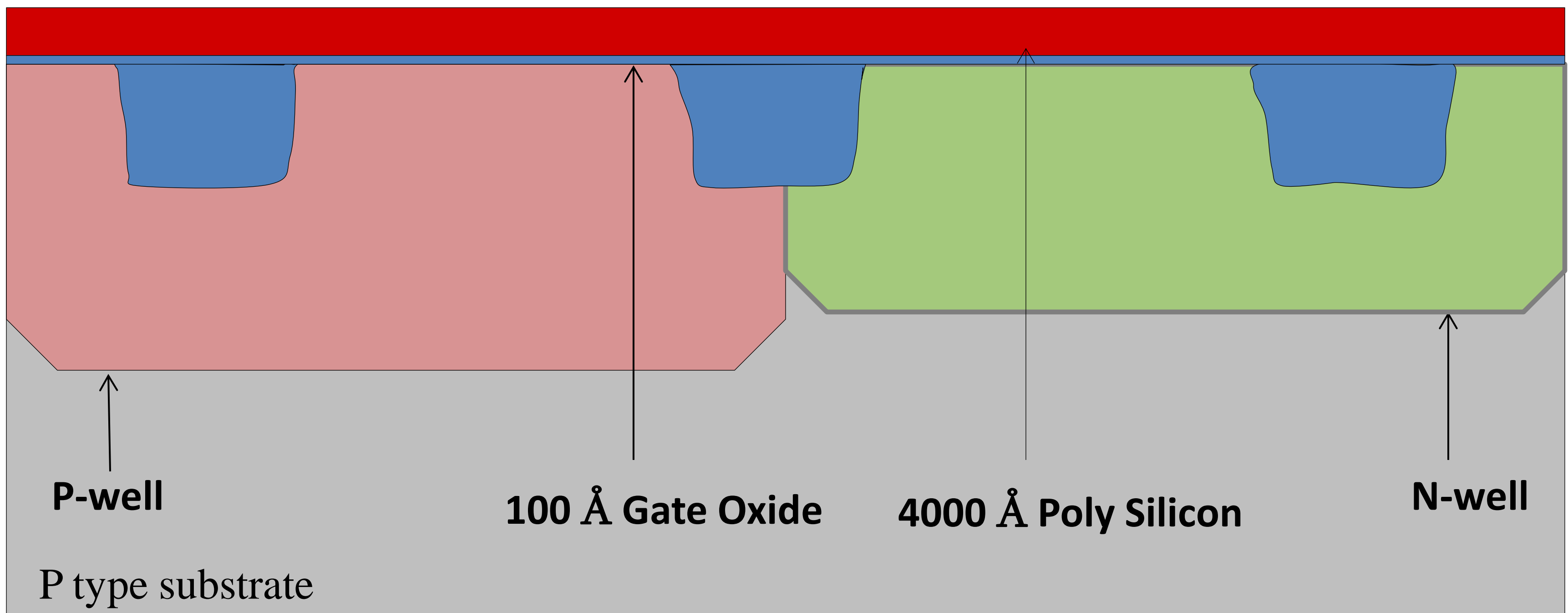
27 – Gate Oxide

Bruce Tube 04
Recipe #463 SMFL TransLC Clean (~1hr)
Recipe#213 Dry O2
Desired oxide thickness: 50 Å (with N_2O),
Initial warm up furnace to 800 ˚C, R/U: 20 minutes from 800 to 900 ˚C,
Soak time: 40 min in dry O_2 at 900 ˚C, R/D: 40 min
Metrology: NanoSpec: Oxide on Silicon (Active Area)



28 – CVD Poly

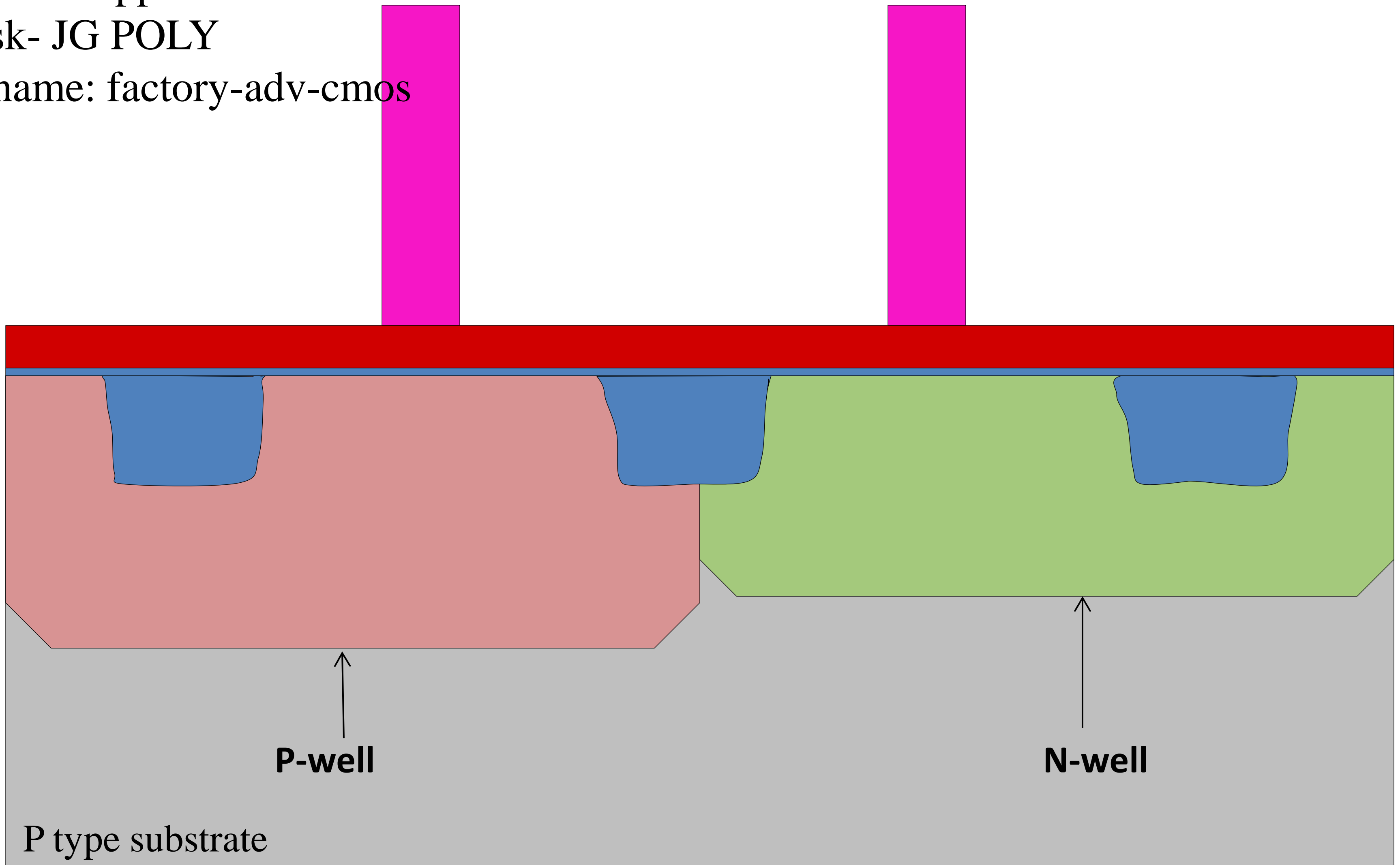
LPCVD Polysilicon Deposition, Recipe #Poly 610
Temp: 610 °C. Dep time ~ 42 min, Base Pressure 300mTorr
SiH4 Flow: 100sccm
Metrology: SpectraMap- Polysilicon on Oxide



29 – Photo Poly (Level -6)

SSI Track: Recipe-COAT.rcp
DEVELOP.rcp
ASML Stepper:
Mask- JG POLY
Jobname: factory-adv-cmos

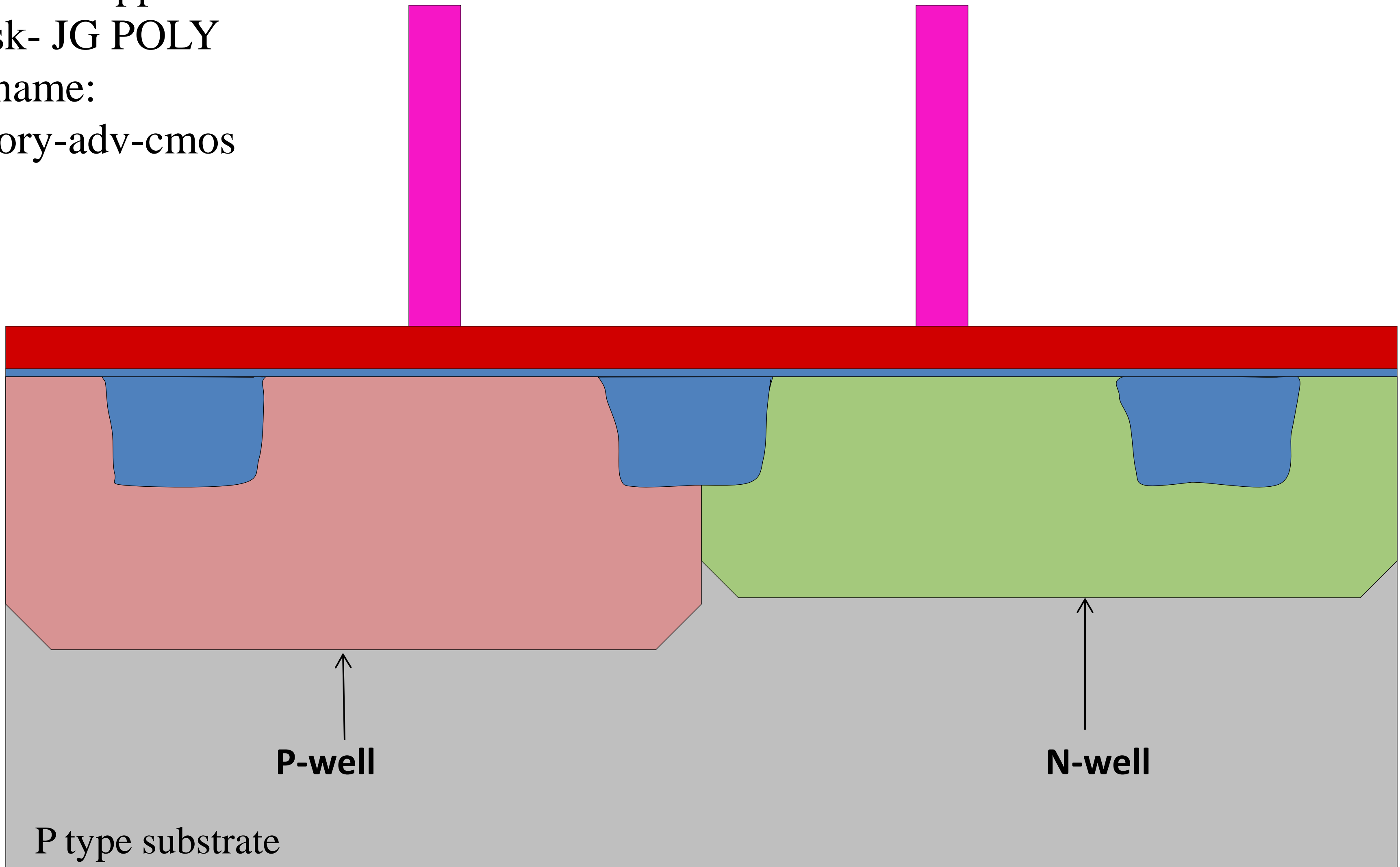
Expose first – shift Mask – Expose again



29 – Photo Poly (Double Exposure)

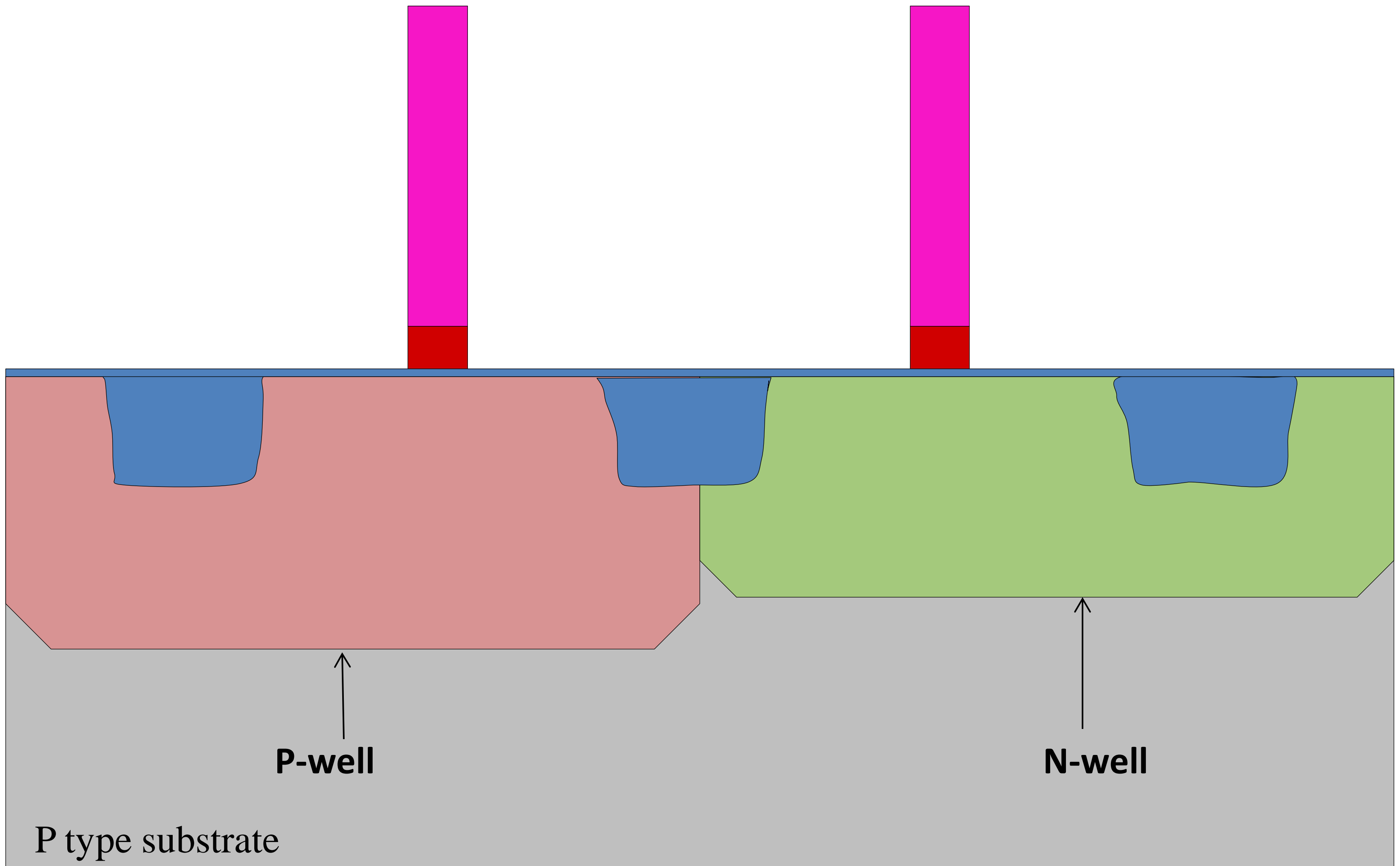
SSI Track: Recipe-COAT.rcp
DEVELOP.rcp
ASML Stepper:
Mask- JG POLY
Jobname:
factory-adv-cmos

