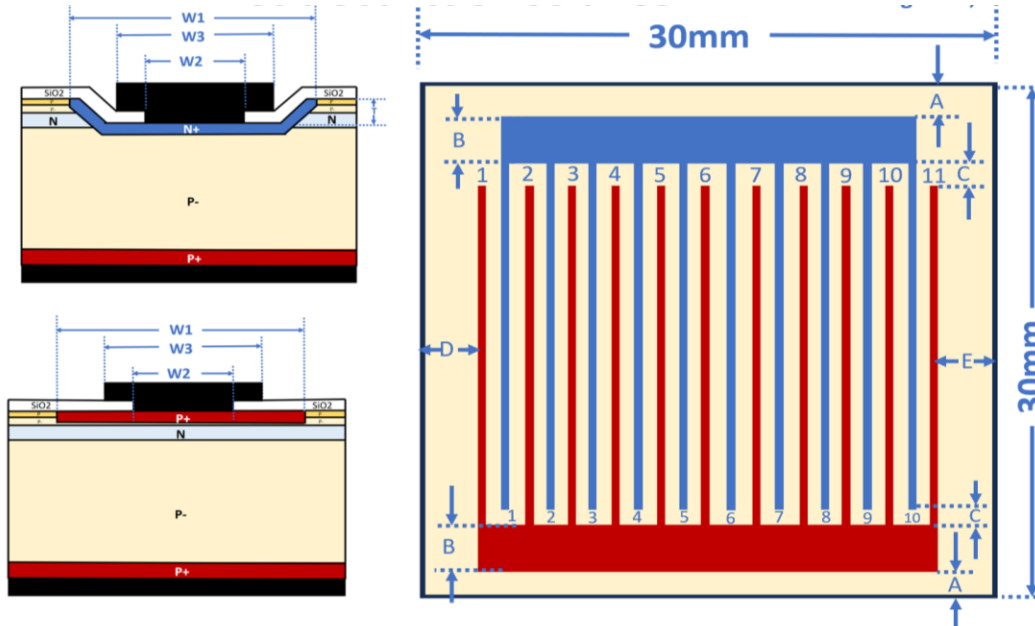


PP-N-P-P+ Double Junction Solar Cell

Yoshiaki Hagiwara, AIPS



MASK01 Silicon KOH Etching and N+ Diffusion

MASK02 P+ Diffusion

MASK03 Contact Window

MASK04 Metal Wiring

Line Length (L) :

$$30 = 2 (A + B) - C + L ;$$

$$L = 30 - 2 (A + B) - C ;$$

Choose A=B=C=1.

We have L = 25.

Line Spacing (S) :

$$30 = D + E + 21 * W1 + 20 * S ;$$

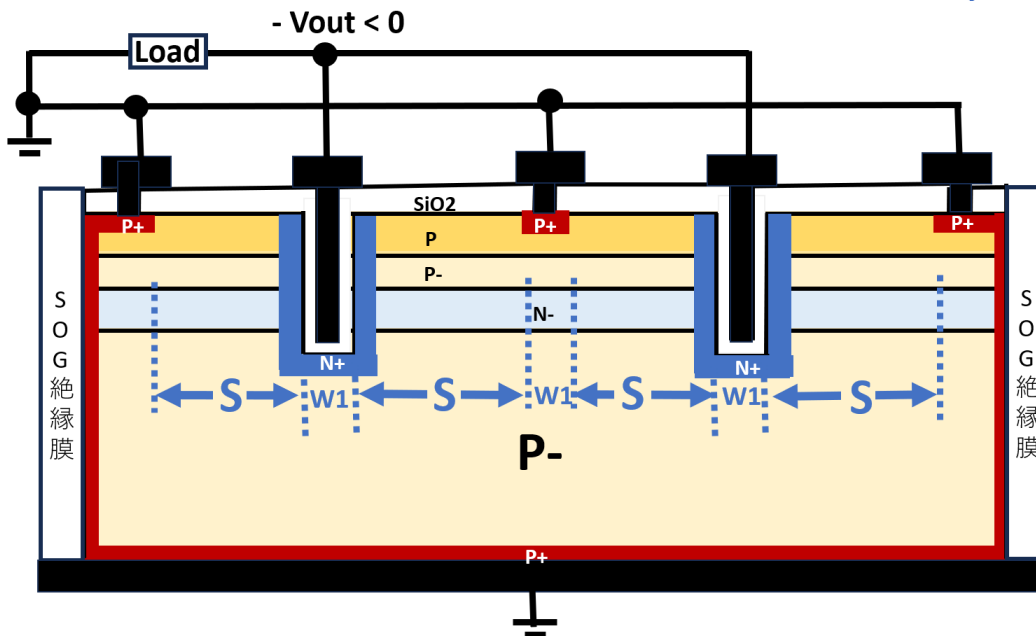
$$S = (30 - D - E - 21 * W1) / 20 ;$$

$$D + E = 30 - 21 * W1 - 20 * S ;$$

Choose S = 1.1 and W1 = 0.3.

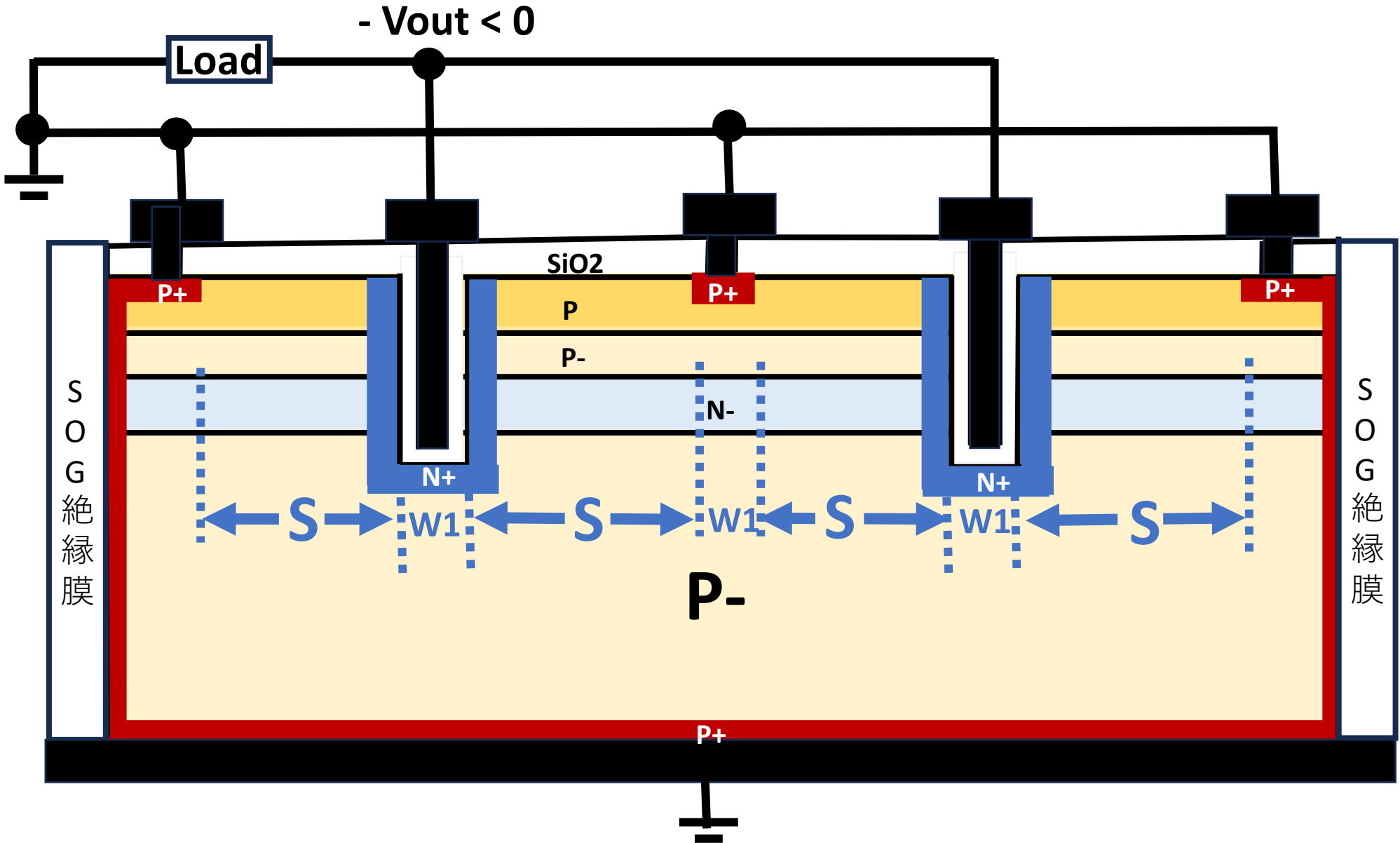
We have (D + E) = 8 - 6.3 = 1.7

Choose D= 0.9 and E = 0.8.