Expose first – shift Mask – Expose again



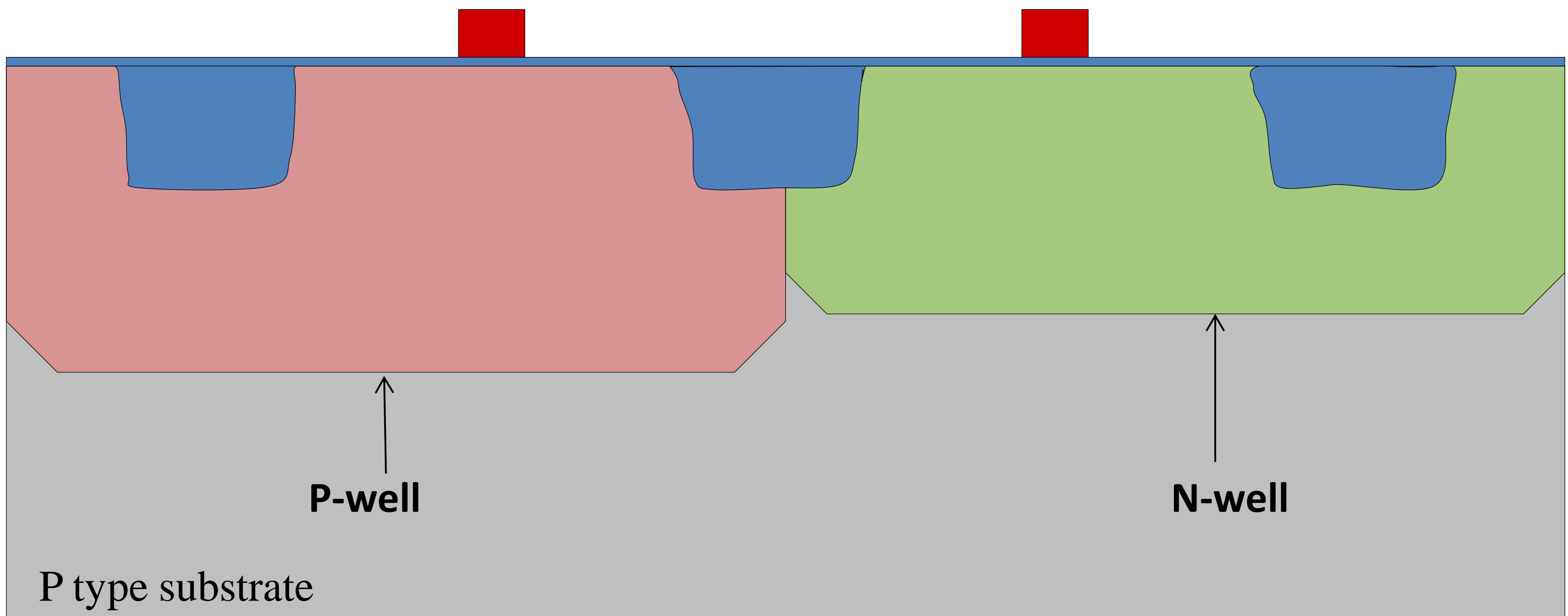
30 – Poly Etch

RIE using Drytek Quad Recipe #FACPOLY (Etch rate: 1150 Å/min)
Metrology: SEM

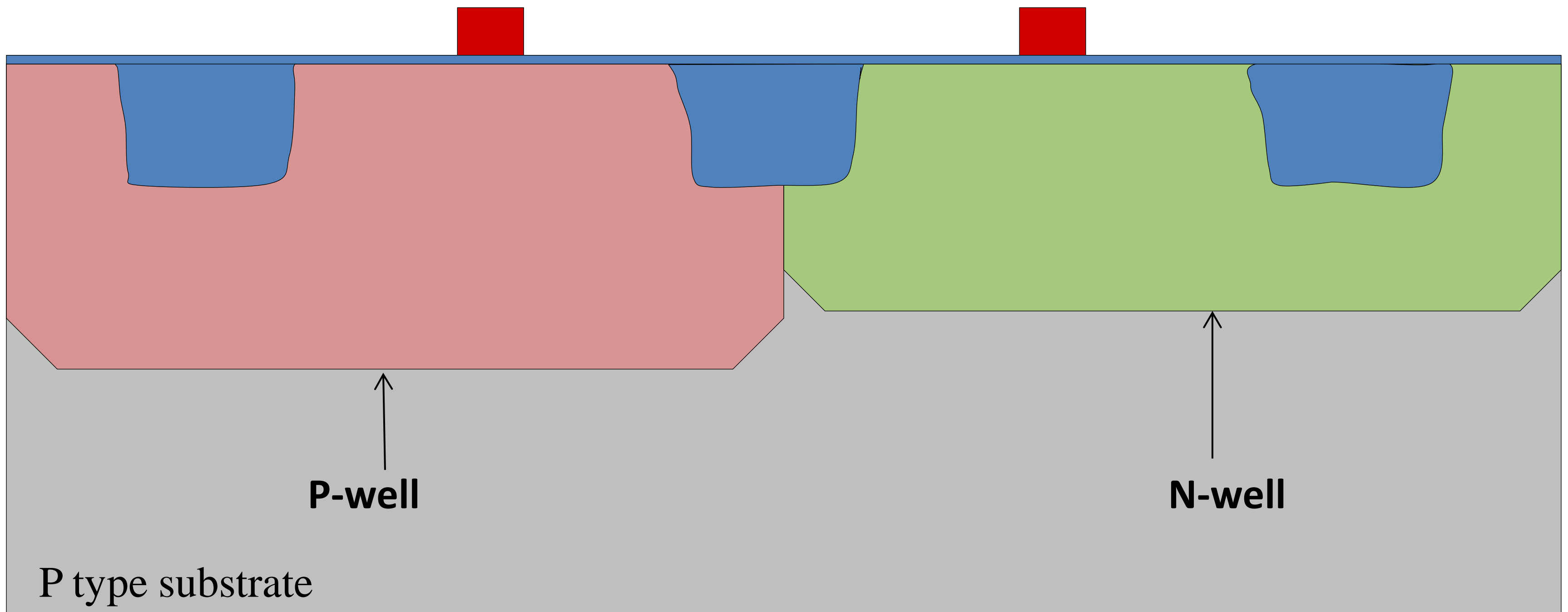


31 – Photoresist Strip

GaSonics Asher: Recipe #FF (O_2 Plasma)
Metrology: Visual/ Inspection Microscope

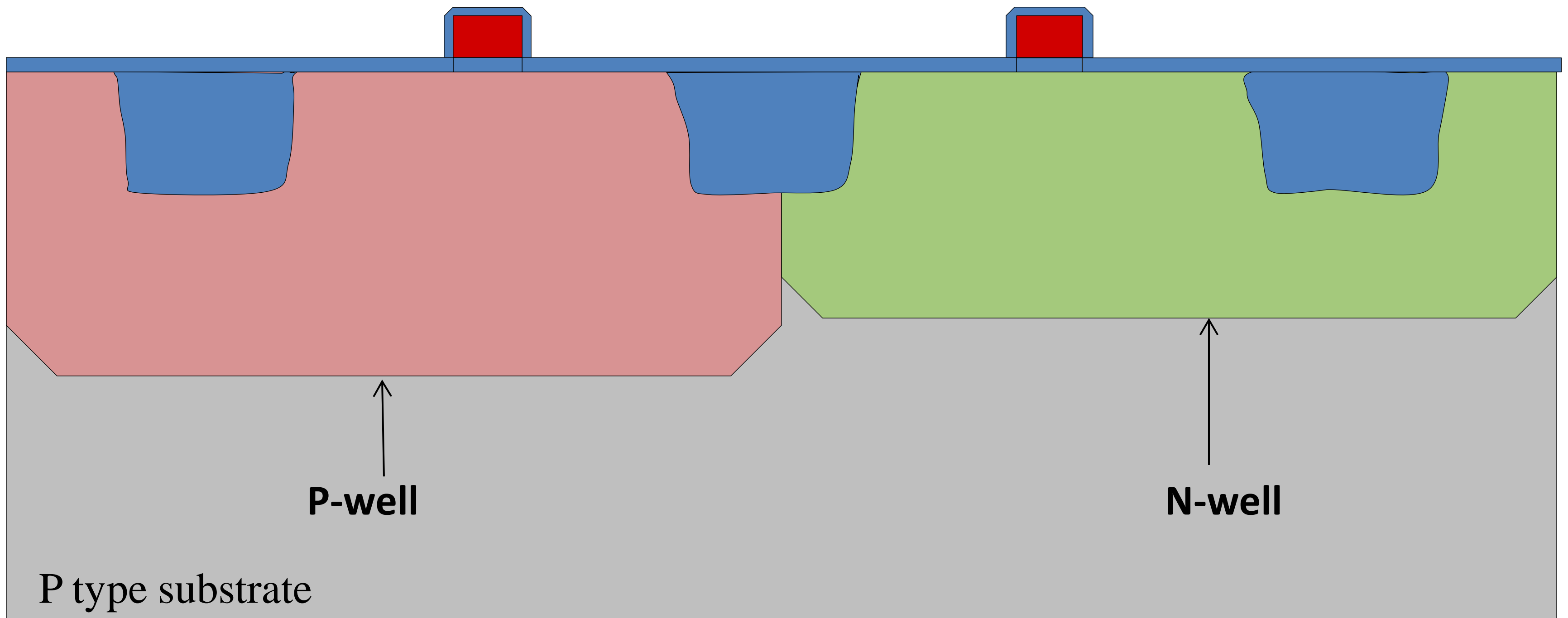


32 – RCA Clean



33 – Poly ReOx

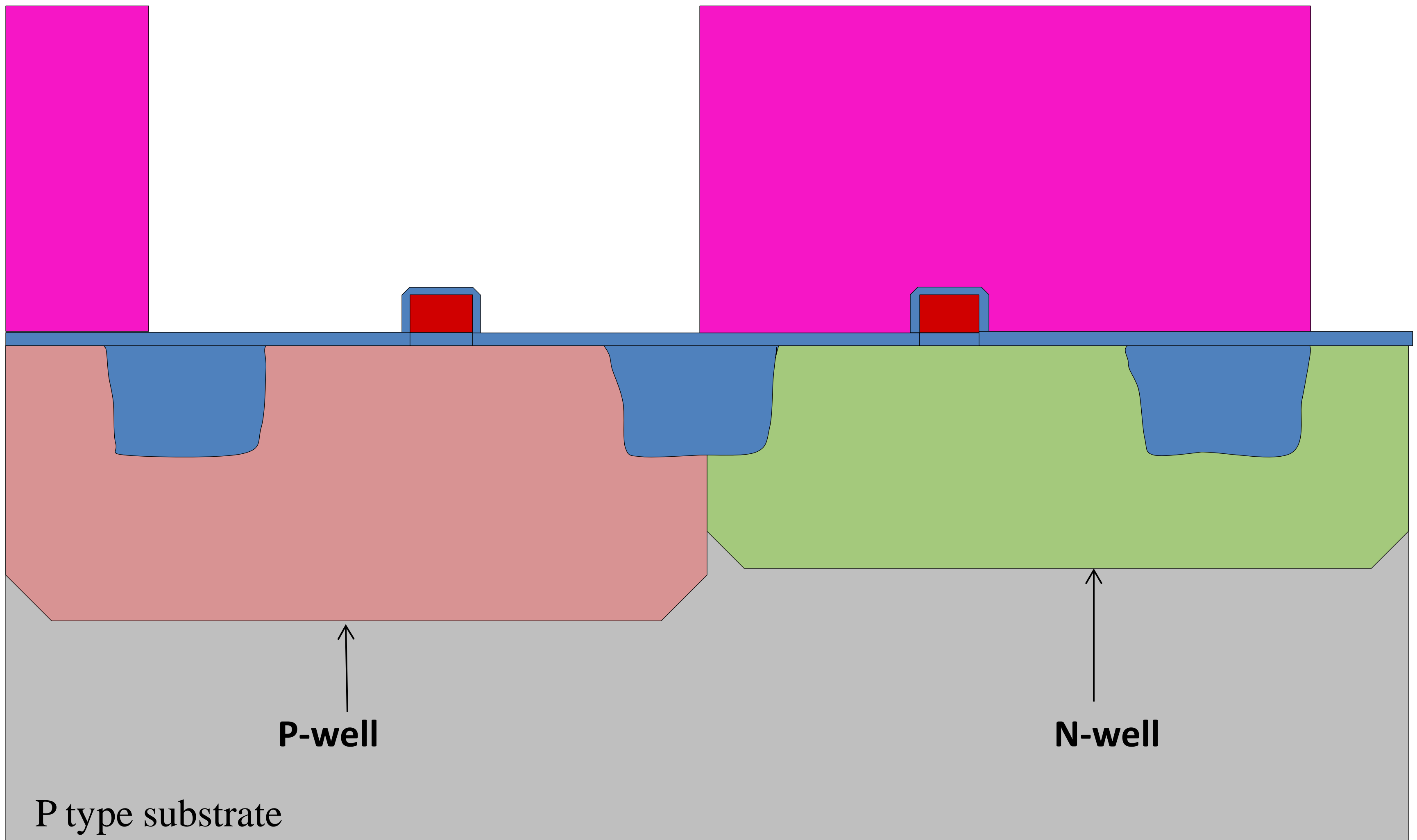
Bruce TUBE 04 (~250 Ǻ)



34 – NLDD Photo (Level – 7)