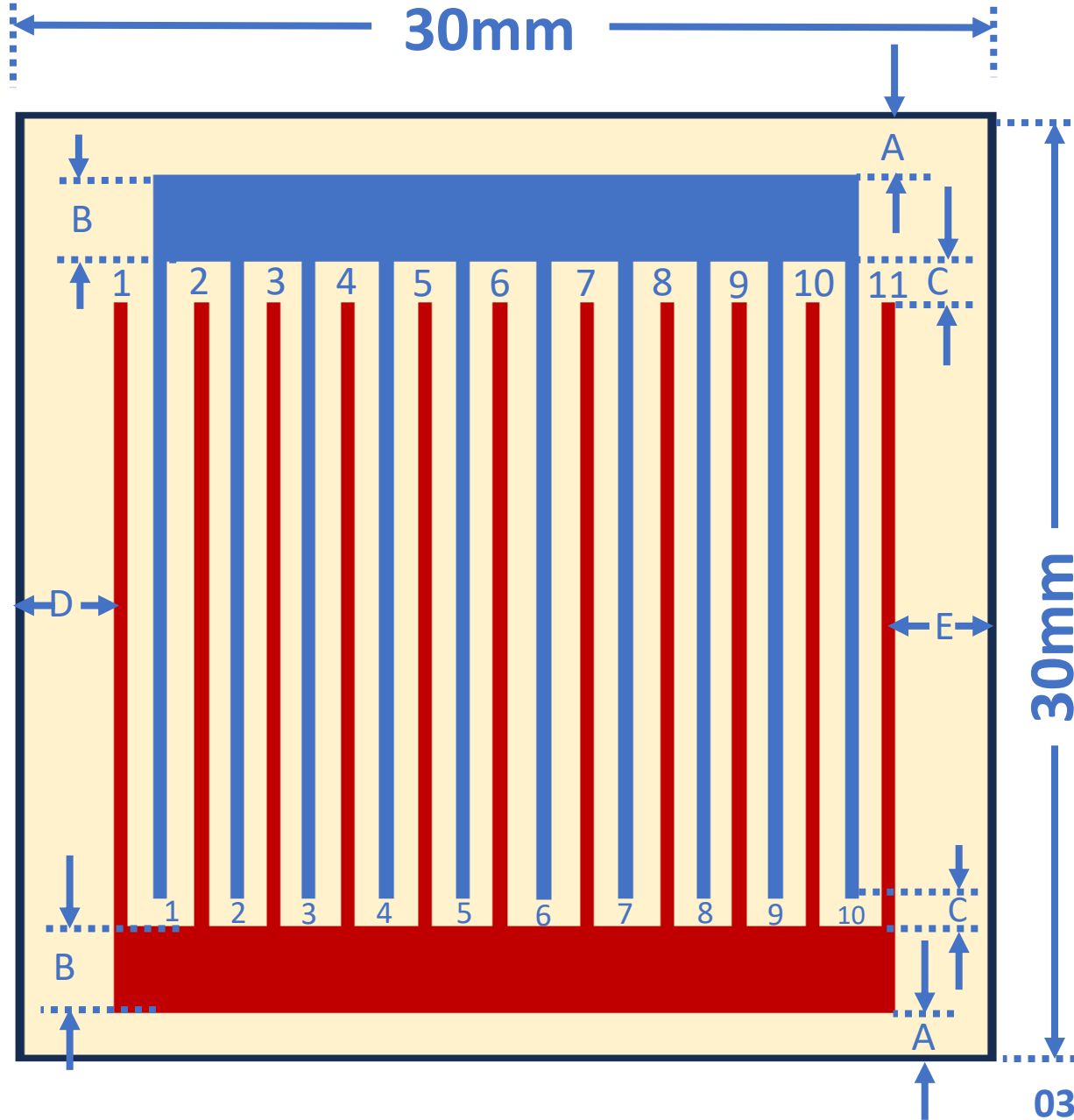
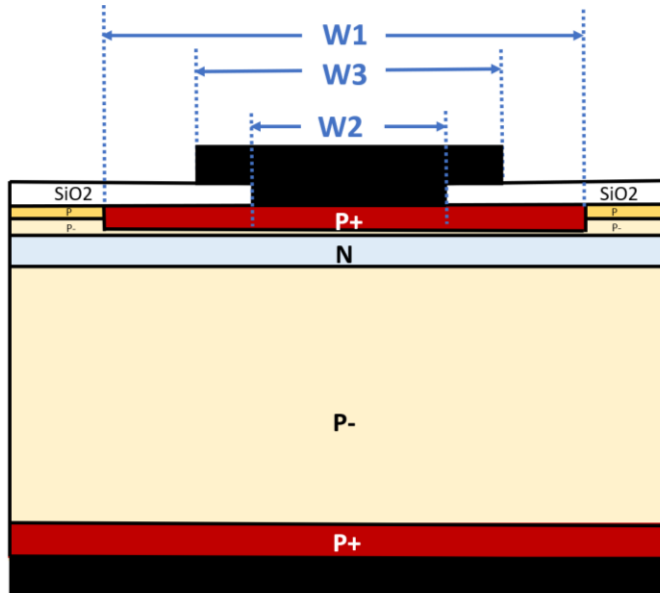
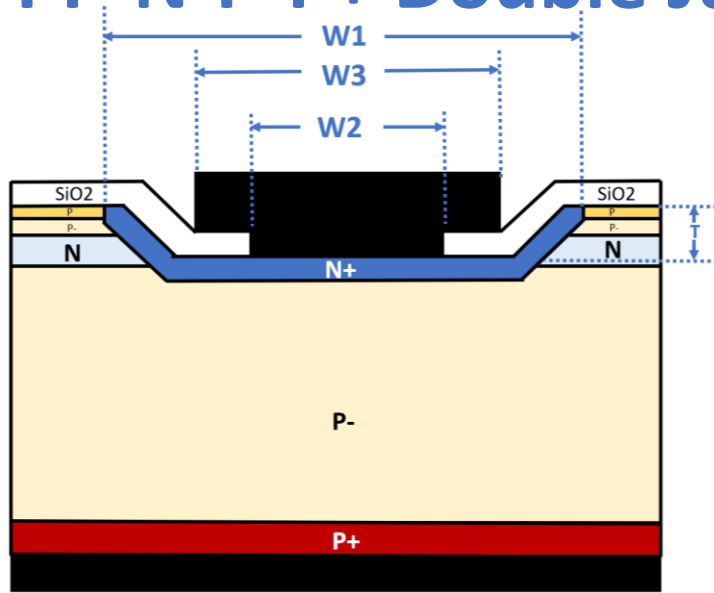
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PP-N-P-P+ Double Junction Solar Cell

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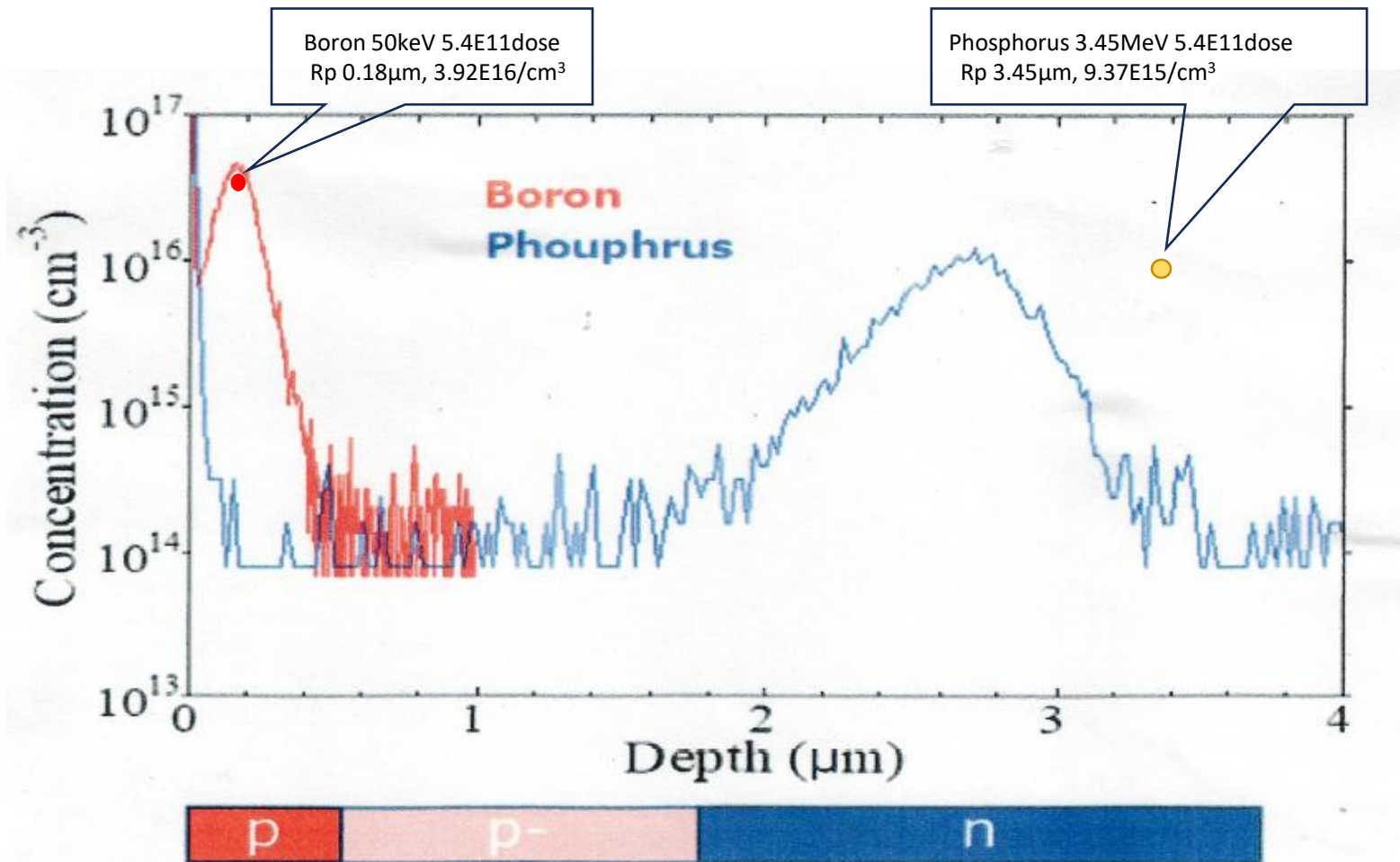