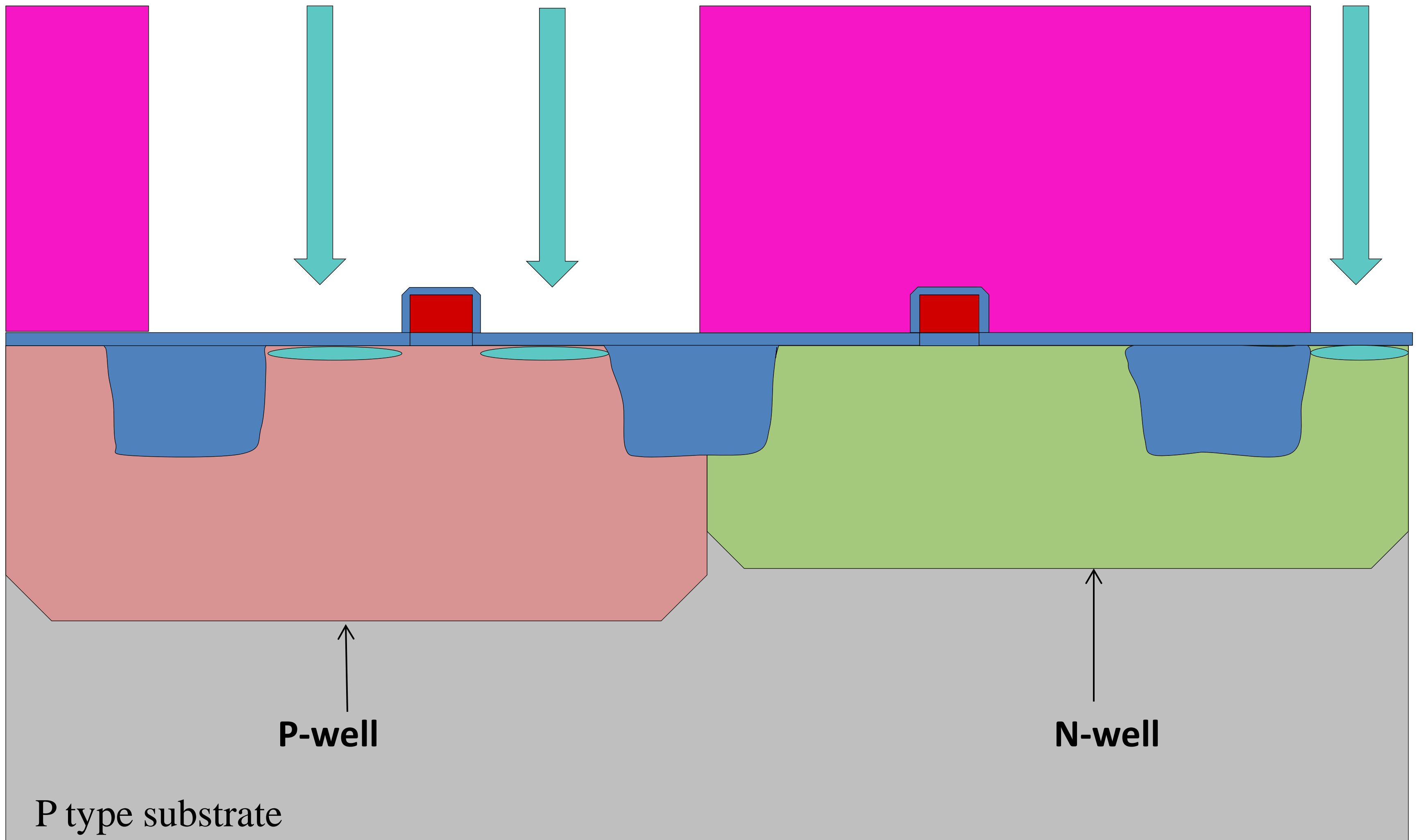
SSI Track: Recipe-COAT.rcp DEVELOP.rcp

ASML Stepper: Mask- ADV NLDD Jobname: factory-adv-cmos



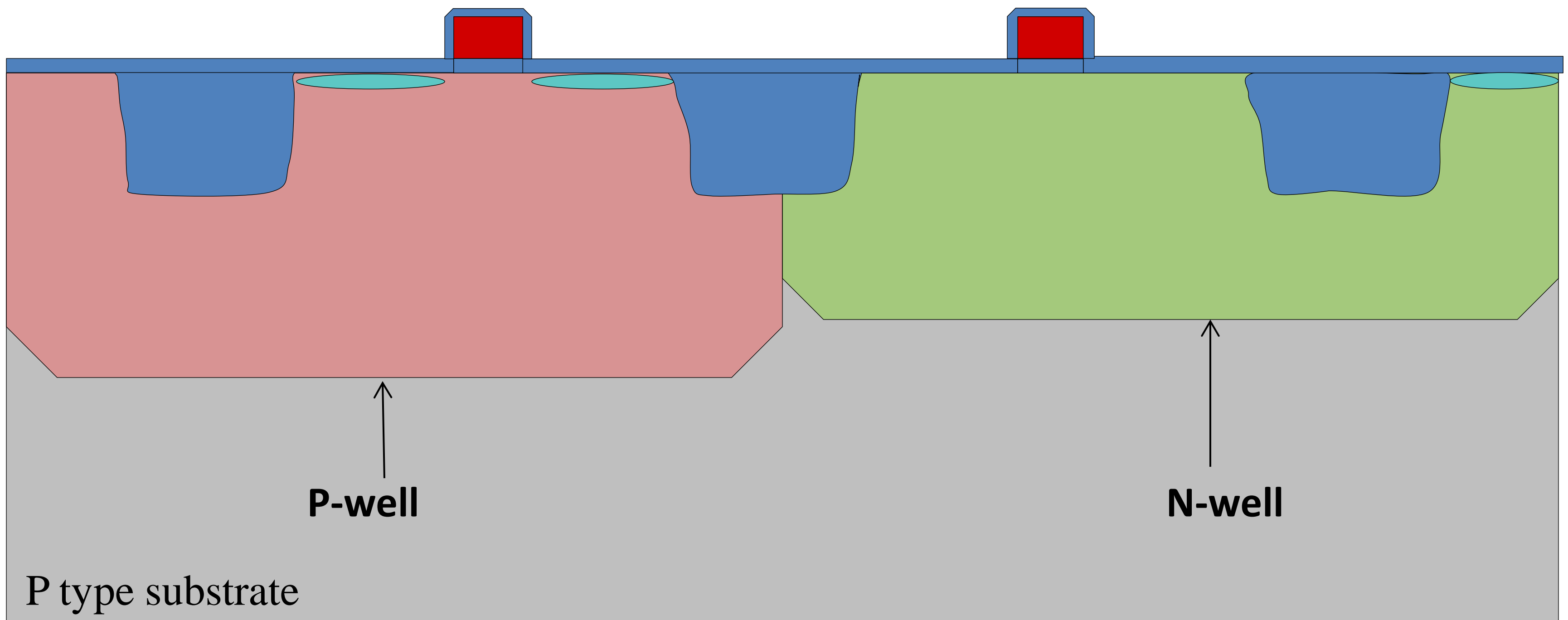
35 – NLDD Implant

5e15 cm^{-2}, 20 keV, Arsenic



36 – Resist Strip

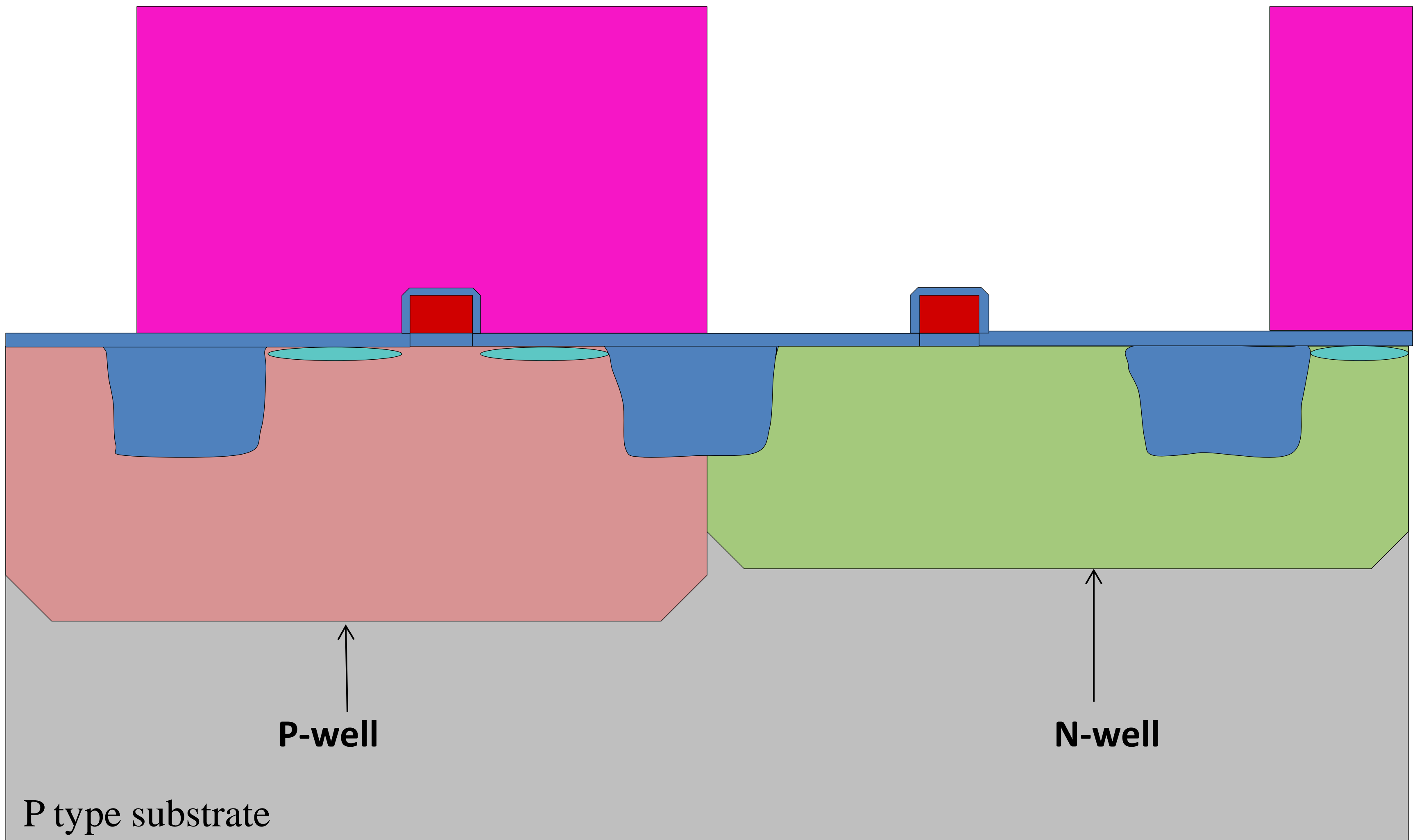
GaSonics Asher: Recipe #FF (O_2 Plasma)
Metrology: Visual/ Inspection Microscope



37 – PLDD Photo (level -8)