Fig.9 Impurity Doping Profile of Fabricated PP-NP- Junction Sample

P型100Ωcmシリコンウェハ キャリア濃度 $1.4 \times 10^{14} \text{cm}^{-3}$

熱処理を1050℃で1時間1回、2時間3回、合計7時間行った場合の、各々ボロンとリンのピーク濃度と深さを計算

ボロン

Dose (cm^{-2})	Peak Depth (μm)	ΔR_p (μm)	Peak Conc. (cm^{-3})
1.8E10	0.18	0.636	1.13E14
5.4E10	0.18	0.636	3.39E14
1.8E11	0.18	0.636	1.13E15
5.4E11	0.18	0.636	3.39E15

採用値



KOHシリコン Eching の深さは $d = 4\mu\text{m}$ が必要です。

リン

Dose (cm^{-2})	Peak Depth (μm)	ΔR_p (μm)	Peak Conc. (cm^{-3})
1.8E10	3.45	0.683	1.05E14
5.4E10	3.45	0.683	3.16E14
1.8E11	3.45	0.683	1.05E15
5.4E11	3.45	0.683	3.16E15

採用値



P型100Ωcmシリコンウェハ キャリア濃度 $1.4 \times 10^{14} \text{cm}^{-3}$

熱処理を1050℃で1時間4回、合計4時間行った場合の、各々ボロンとリンのピーク濃度と深さを計算

ボロン

Dose (cm^{-2})	Peak Depth Rp (μm)	ΔRp (μm)	Peak Concentration (cm^{-3})
1.8×10^{10}	0.18	0.521	1.38×10^{14}
5.4×10^{10}	0.18	0.521	4.14×10^{14}
1.8×10^{11}	0.18	0.521	1.38×10^{15}
5.4×10^{11}	0.18	0.521	4.14×10^{15}

採用値



KOHシリコン Eching の深さは $d = 4\mu\text{m}$ が必要です。

リン

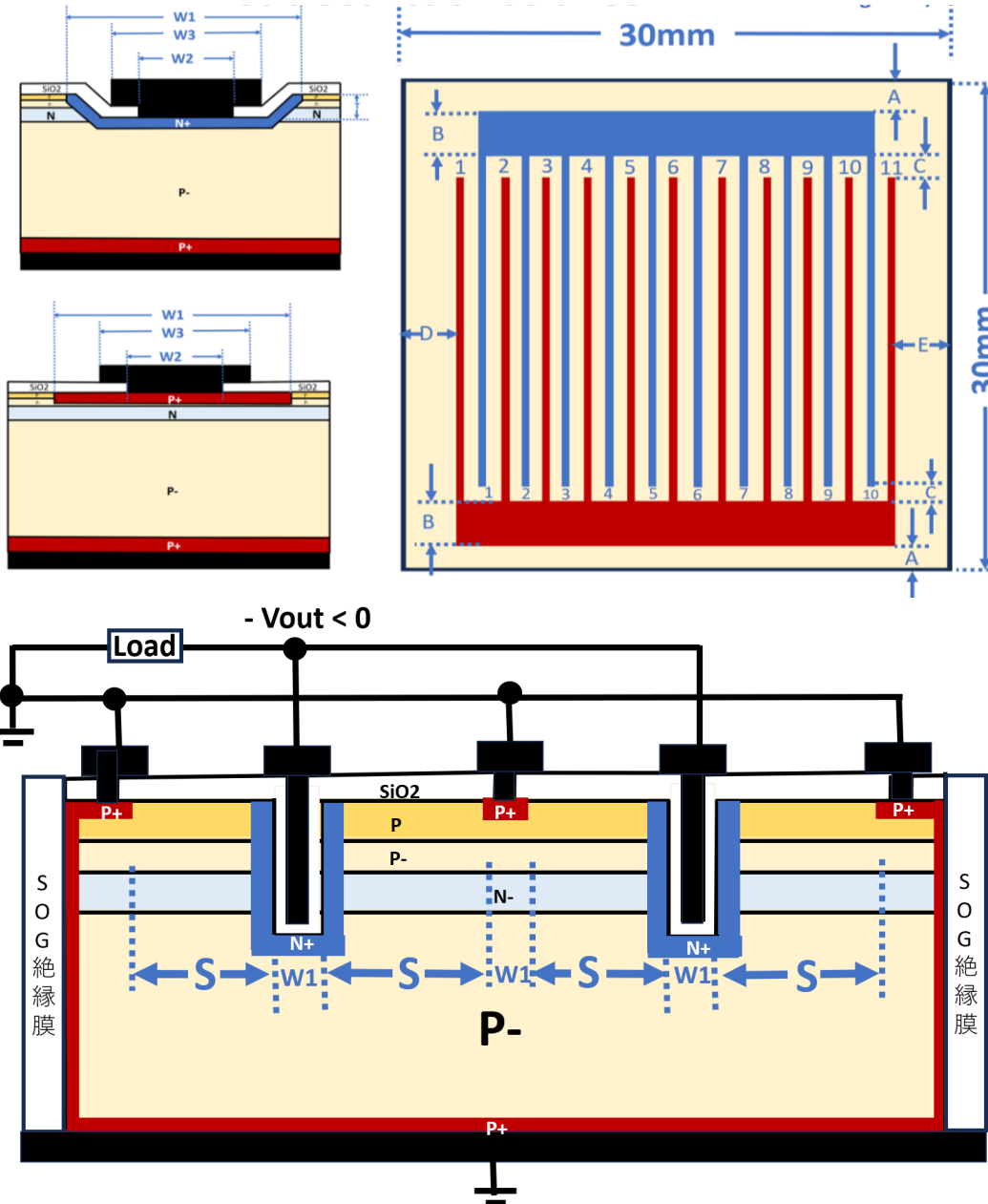
Dose (cm^{-2})	Peak Depth Rp (μm)	ΔRp (μm)	Peak Concentration (cm^{-3})
1.8×10^{10}	3.45	0.567	1.27×10^{14}
5.4×10^{10}	3.45	0.567	3.80×10^{14}
1.8×10^{11}	3.45	0.567	1.27×10^{15}
5.4×10^{11}	3.45	0.567	3.80×10^{15}

採用値



PP-N-P-P+ Double Junction Solar Cell

Yoshiaki Hagiwara, AIPS



MASK01 Silicon KOH Etching and N+ Diffusion

MASK02 P+ Diffusion

MASK03 Contact Window

MASK04 Metal Wiring

Line Length (L) :

$$30 = 2 (A + B) - C + L ;$$

$$L = 30 - 2 (A + B) - C ;$$

Choose A=B=C=1.

We have L = 25.

Line Spacing (S) :

$$30 = D + E + 21 * W1 + 20 * S ;$$

$$S = (30 - D - E - 21 * W1) / 20 ;$$

$$D + E = 30 - 21 * W1 - 20 * S ;$$

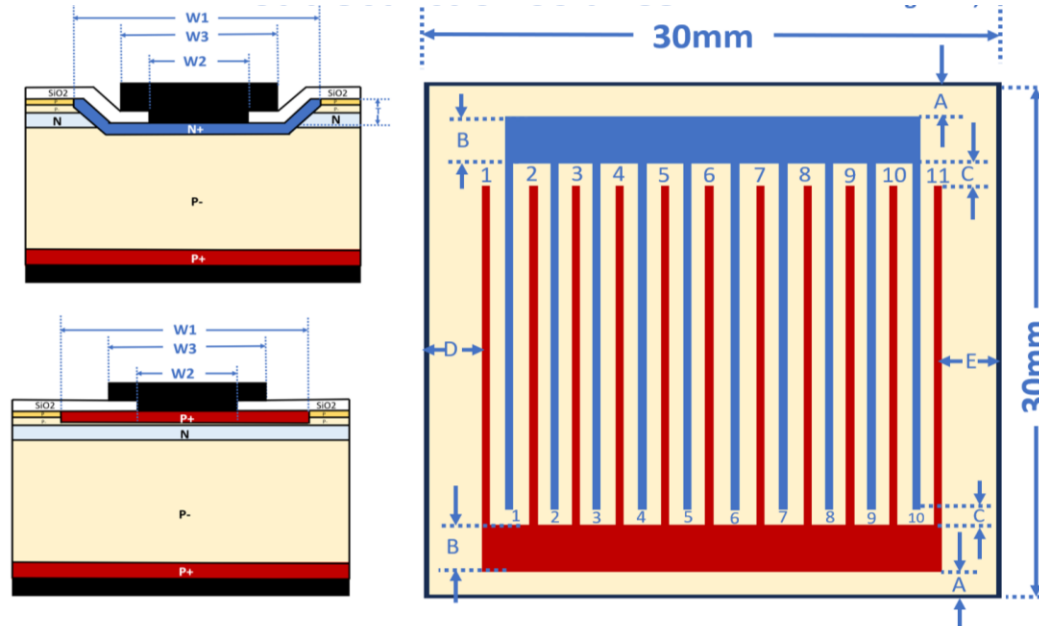
Choose S = 1.1 and W1 = 0.3.

We have (D + E) = 8 - 6.3 = 1.7

Choose D= 0.9 and E = 0.8.