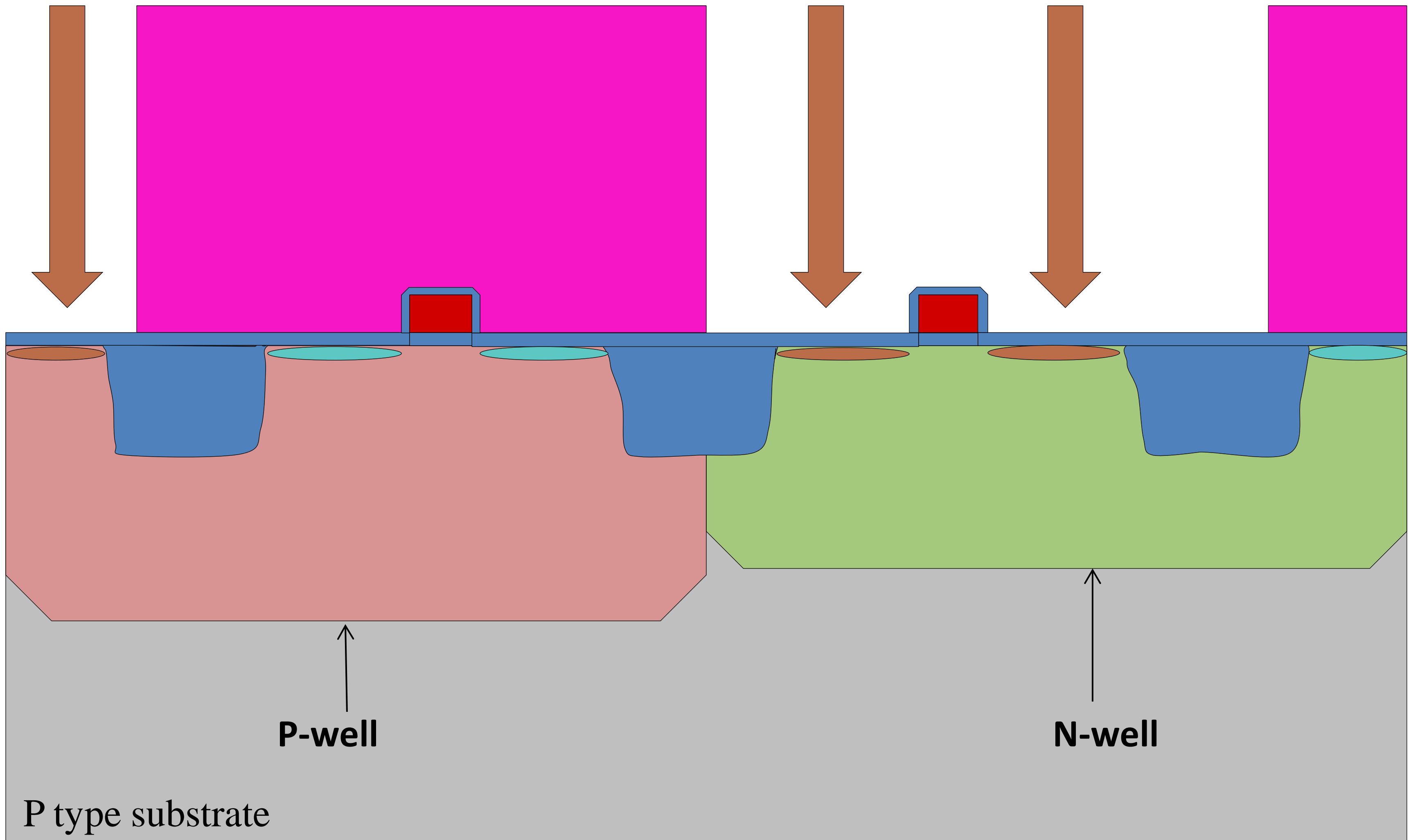
SSI Track: Recipe-COAT.rcp DEVELOP.rcp

ASML Stepper: Mask- JG PLDD   Jobname: factory-adv-cmos



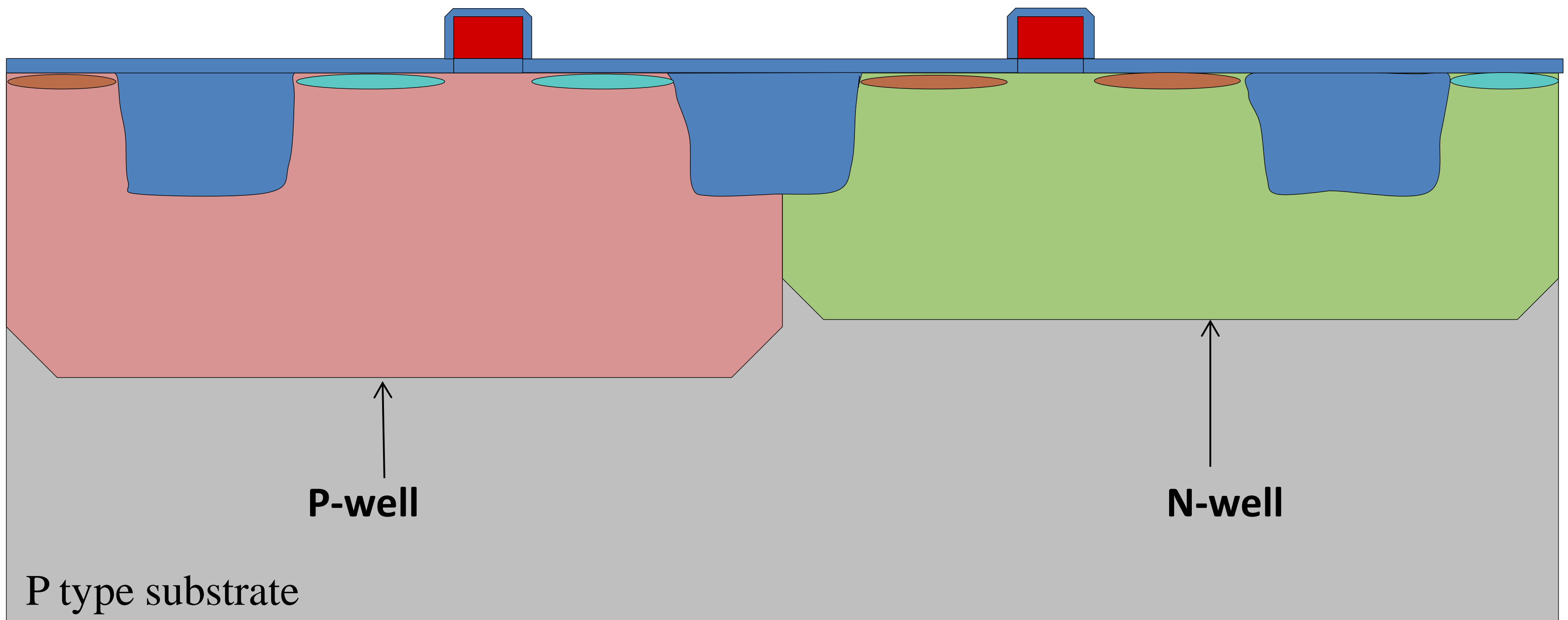
38 – PLDD Implant

9e14 cm^{-2}, 20 KeV, BF2

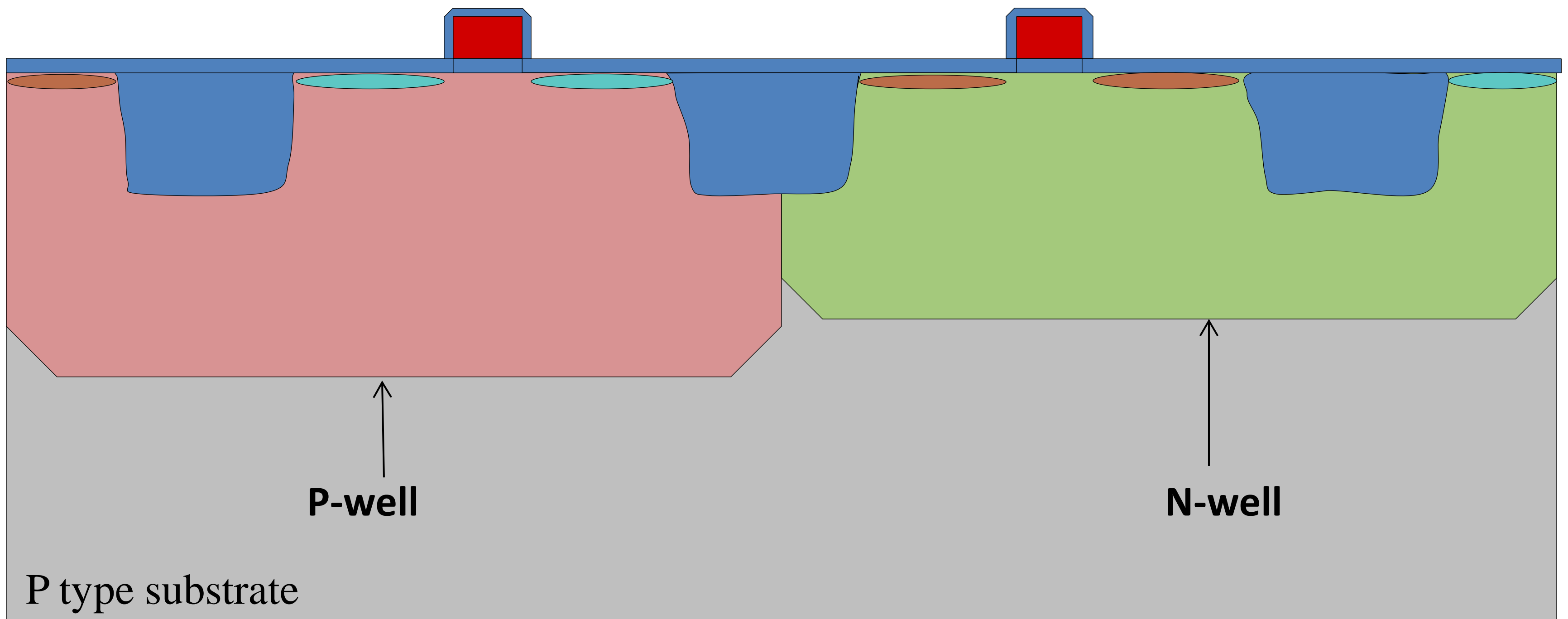


39 – Resist Strip

GaSonics Asher: Recipe #FF (O_2 Plasma)
Metrology: Visual/ Inspection Microscope

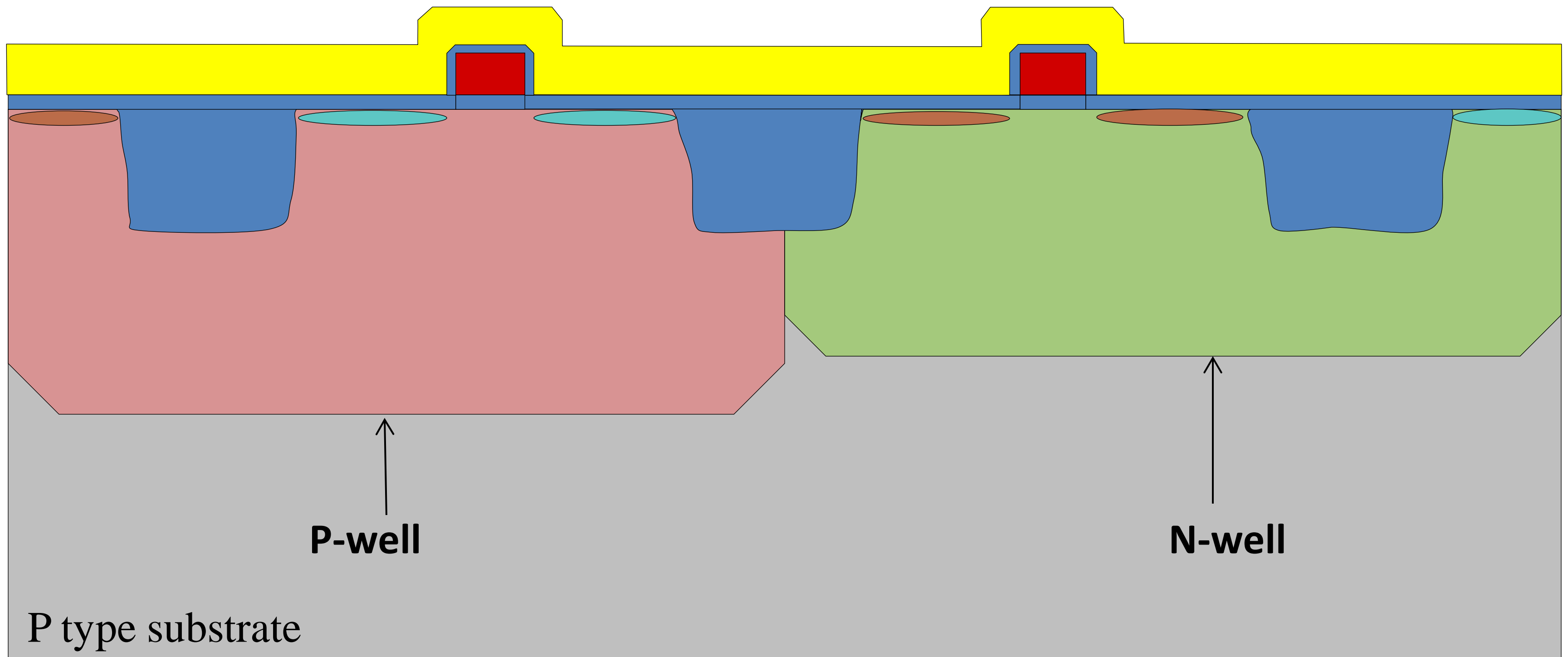


40 – RCA Clean



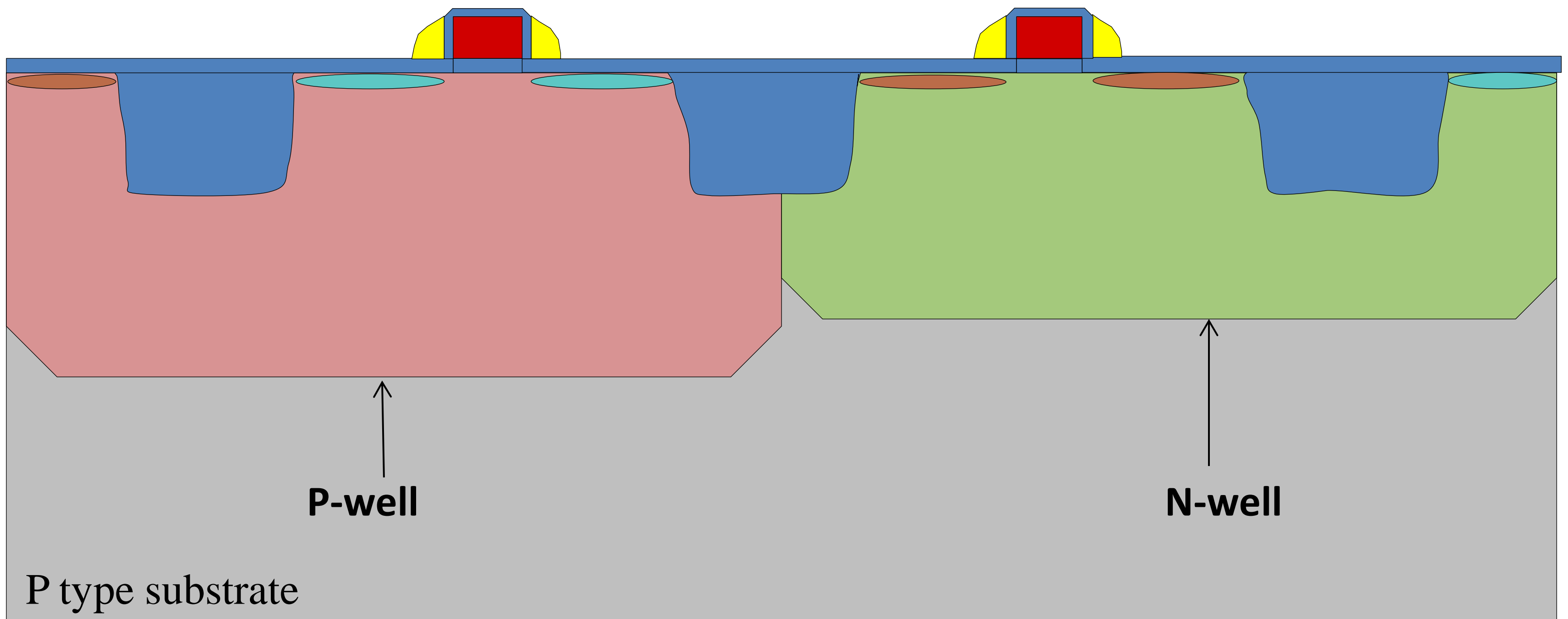
41 – CVD Nitride

LPCVD Nitride (Lower Tube) (~ 1500 Å)
Metrology: Nanospec (Nitride on Oxide)



42 – Etch Nitride

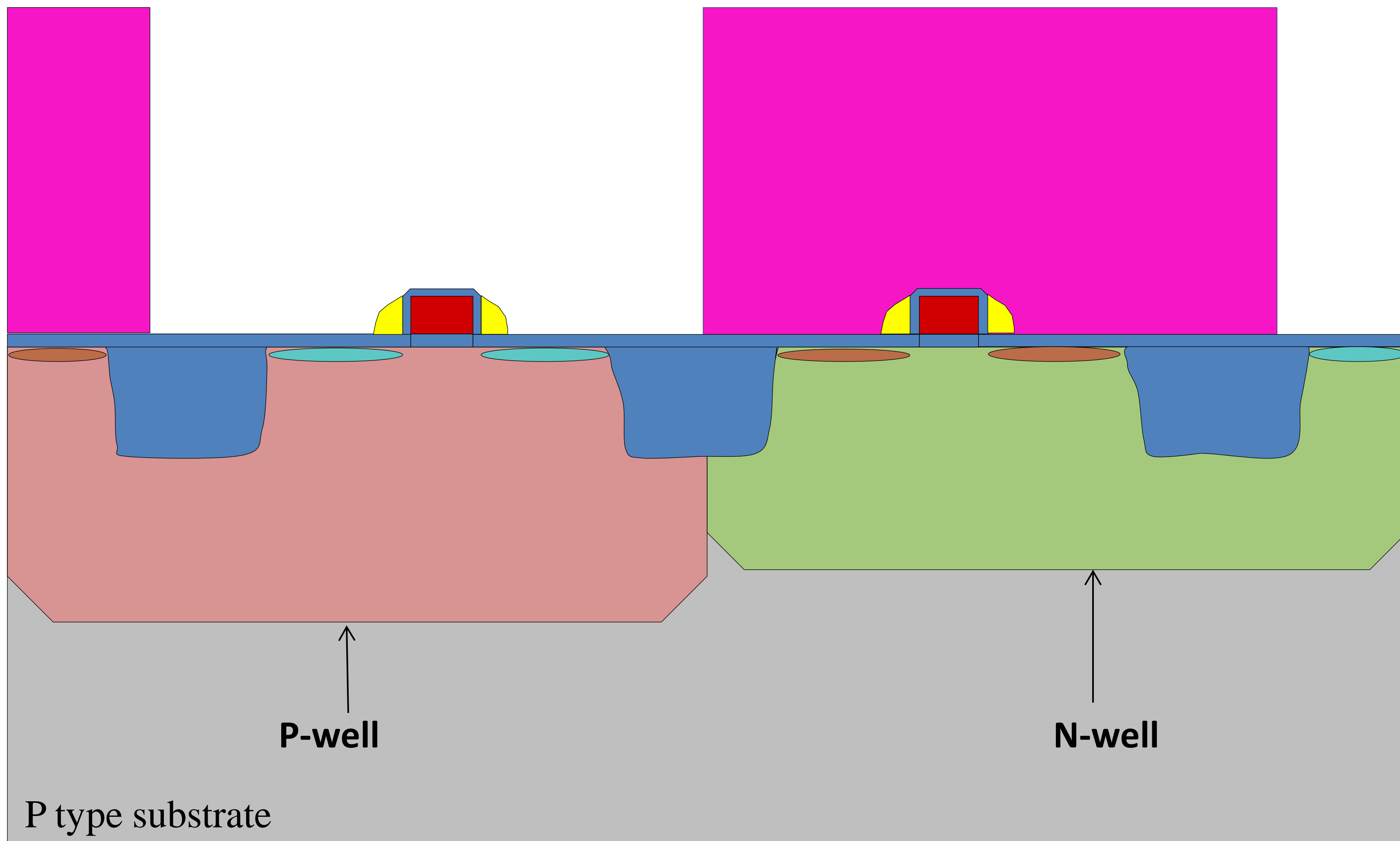
RIE on Drytek Quad Recipe #FACADVSP
Metrology: SEM



43 – Photo N+ DS (Level -9)

SSI Track: Recipe-COAT.rcp DEVELOP.rcp

ASML Stepper: Mask- ADV N+DS Jobname: factory-adv-cmos



44 – Implant N+ DS

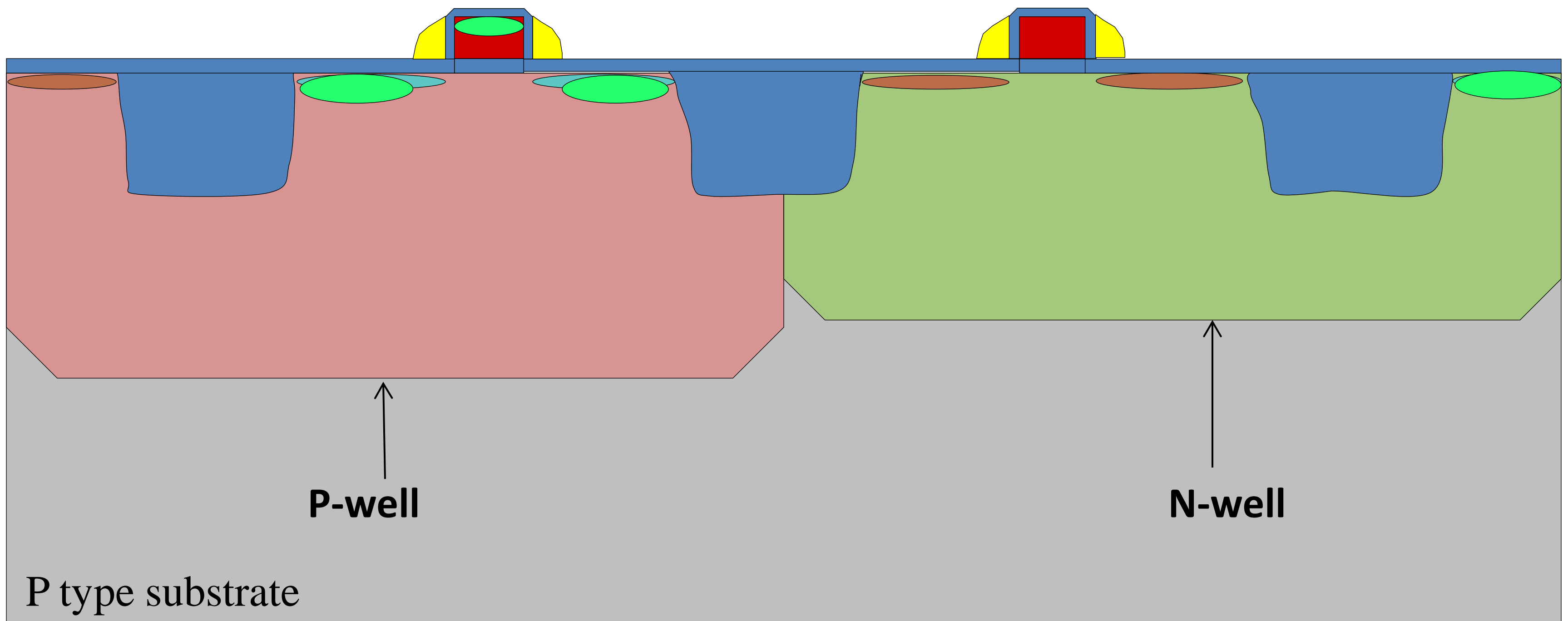
1e15 cm^{-2}, 25 keV, P31

N-well

P type substrate

45 – Photoresist Strip

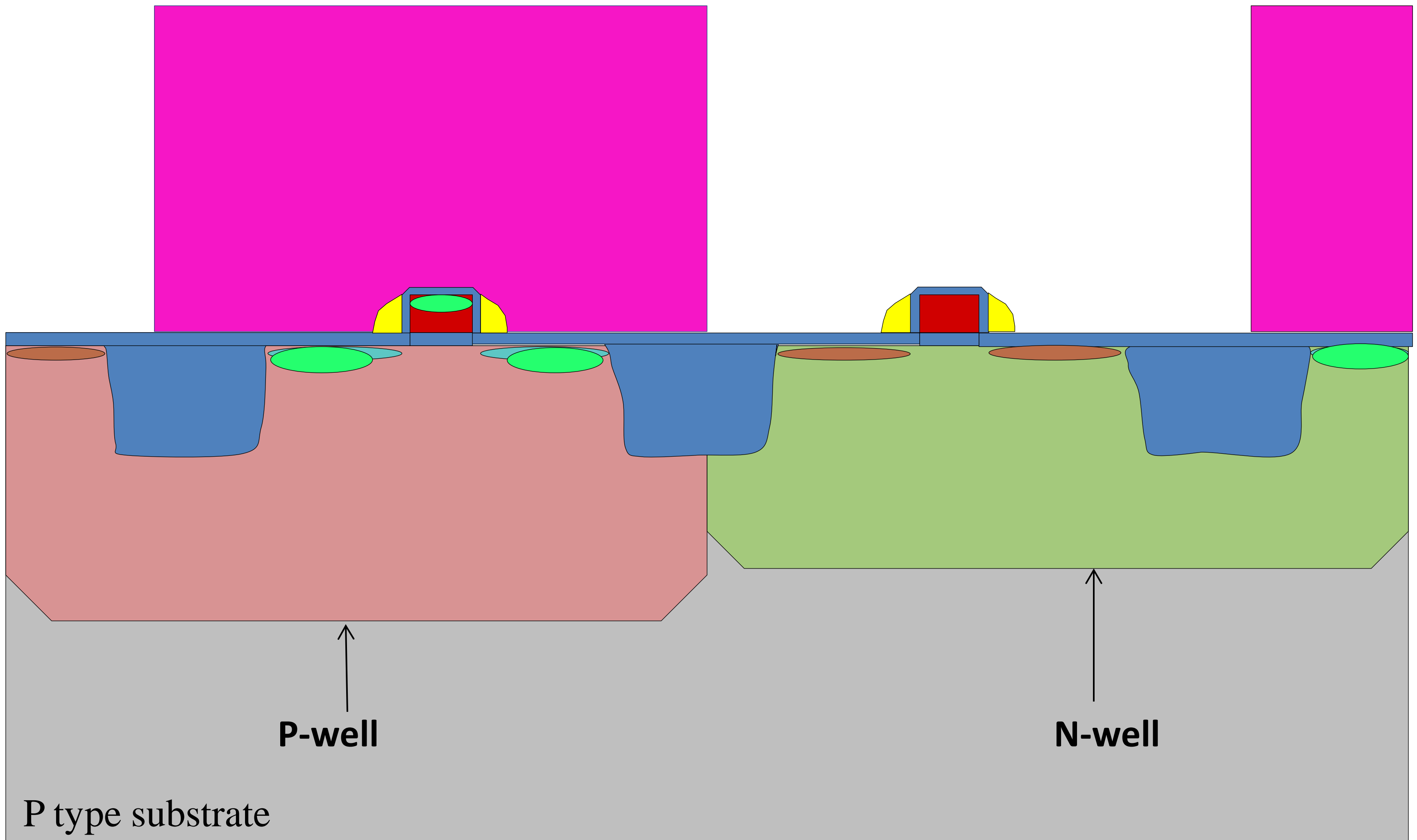
GaSonics Asher: Recipe #FF (O_2 Plasma)
Metrology: Visual/ Inspection Microscope



46 – Photo P+ DS (Level – 10)