PP-N-P-P+ Double Junction Solar Cell

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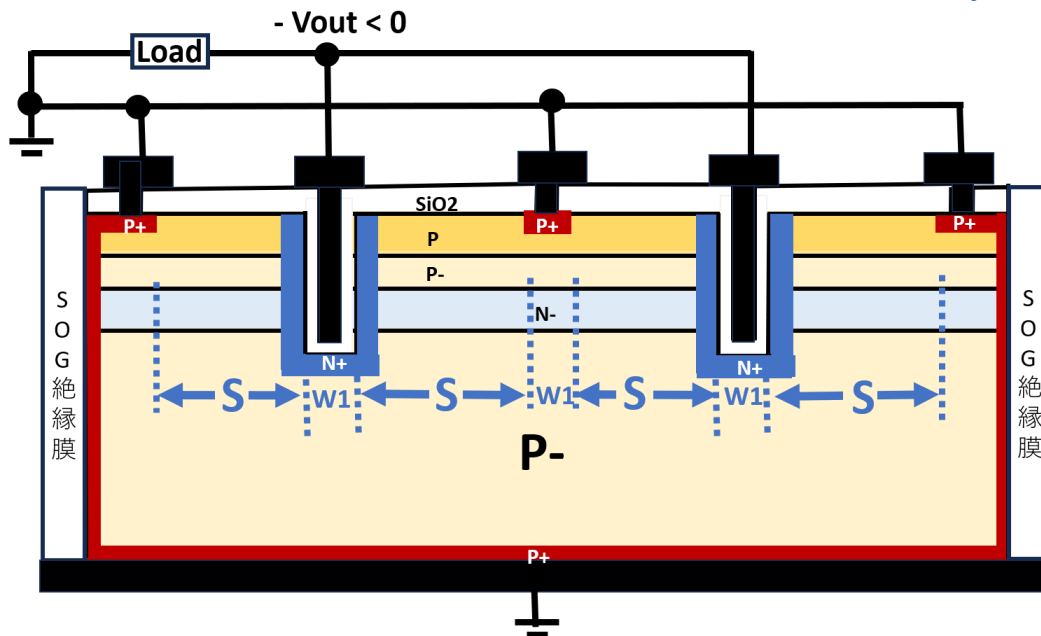


$A=1; B=1; C=1; D=0.9; E=0.8; L=25;$
 $W1=0.3; W2=0.1; W3=0.2; S=1.1;$

MASK01 Silicon KOH Etching and N⁺ Diffusion

***** MASK1 *****

1001	X=1.0	Y=2.3	W=1.0	H=25.5
1002	X=2.0	Y=2.3	W=25.0	H=0.3
1003	X=2.0	Y=5.1	W=25.0	H=0.3
1004	X=2.0	Y=7.9	W=25.0	H=0.3
1005	X=2.0	Y=10.7	W=25.0	H=0.3
1006	X=2.0	Y=13.5	W=25.0	H=0.3
1007	X=2.0	Y=16.3	W=25.0	H=0.3
1008	X=2.0	Y=19.1	W=25.0	H=0.3
1009	X=2.0	Y=21.9	W=25.0	H=0.3
1010	X=2.0	Y=24.7	W=25.0	H=0.3
1011	X=2.0	Y=27.5	W=25.0	H=0.3



PP-N-P-P+ Double Junction Solar Cell

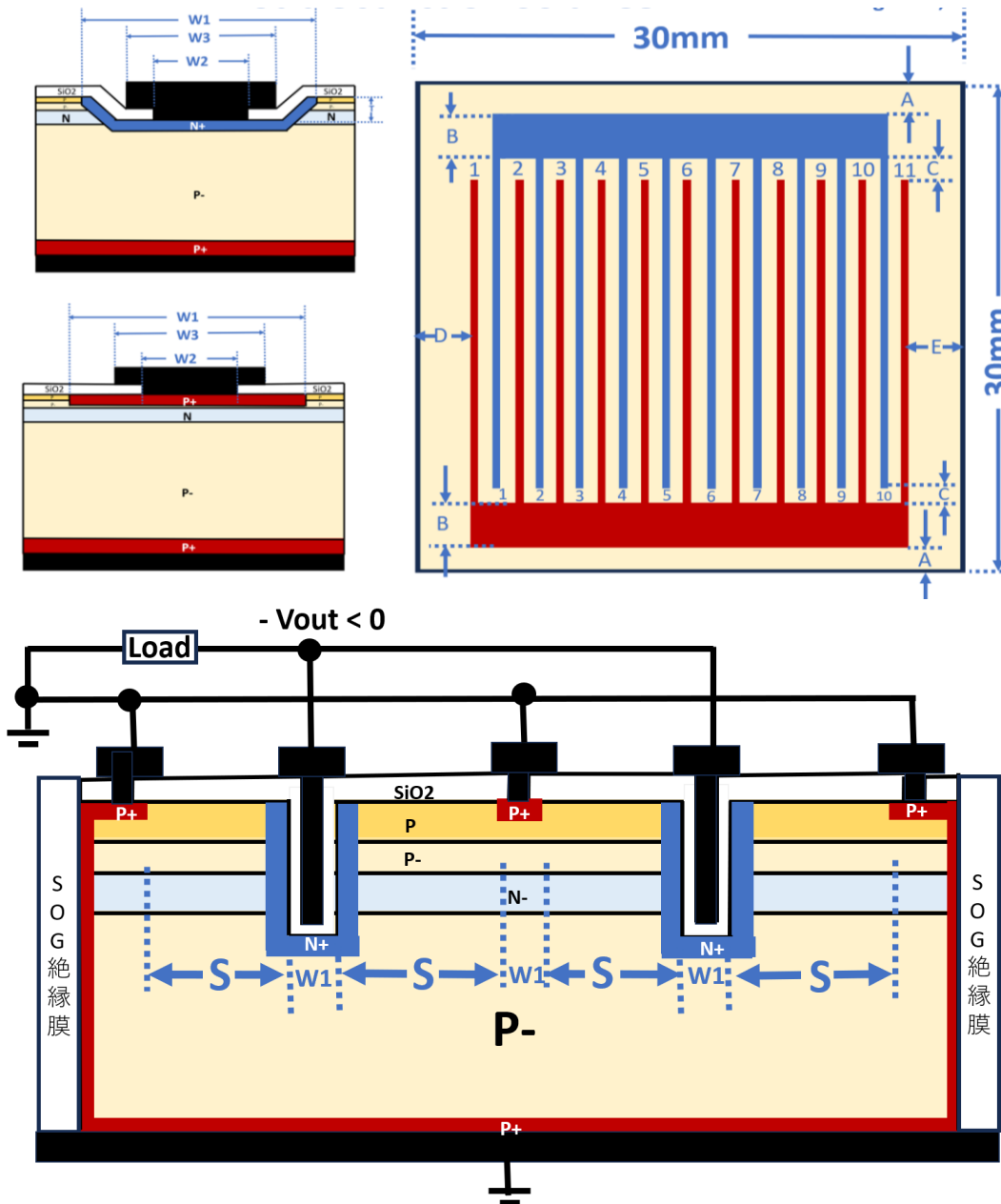
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$A=1; B=1; C=1; D=0.9; E=0.8; L=25;$
 $W1=0.3; W2=0.1; W3=0.2; S=1.1;$