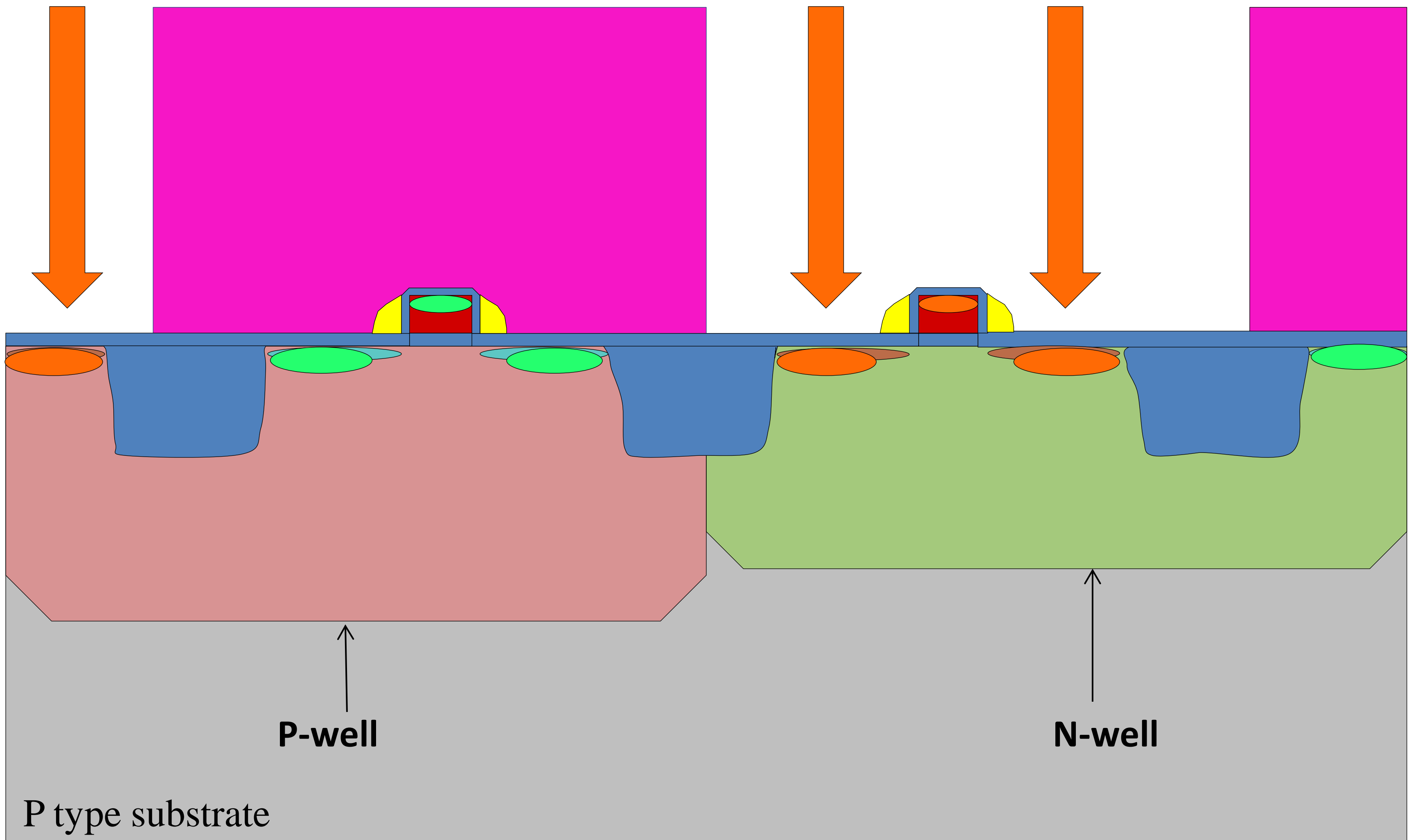
SSI Track: Recipe-COAT.rcp DEVELOP.rcp

ASML Stepper: Mask- JG P+DS   Jobname: factory-adv-cmos



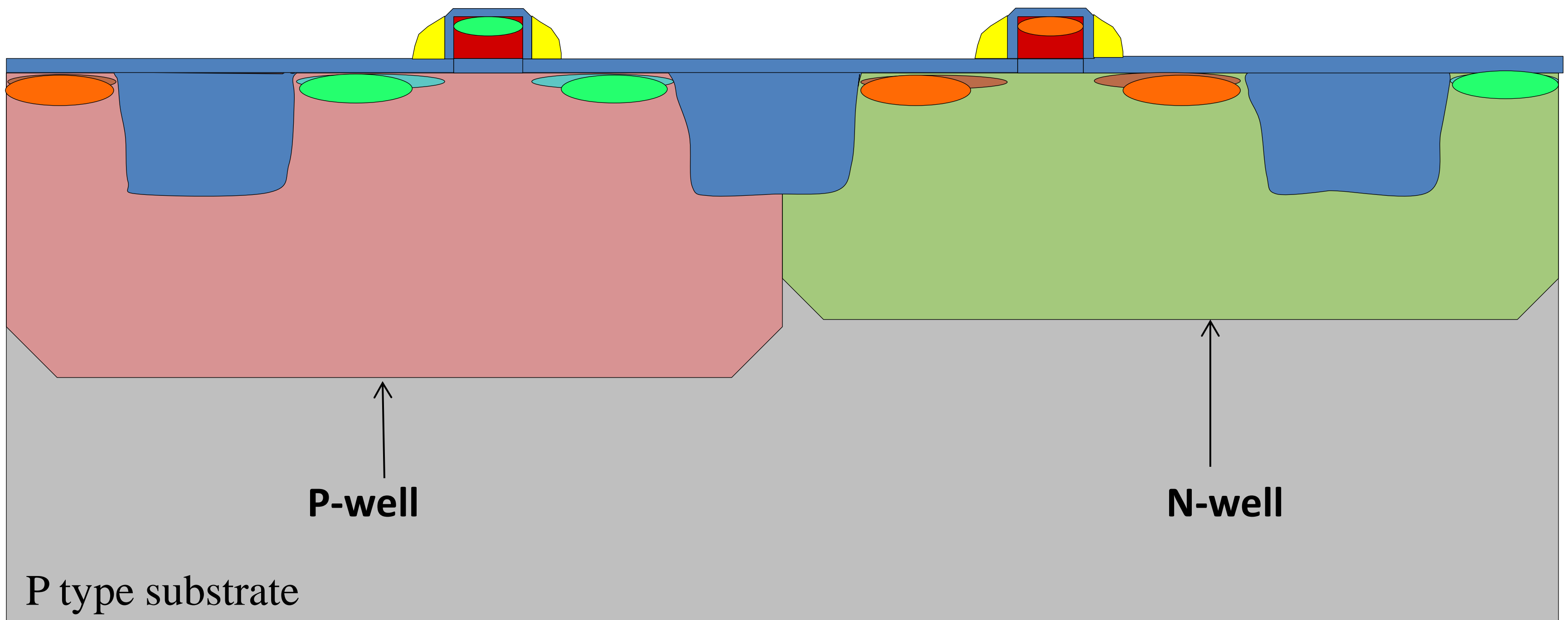
47 – Implant P+ DS

5e15 cm^{-2}, 27 keV, BF2

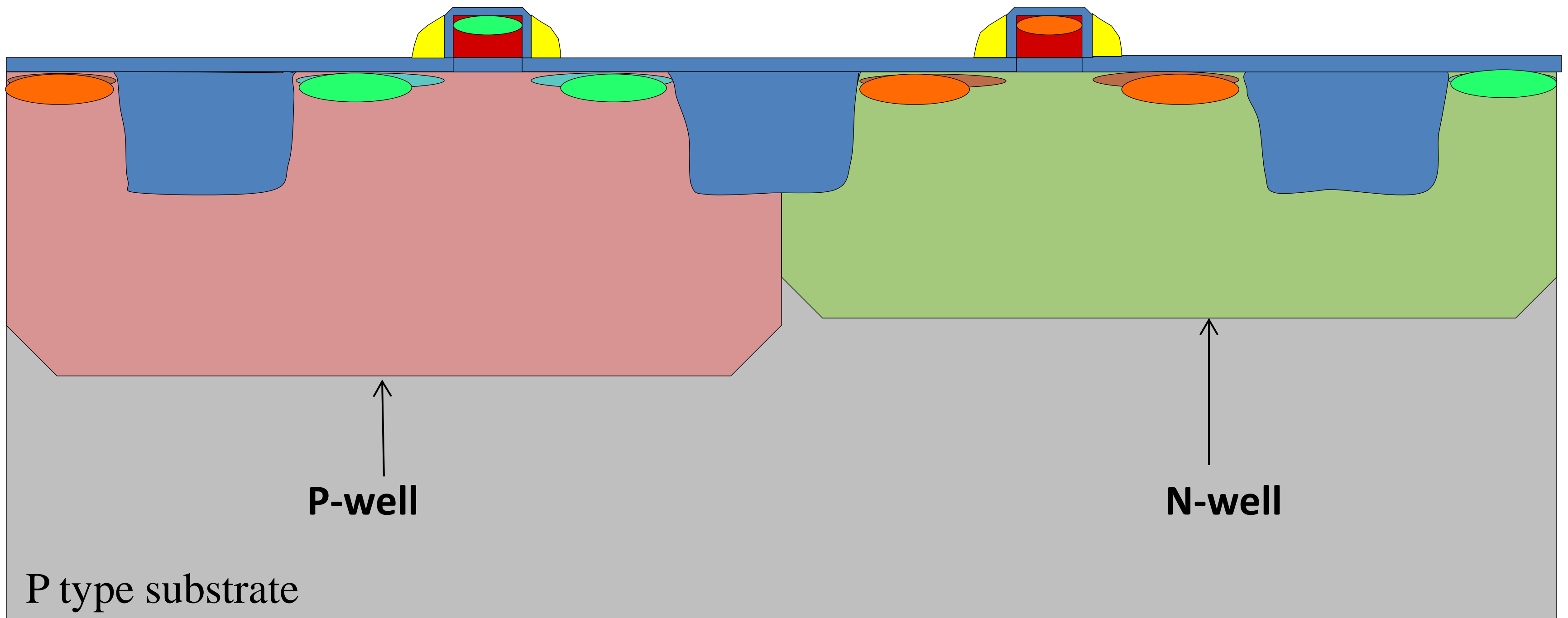


48 – Photoresist Strip

GaSonics Asher: Recipe #FF (O_2 Plasma)
Metrology: Visual/ Inspection Microscope

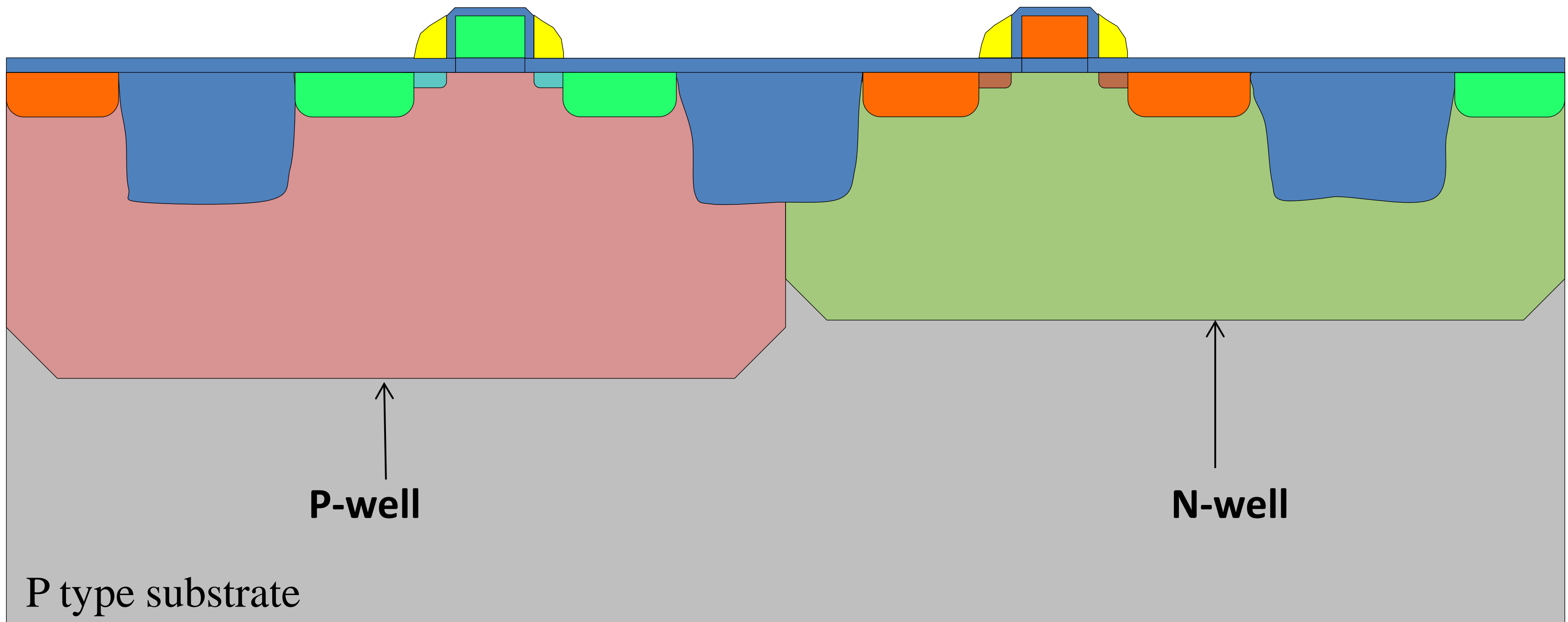


49 – RCA Clean



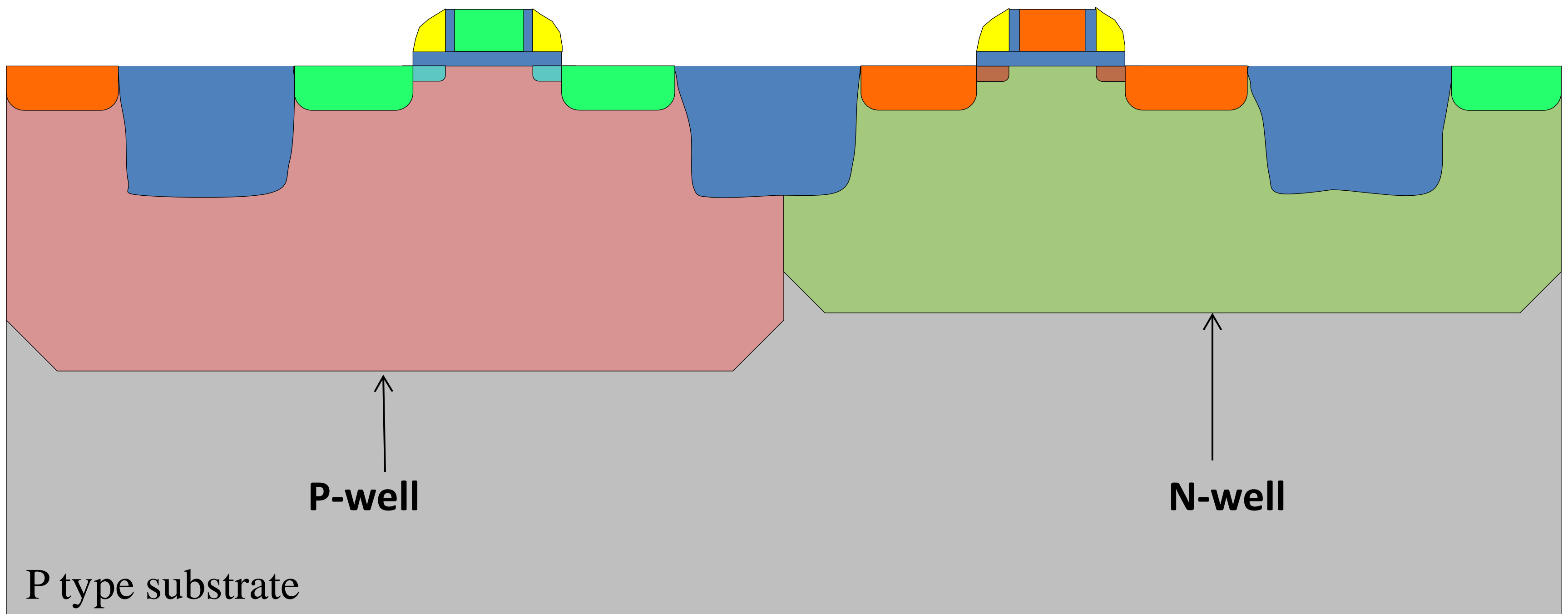
50 – SD Anneal (RTP)

Rapid Thermal Anneal: R/U: 700 - 1050 C in 3 sec,
Soak: 1050 C for 5 sec (N2 Ambient),
R/D: 1050 - 700 C in 6 sec
Metrology: SIMS Analysis



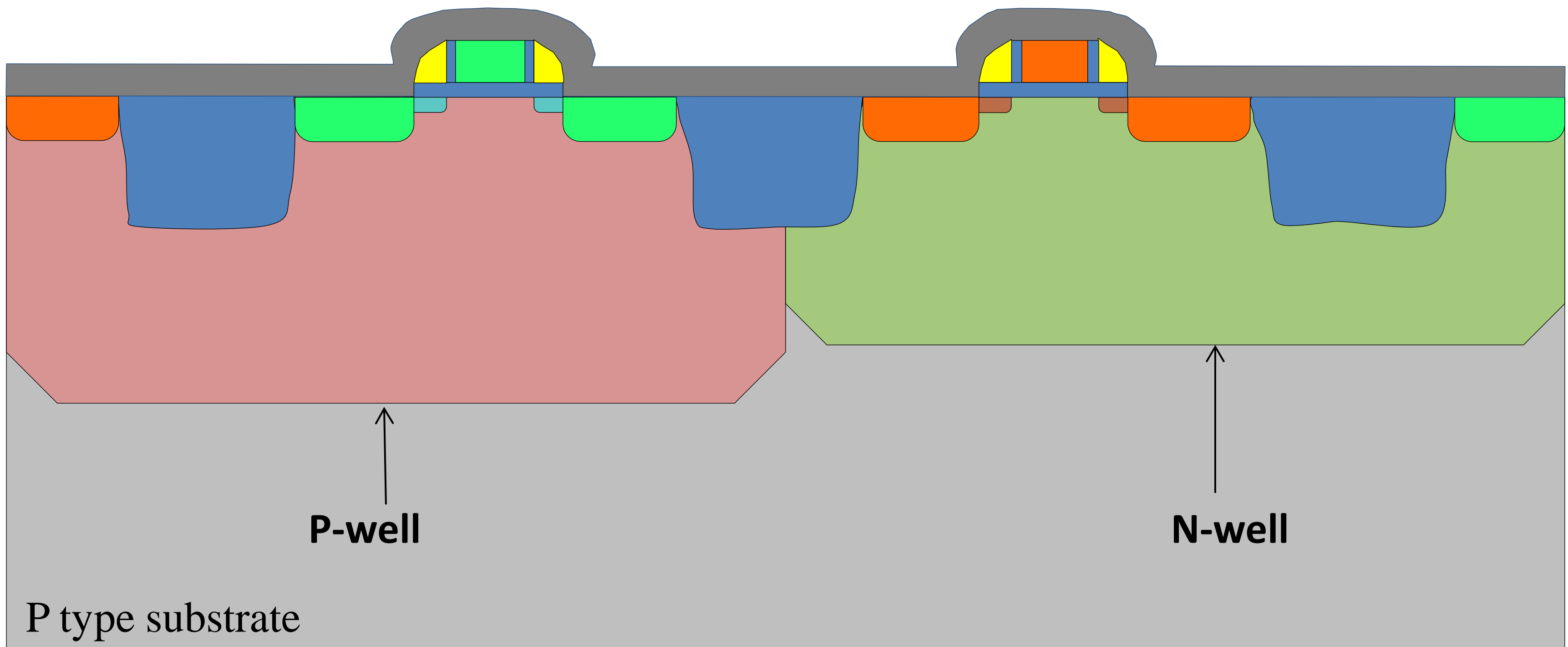
51 – Oxide Etch

10:1 Buffered HF BOE, Etch for 1 min
(Etch rate: 586 Å/min)
Rinse in DI water, SRD
Metrology: NanoSpec (Active Area)



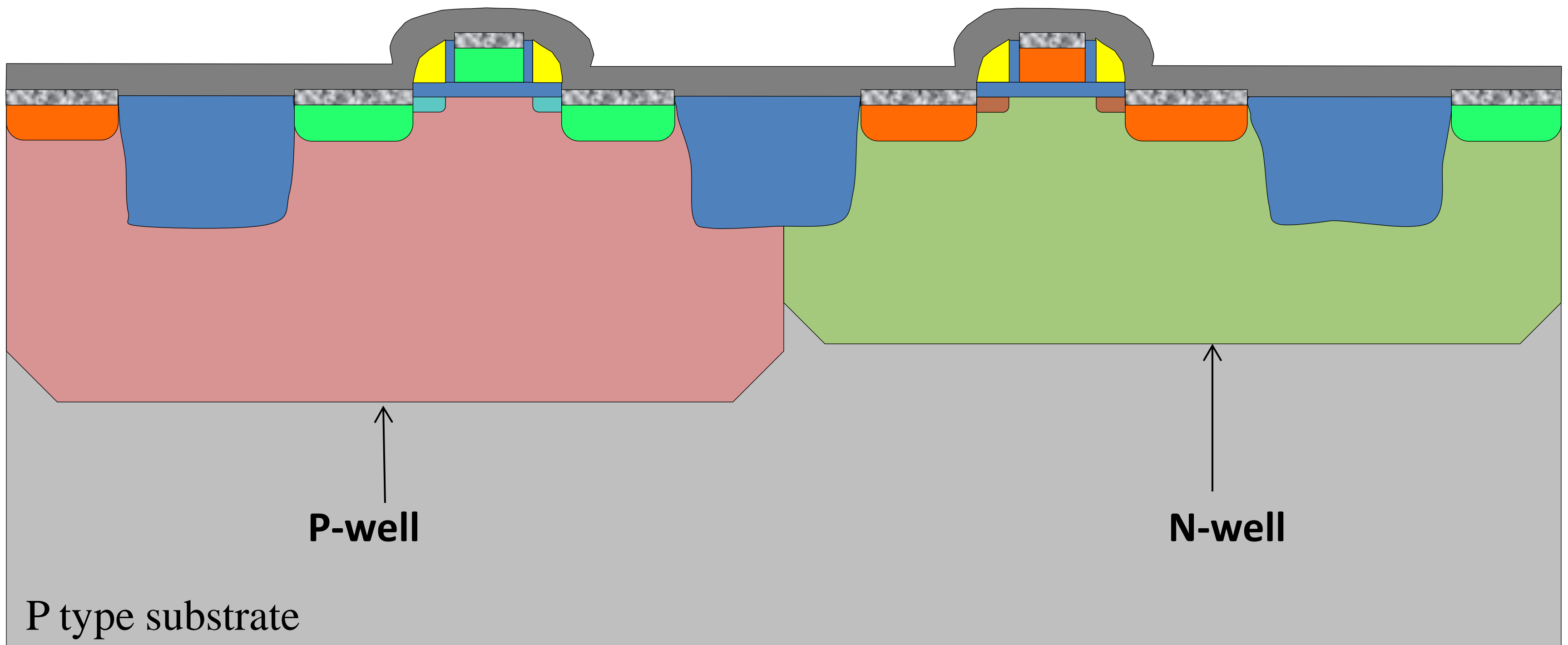
52 – Ti Deposition

CVC 601 Sputter: 4” target 350 Watt for 300 sec
(Dep. rate: 100 Å/min)
Metrology: Profilometer (Use tape and measure step height)



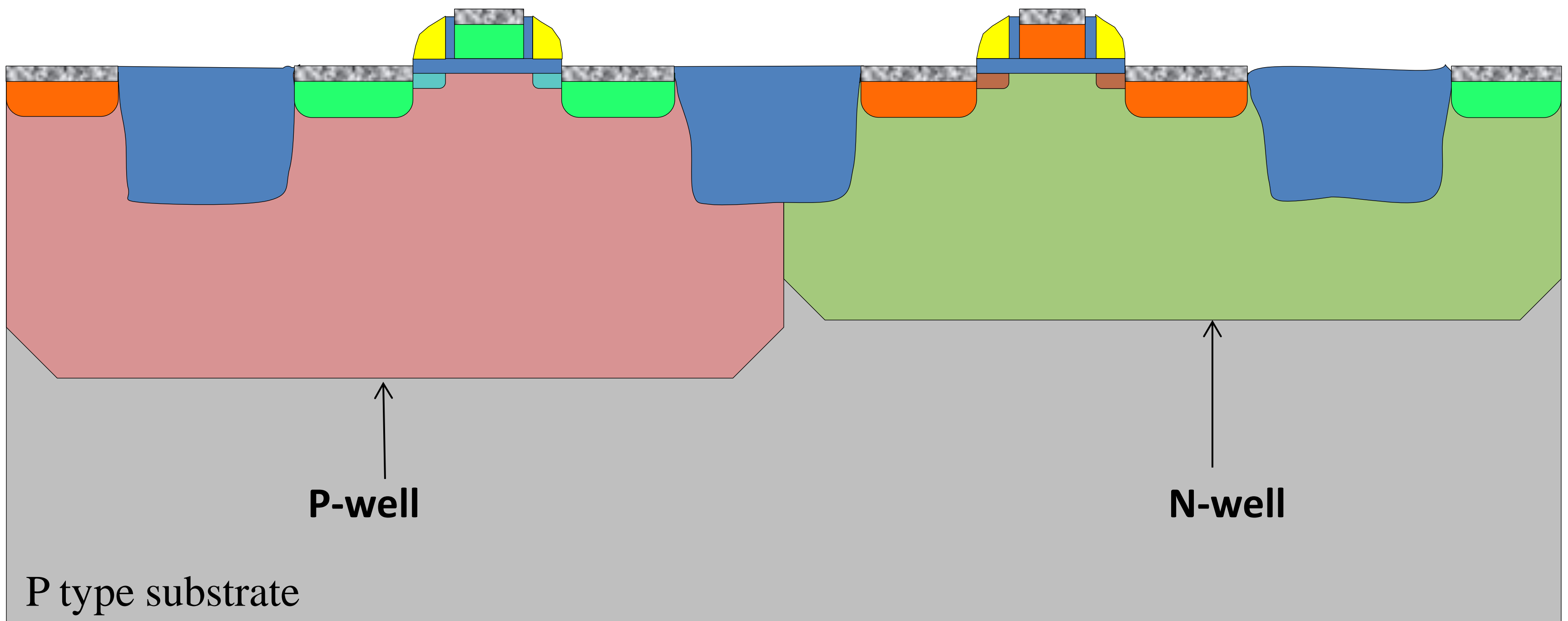
53 – RTP 1 (TiSi)

RTA: R/U: 25 - 650 C in 5 sec,
Soak: 650 C for 5 sec (N2 Ambient),
R/D: 650 - 25 C in 5 sec



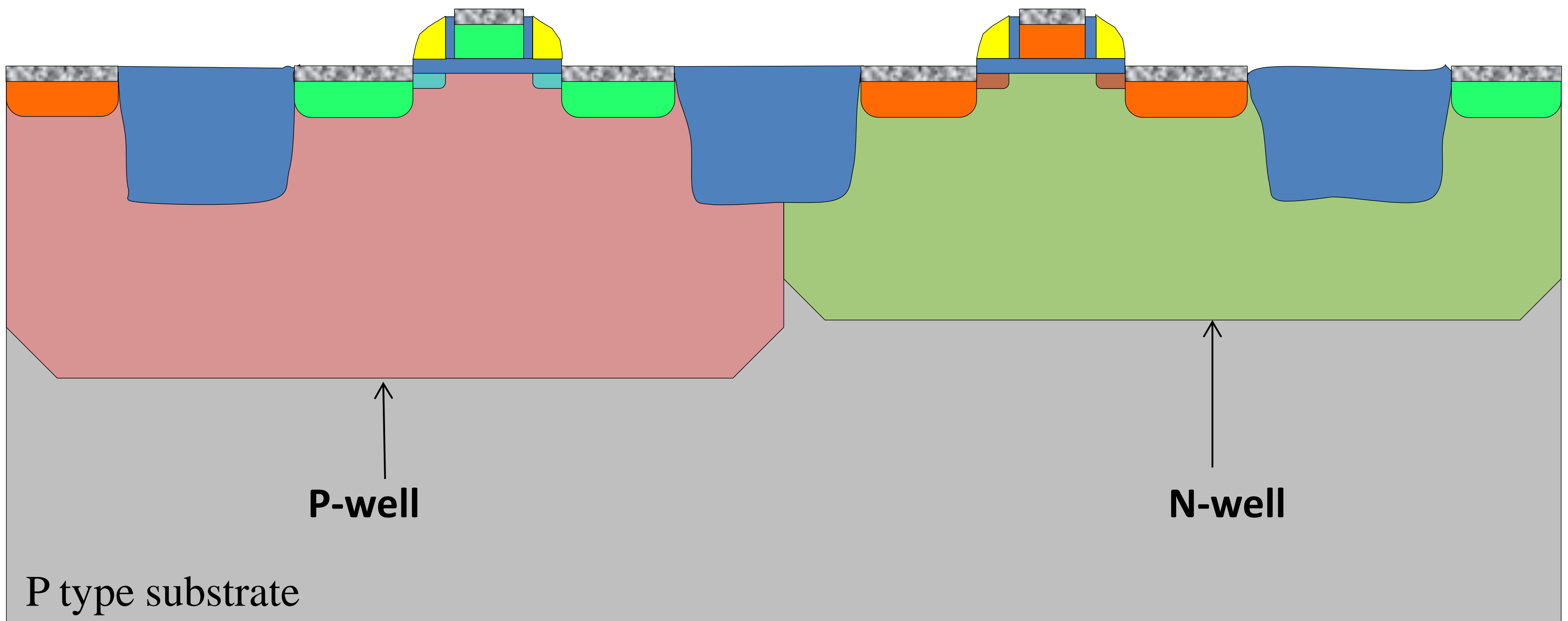
54 – Ti Etch

H2SO4 1:2 @ 150 C for 2 min



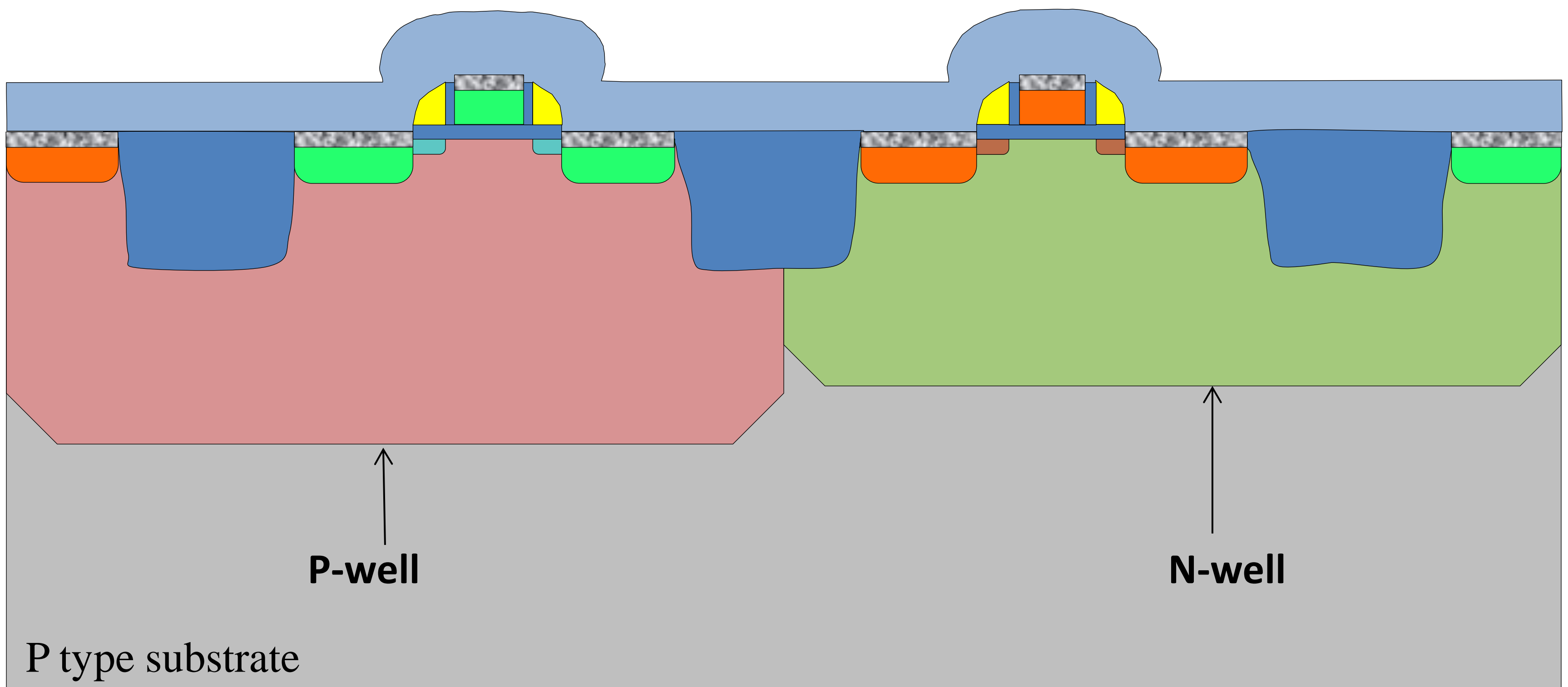
55 – RTP 2 ($TiSi_2$)

RTA: R/U: 25 - 700 C in 5 sec,
Soak: 700 C for 5 sec (N2 Ambient),
R/D: 700 - 25 C in 10 sec



56 – CVD TEOS

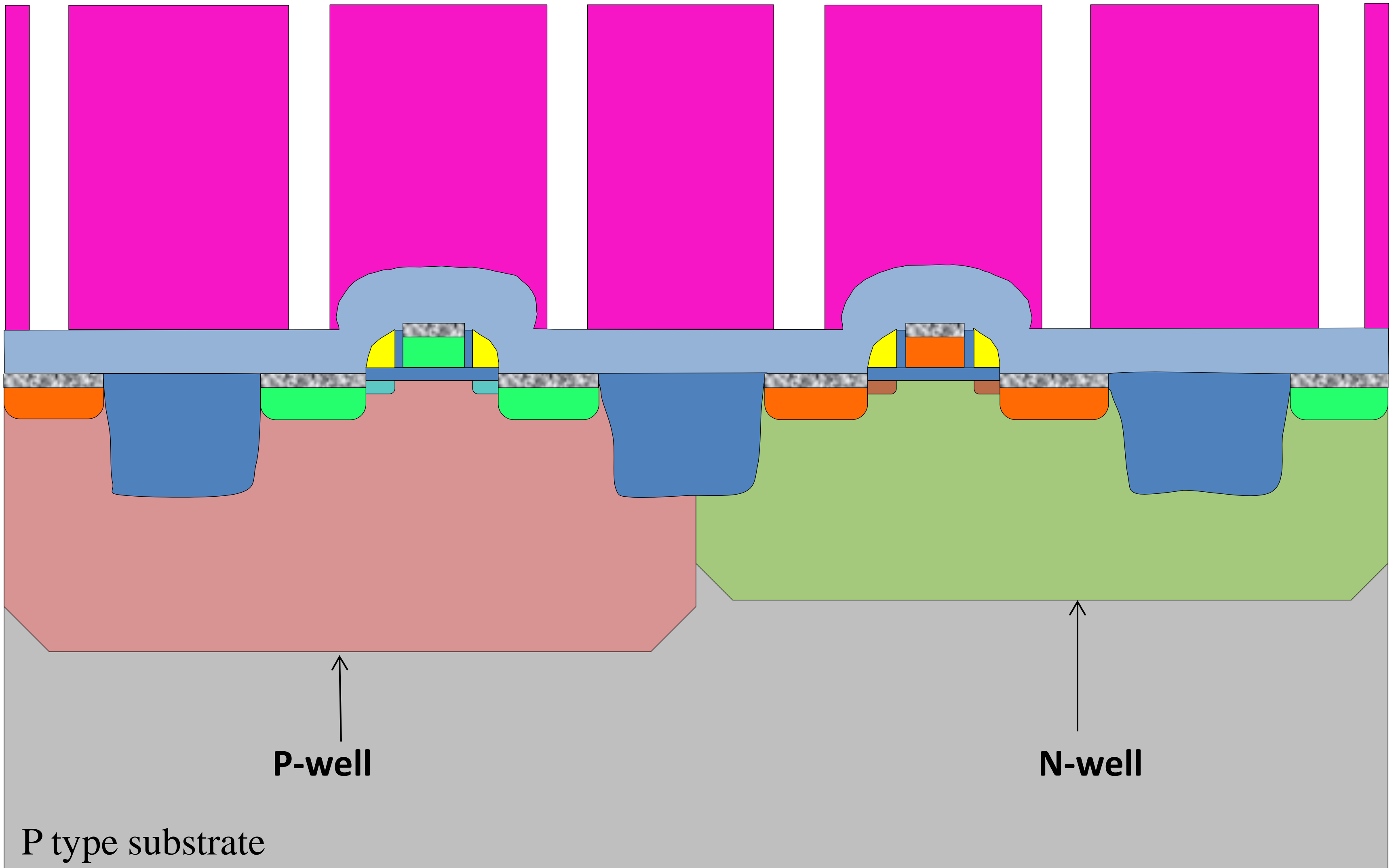
AME P5000: Recipe #A6-FAC 0.4M TEOS, (~2000 Å)



57 – Photo CC (Level – 11)