MASK02 P+ Diffusion

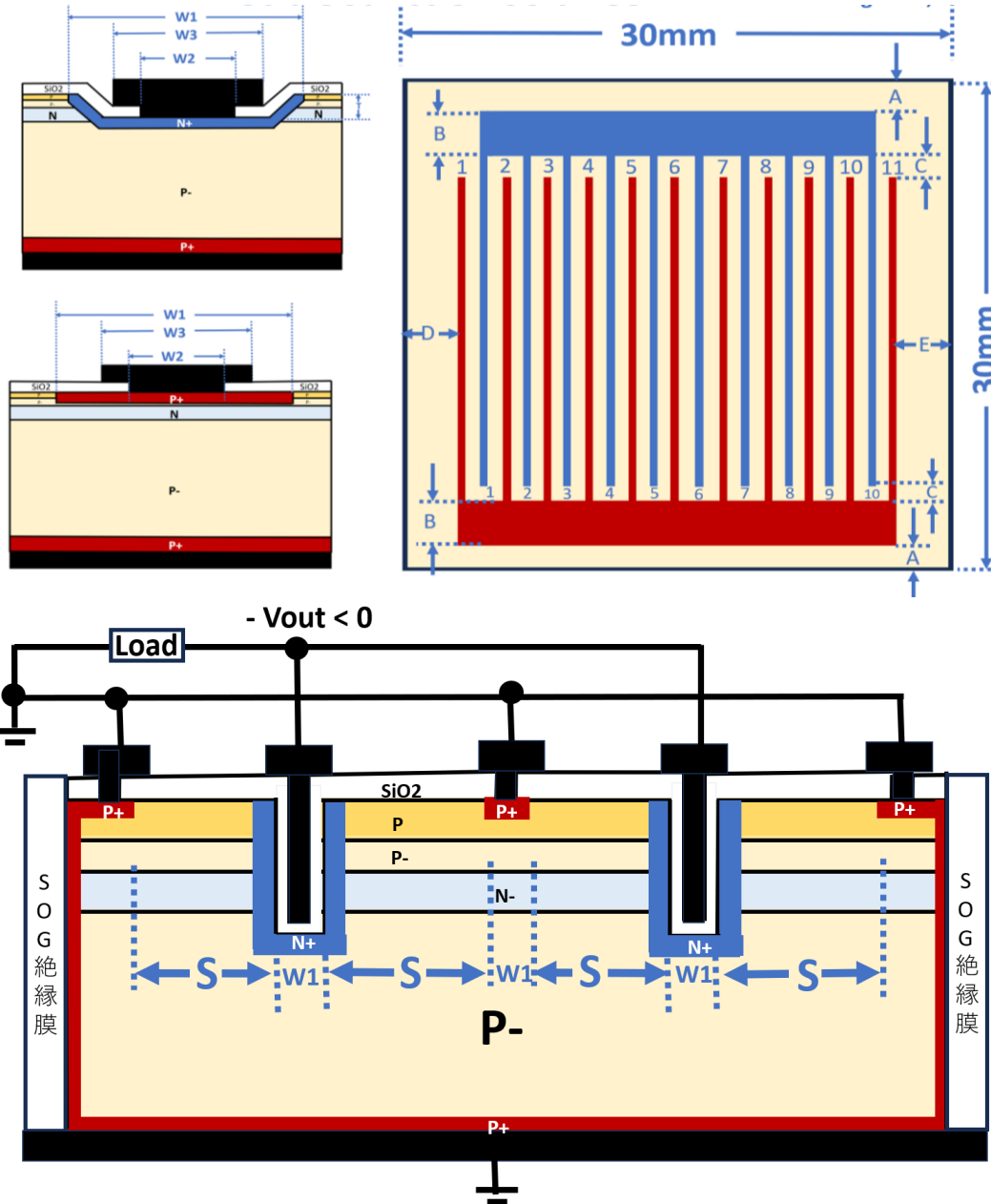
***** MASK2 *****

2001	X=28.0	Y=0.9	W=1.0	H=28.3
2002	X=3.0	Y=0.9	W=25.0	H=0.3
2003	X=3.0	Y=3.7	W=25.0	H=0.3
2004	X=3.0	Y=6.5	W=25.0	H=0.3
2005	X=3.0	Y=9.3	W=25.0	H=0.3
2006	X=3.0	Y=12.1	W=25.0	H=0.3
2007	X=3.0	Y=14.9	W=25.0	H=0.3
2008	X=3.0	Y=17.7	W=25.0	H=0.3
2009	X=3.0	Y=20.5	W=25.0	H=0.3
2010	X=3.0	Y=23.3	W=25.0	H=0.3
2011	X=3.0	Y=26.1	W=25.0	H=0.3
2012	X=3.0	Y=28.9	W=25.0	H=0.3



PP-N-P-P+ Double Junction Solar Cell

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**A=1;B=1;C=1;D=0.9;E=0.8;L=25;
W1=0.3;W2=0.1;W3=0.2;S=1.1;**

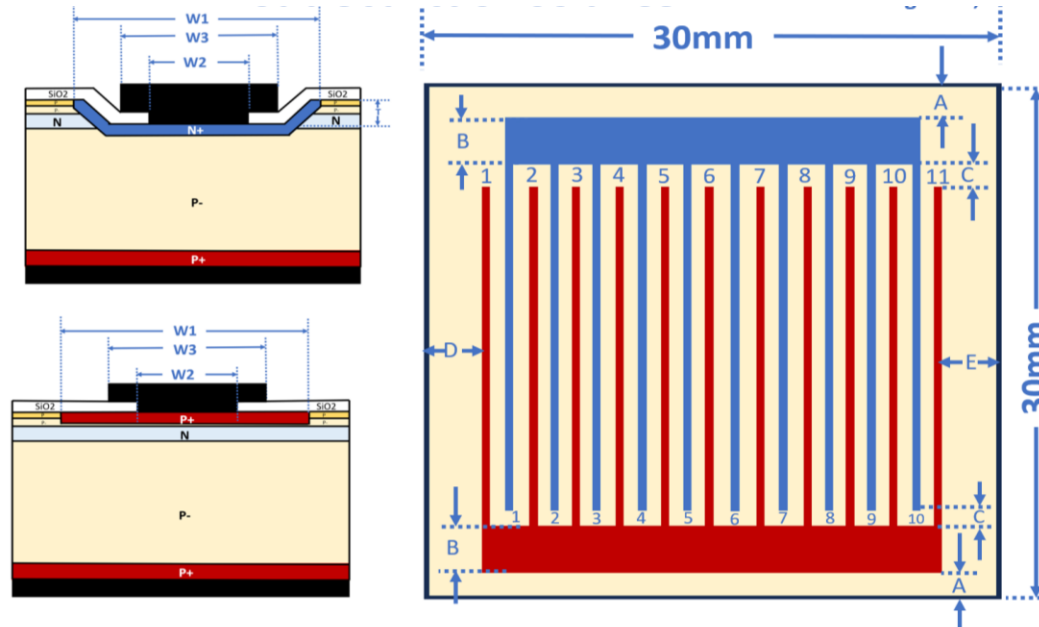
MASK03 Contact Window

***** MASK3 *****

3001	X=1. 1	Y=2. 4	W=0. 8	H=25. 3
3002	X=2. 1	Y=2. 4	W=24. 8	H=0. 1
3003	X=2. 1	Y=5. 2	W=24. 8	H=0. 1
3004	X=2. 1	Y=8. 0	W=24. 8	H=0. 1
3005	X=2. 1	Y=10. 8	W=24. 8	H=0. 1
3006	X=2. 1	Y=13. 6	W=24. 8	H=0. 1
3007	X=2. 1	Y=16. 4	W=24. 8	H=0. 1
3008	X=2. 1	Y=19. 2	W=24. 8	H=0. 1
3009	X=2. 1	Y=22. 0	W=24. 8	H=0. 1
3010	X=2. 1	Y=24. 8	W=24. 8	H=0. 1
3011	X=2. 1	Y=27. 6	W=24. 8	H=0. 1
3012	X=28. 1	Y=1. 0	W=0. 8	H=28. 1
3013	X=3. 1	Y=1. 0	W=24. 8	H=0. 1
3014	X=3. 1	Y=3. 8	W=24. 8	H=0. 1
3015	X=3. 1	Y=6. 6	W=24. 8	H=0. 1
3016	X=3. 1	Y=9. 4	W=24. 8	H=0. 1
3017	X=3. 1	Y=12. 2	W=24. 8	H=0. 1
3018	X=3. 1	Y=15. 0	W=24. 8	H=0. 1
3019	X=3. 1	Y=17. 8	W=24. 8	H=0. 1
3020	X=3. 1	Y=20. 6	W=24. 8	H=0. 1
3021	X=3. 1	Y=23. 4	W=24. 8	H=0. 1
3022	X=3. 1	Y=26. 2	W=24. 8	H=0. 1
3023	X=3. 1	Y=29. 0	W=24. 8	H=0. 1

PP-N-P-P+ Double Junction Solar Cell

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$A=1; B=1; C=1; D=0.9; E=0.8; L=25;$
 $W1=0.3; W2=0.1; W3=0.2; S=1.1;$

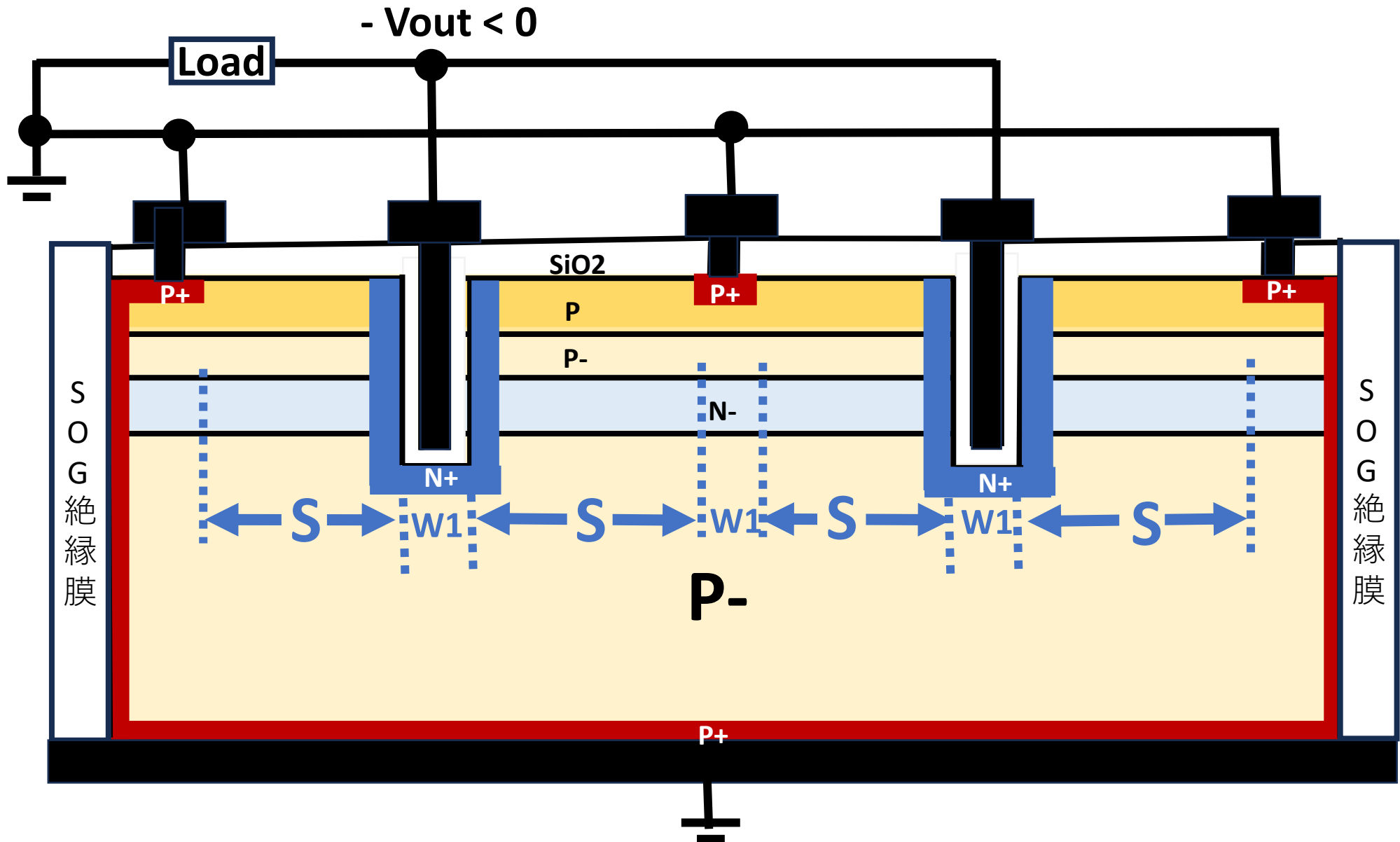
MASK04 Metal Wiring

***** MASK4 *****

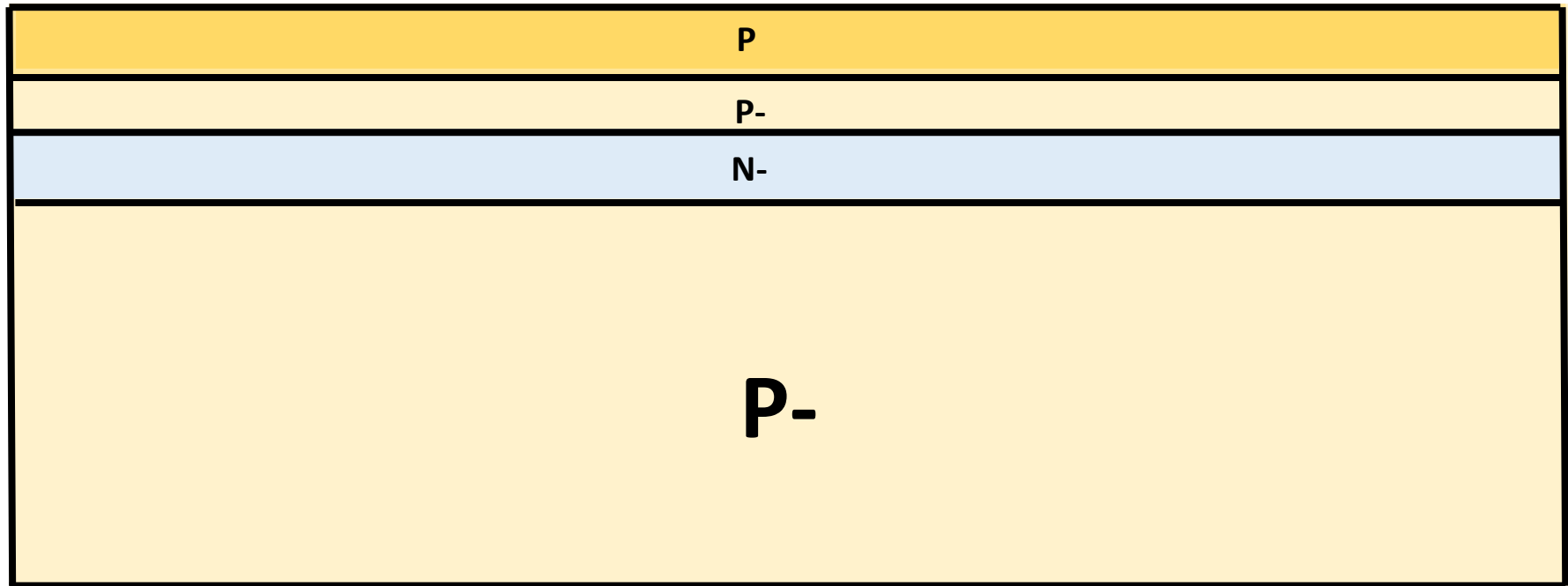
4001	X=1.05	Y=2.35	W=0.9	H=25.4
4002	X=2.05	Y=2.35	W=24.9	H=0.2
4003	X=2.05	Y=5.15	W=24.9	H=0.2
4004	X=2.05	Y=7.95	W=24.9	H=0.2
4005	X=2.05	Y=10.75	W=24.9	H=0.2
4006	X=2.05	Y=13.55	W=24.9	H=0.2
4007	X=2.05	Y=16.35	W=24.9	H=0.2
4008	X=2.05	Y=19.15	W=24.9	H=0.2
4009	X=2.05	Y=21.95	W=24.9	H=0.2
4010	X=2.05	Y=24.75	W=24.9	H=0.2
4011	X=2.05	Y=27.55	W=24.9	H=0.2
4012	X=28.05	Y=0.95	W=0.9	H=28.2
4013	X=3.05	Y=0.95	W=24.9	H=0.2
4014	X=3.05	Y=3.75	W=24.9	H=0.2
4015	X=3.05	Y=6.55	W=24.9	H=0.2
4016	X=3.05	Y=9.35	W=24.9	H=0.2
4017	X=3.05	Y=12.15	W=24.9	H=0.2
4018	X=3.05	Y=14.95	W=24.9	H=0.2
4019	X=3.05	Y=17.75	W=24.9	H=0.2
4020	X=3.05	Y=20.55	W=24.9	H=0.2
4021	X=3.05	Y=23.35	W=24.9	H=0.2
4022	X=3.05	Y=26.15	W=24.9	H=0.2
4023	X=3.05	Y=28.95	W=24.9	H=0.2

PP-N-P-P+ Double Junction Solar Cell

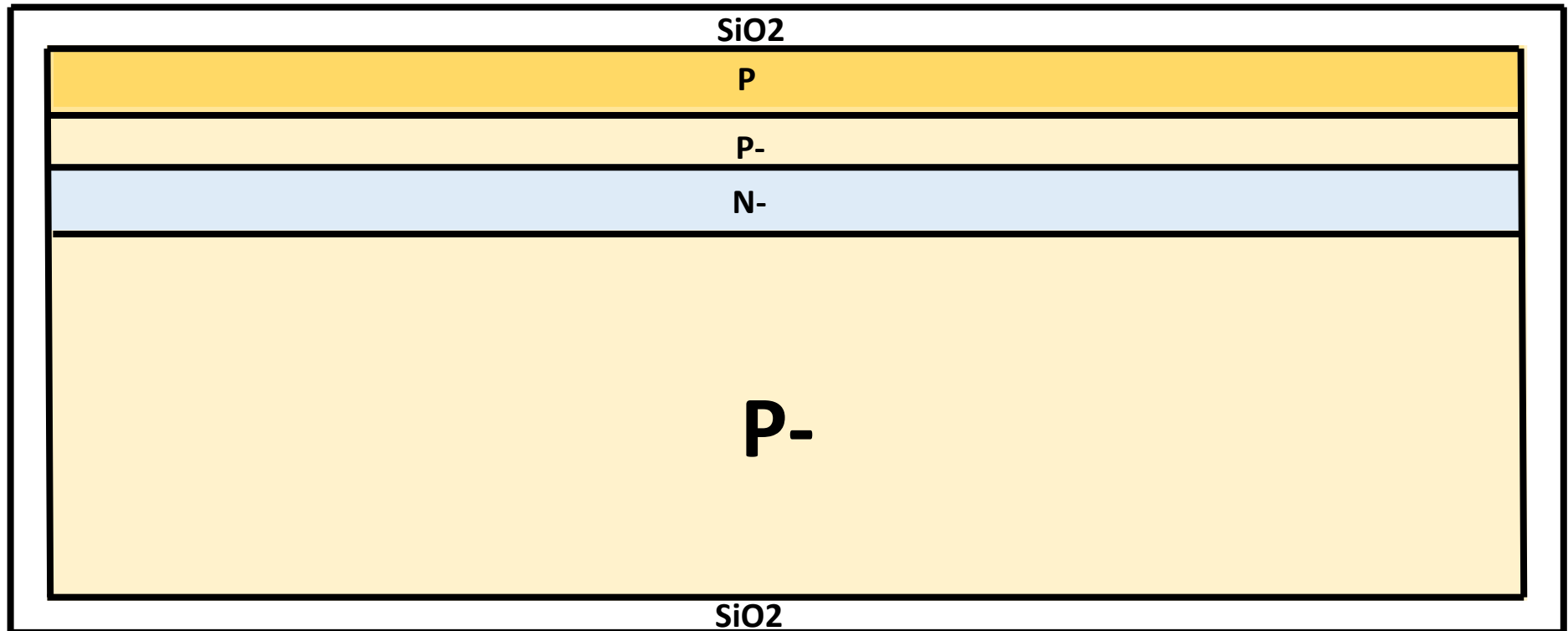
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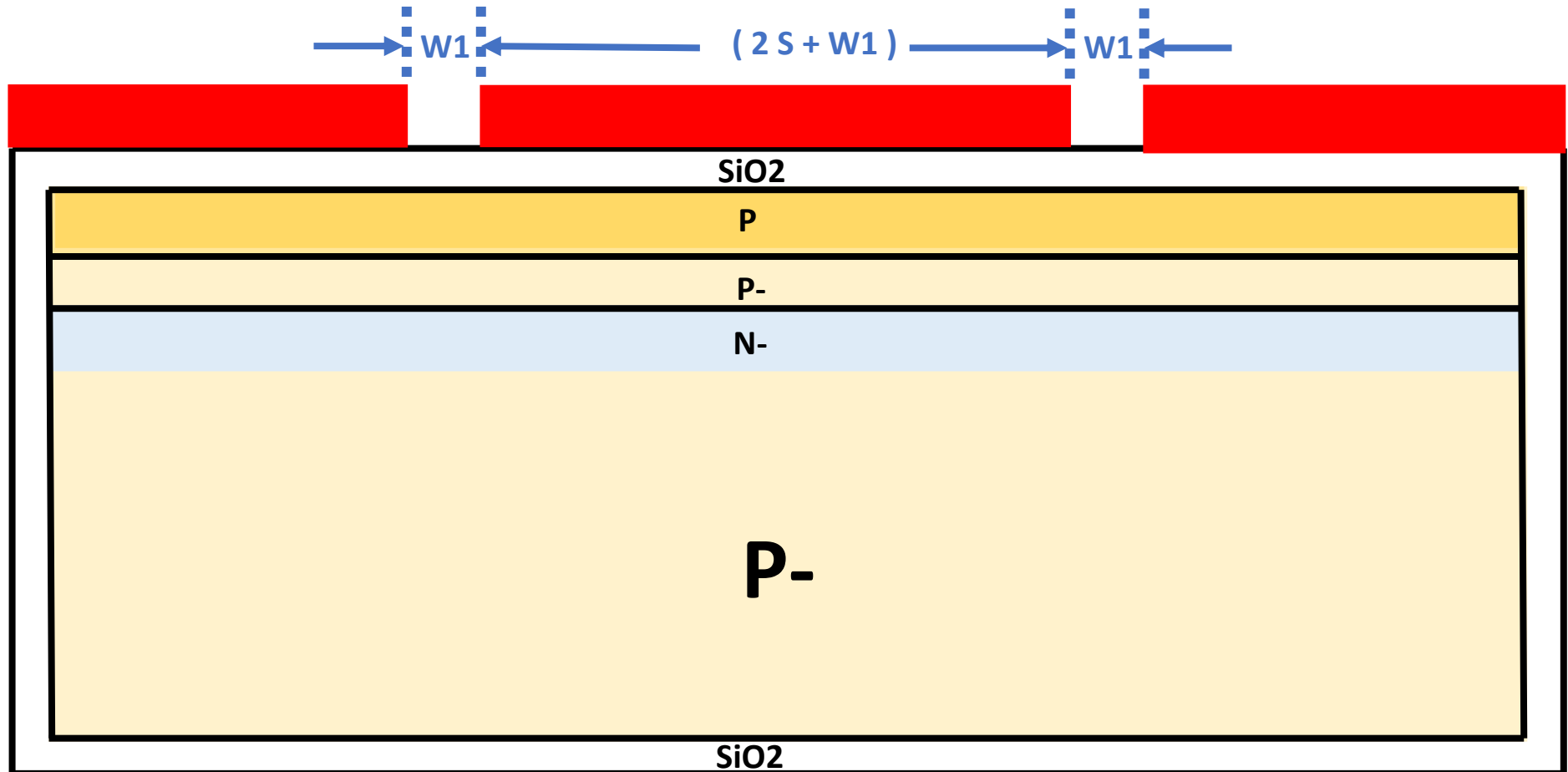
P01 Cleaning Silicon Wafer