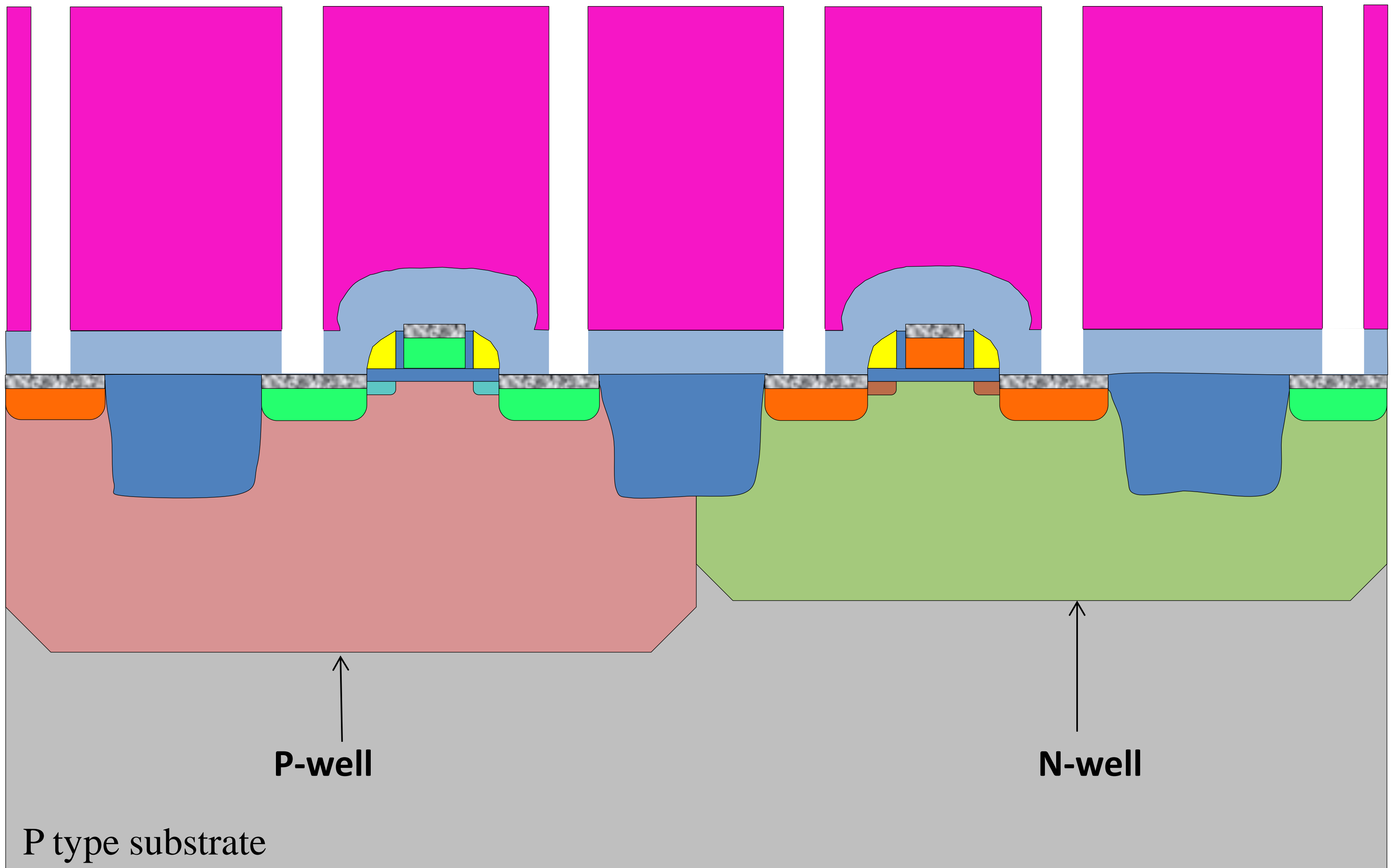
SSI Track: Recipe-COAT.rcp DEVELOP.rcp

ASML Stepper: Mask- JG CC   Jobname: factory-adv-cmos



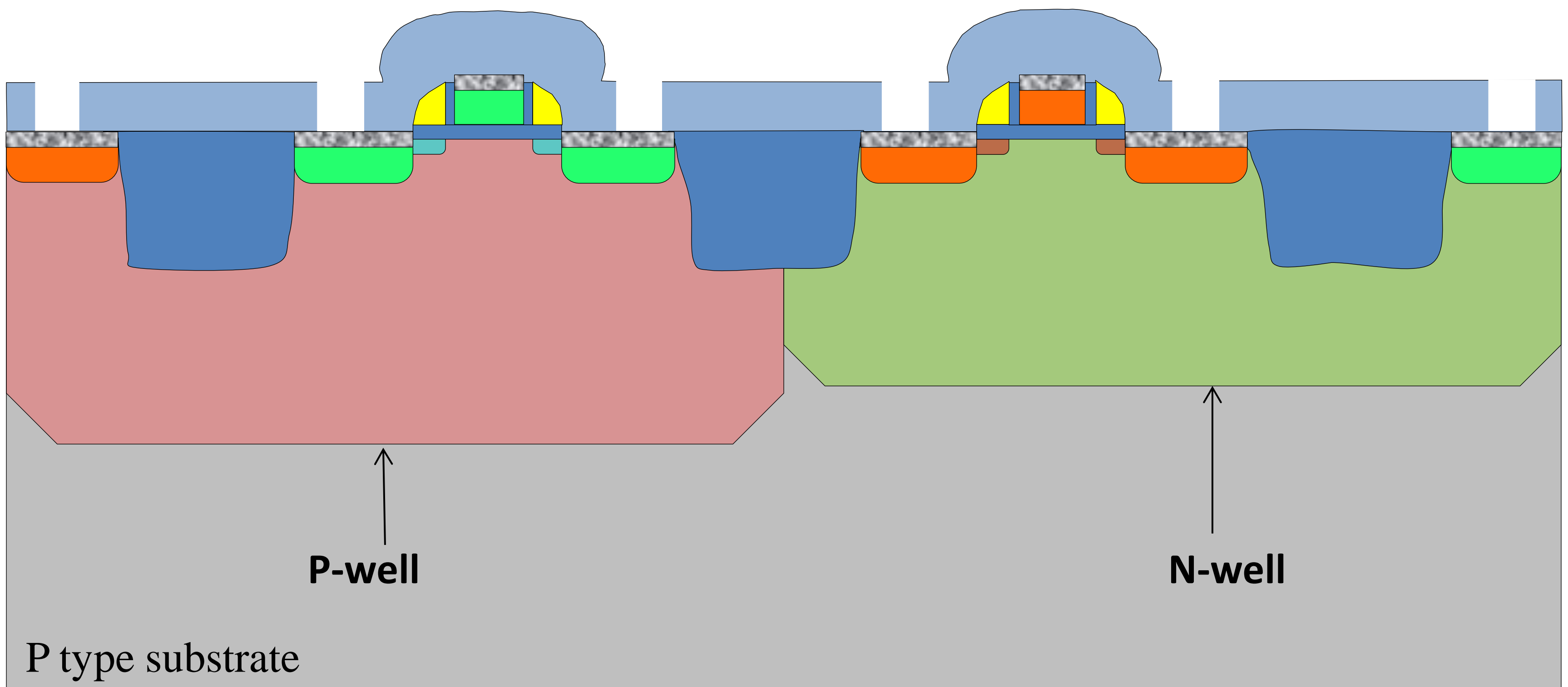
58 – Etch CC

RIE in Drytek Quad Recipe #FACCUT 15 min

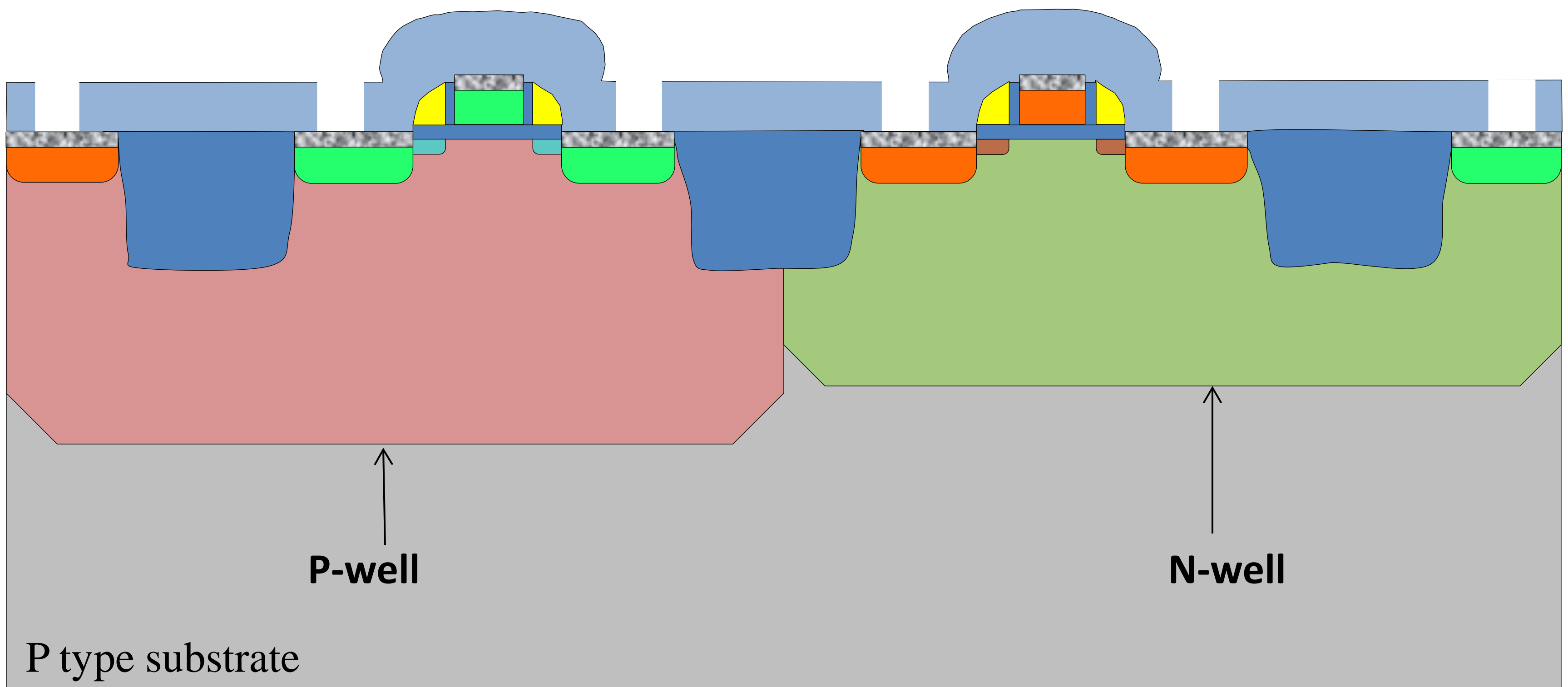


59 – Photoresist Strip

GaSonics Asher: Recipe #FF (O_2 Plasma)
Metrology: Visual/ Inspection Microscope

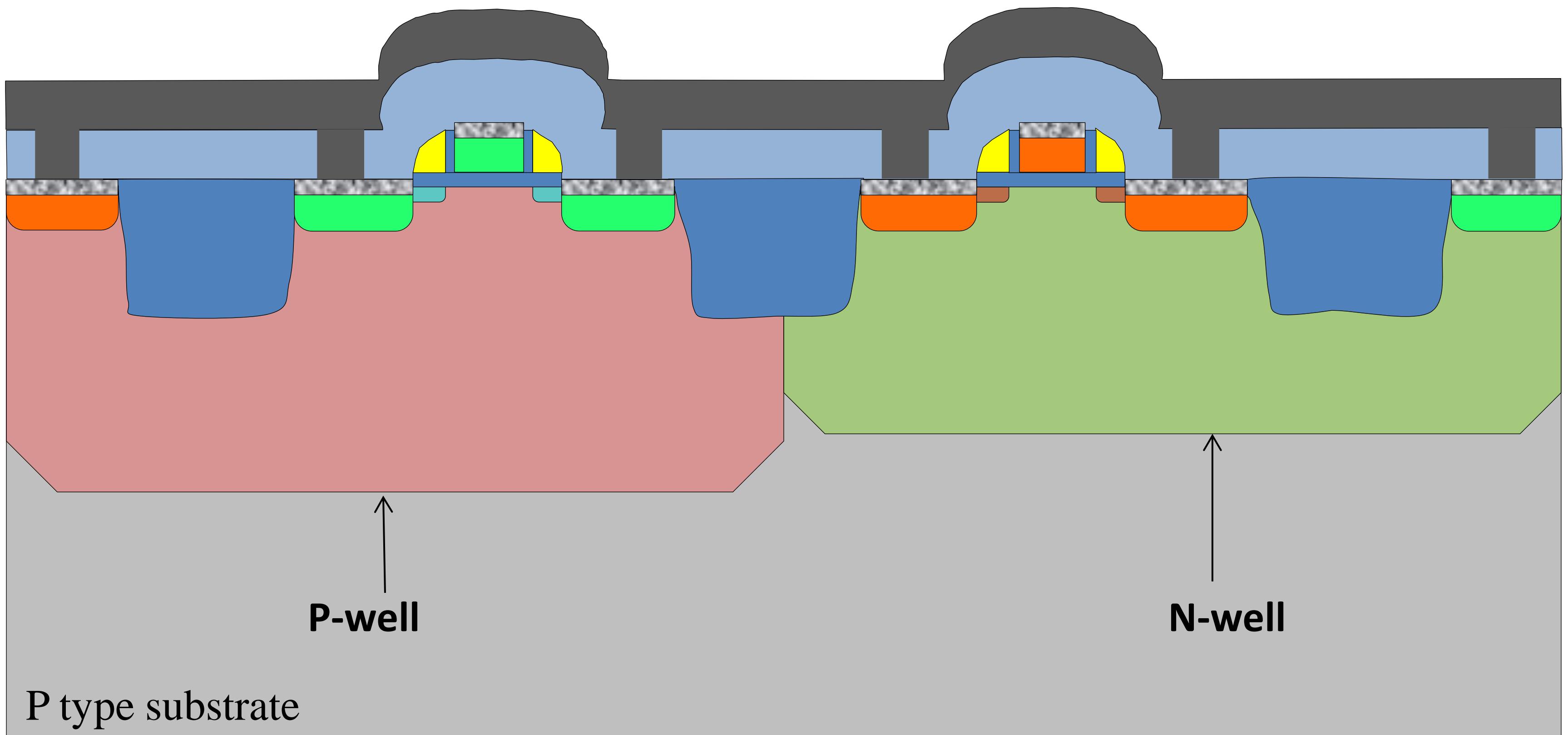


60 – RCA Clean



61 – Metal 1 - Aluminum Dep

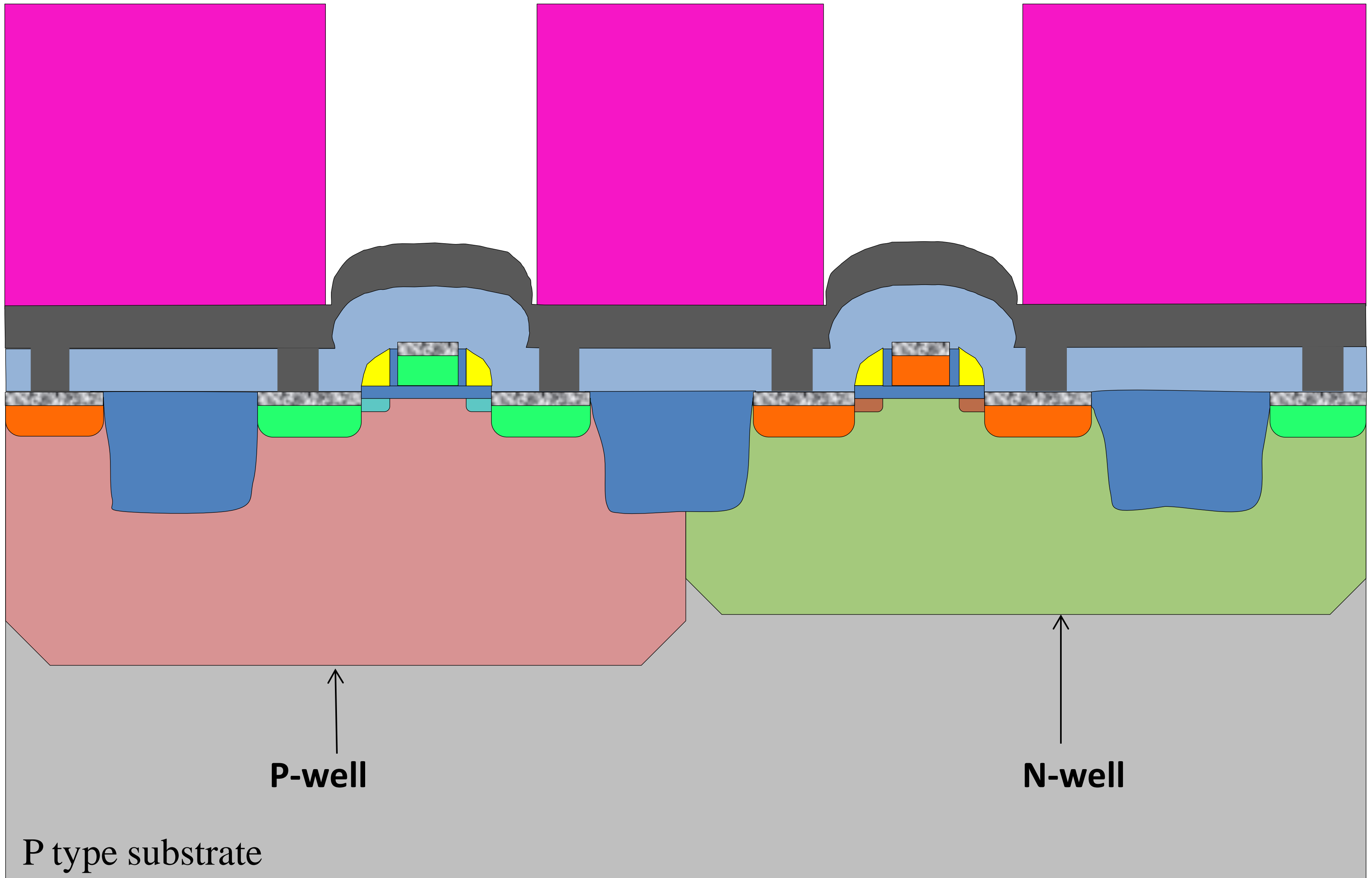
CVC 601 Sputter 2000 Watt 900 sec (~3000 Å)



62 – Photo Metal1 (Level 12)

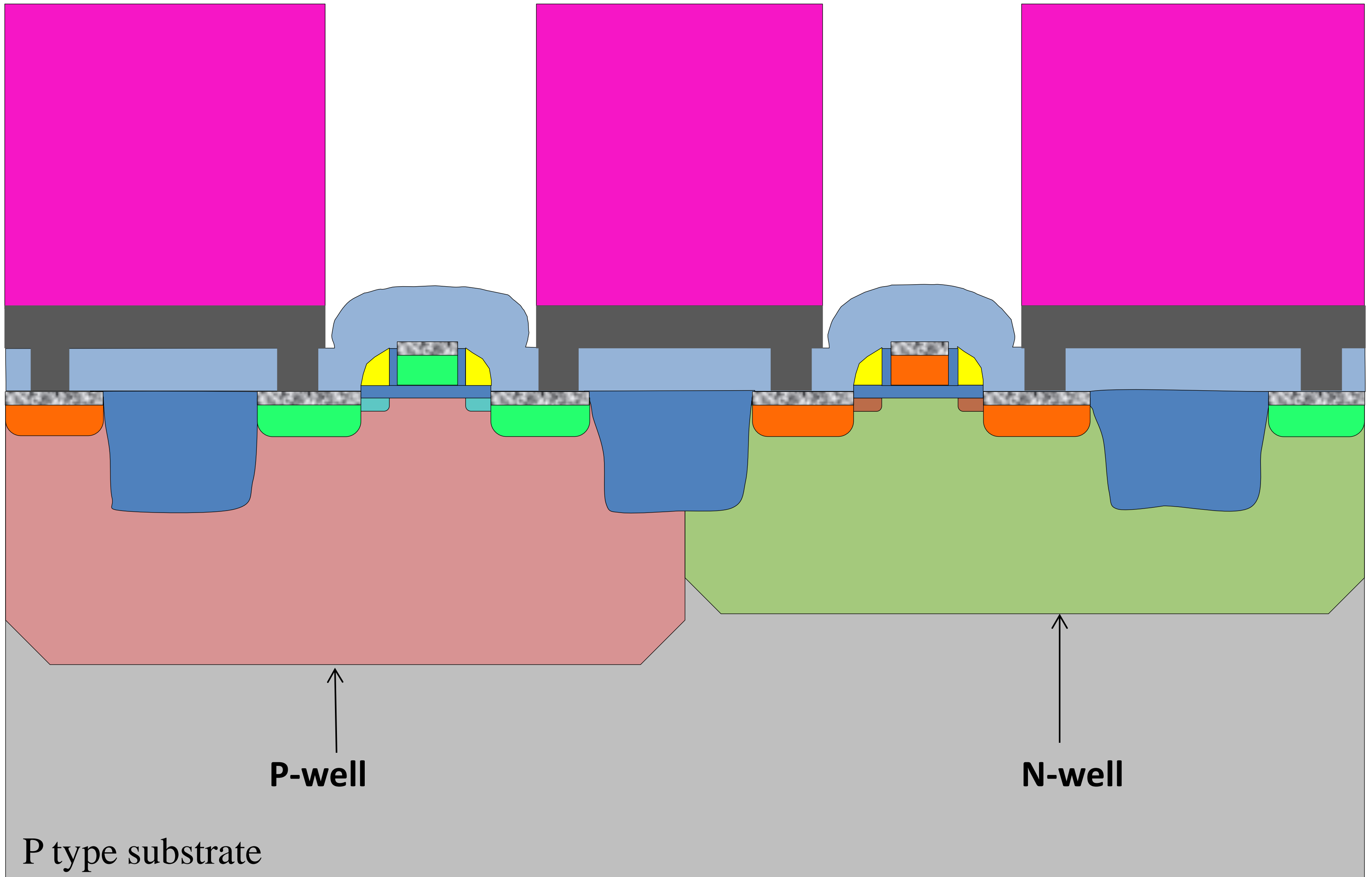
SSI Track: Recipe-COATMTL.rcp DEVMTL.rcp

ASML Stepper: Mask- ADV M1 Jobname: factory-adv-cmos



63 – Al Etch

LAM 4600 Recipe #122122



64 – Photoresist Strip

GaSonics Asher: Recipe #FF (O_2 Plasma)
Metrology: Visual/ Inspection Microscope

P-well

N-well

P type substrate