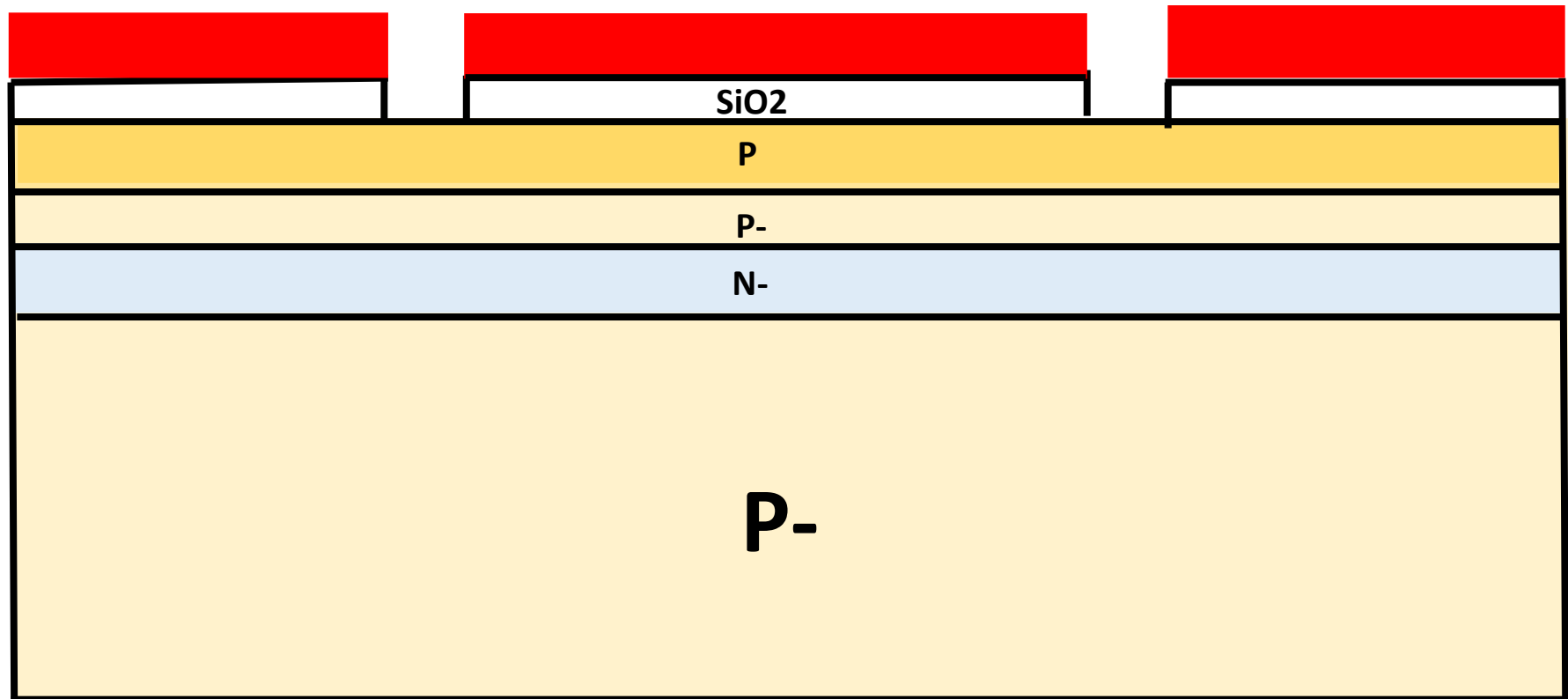
P02 First Oxidation



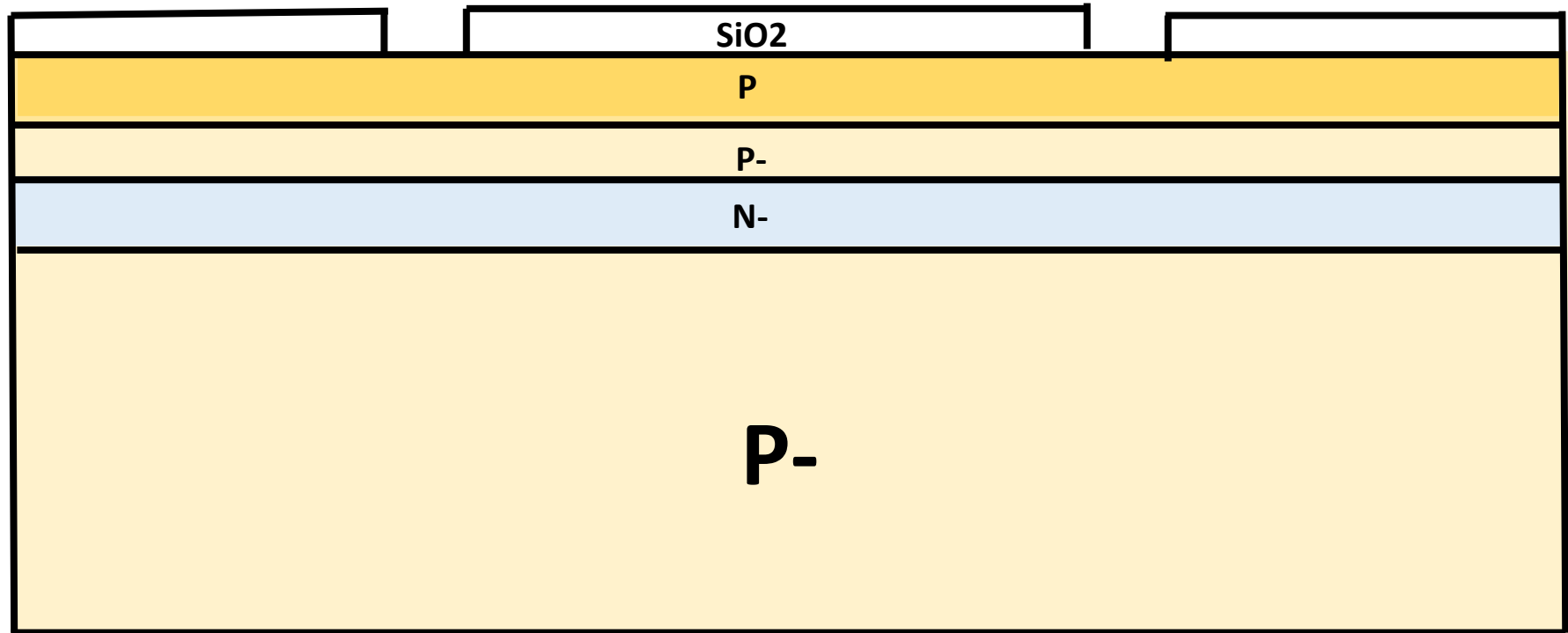
P03 Mask 01 First Resist Coating and Patterning



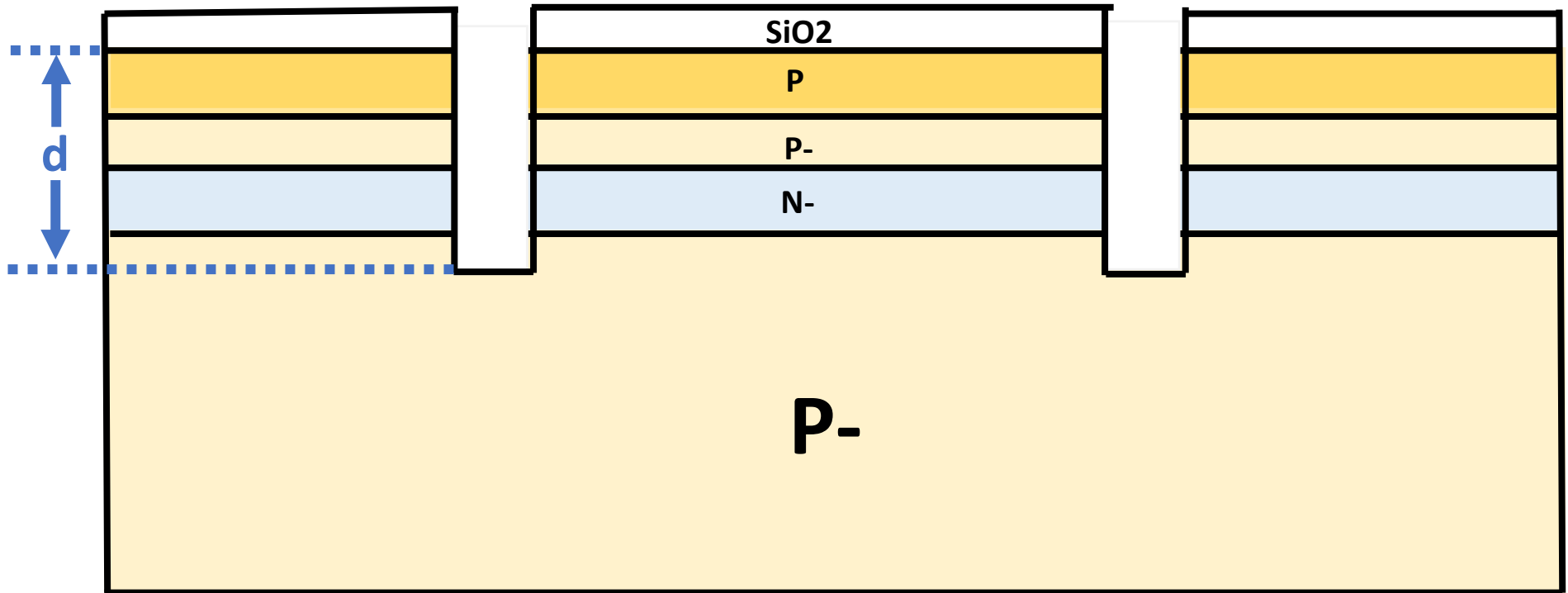
P04 First SiO₂ Etching



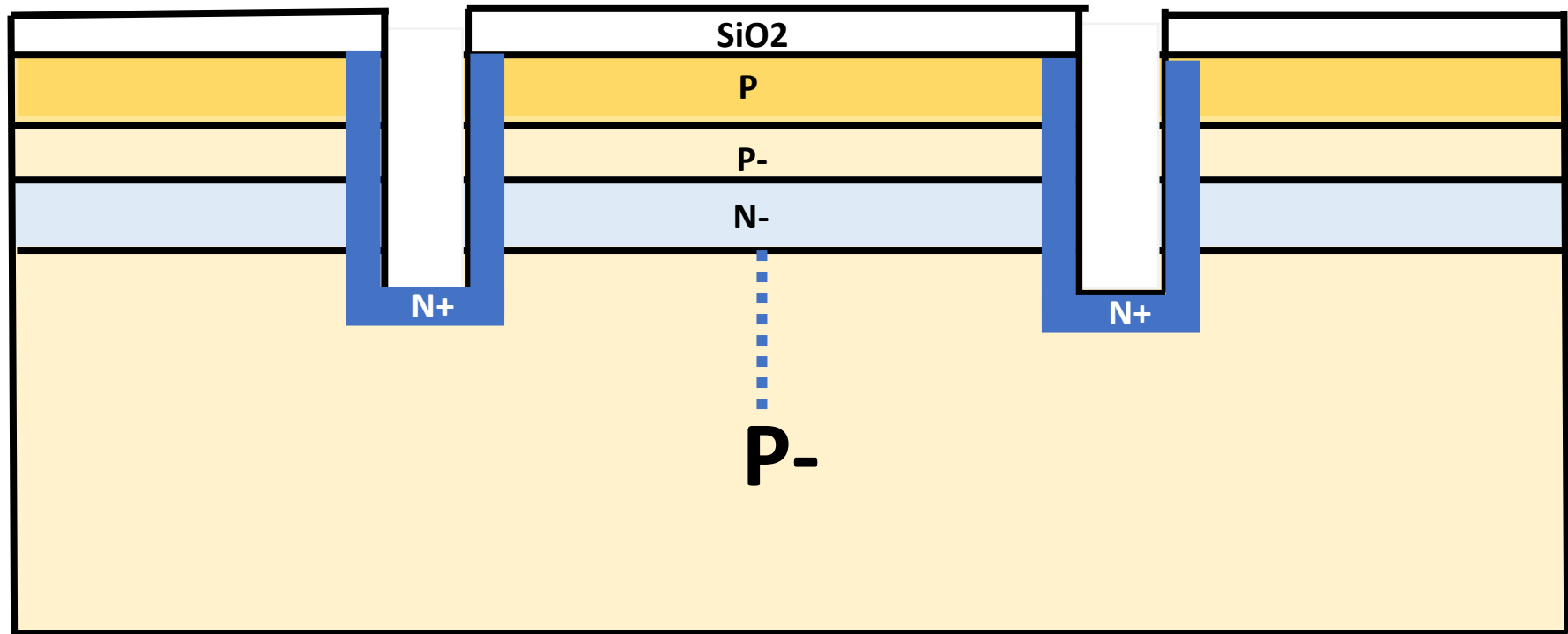
P05 Remove Resist



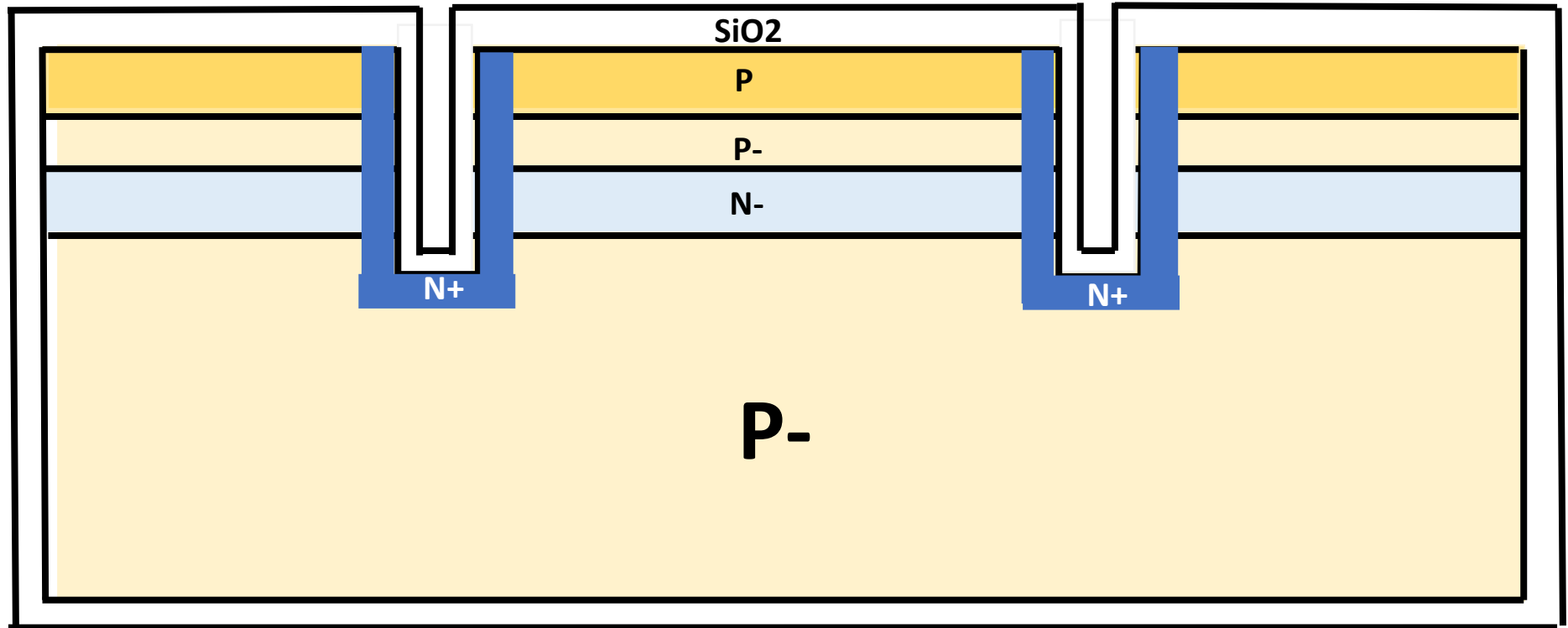
P06 Silicon KOH Etching



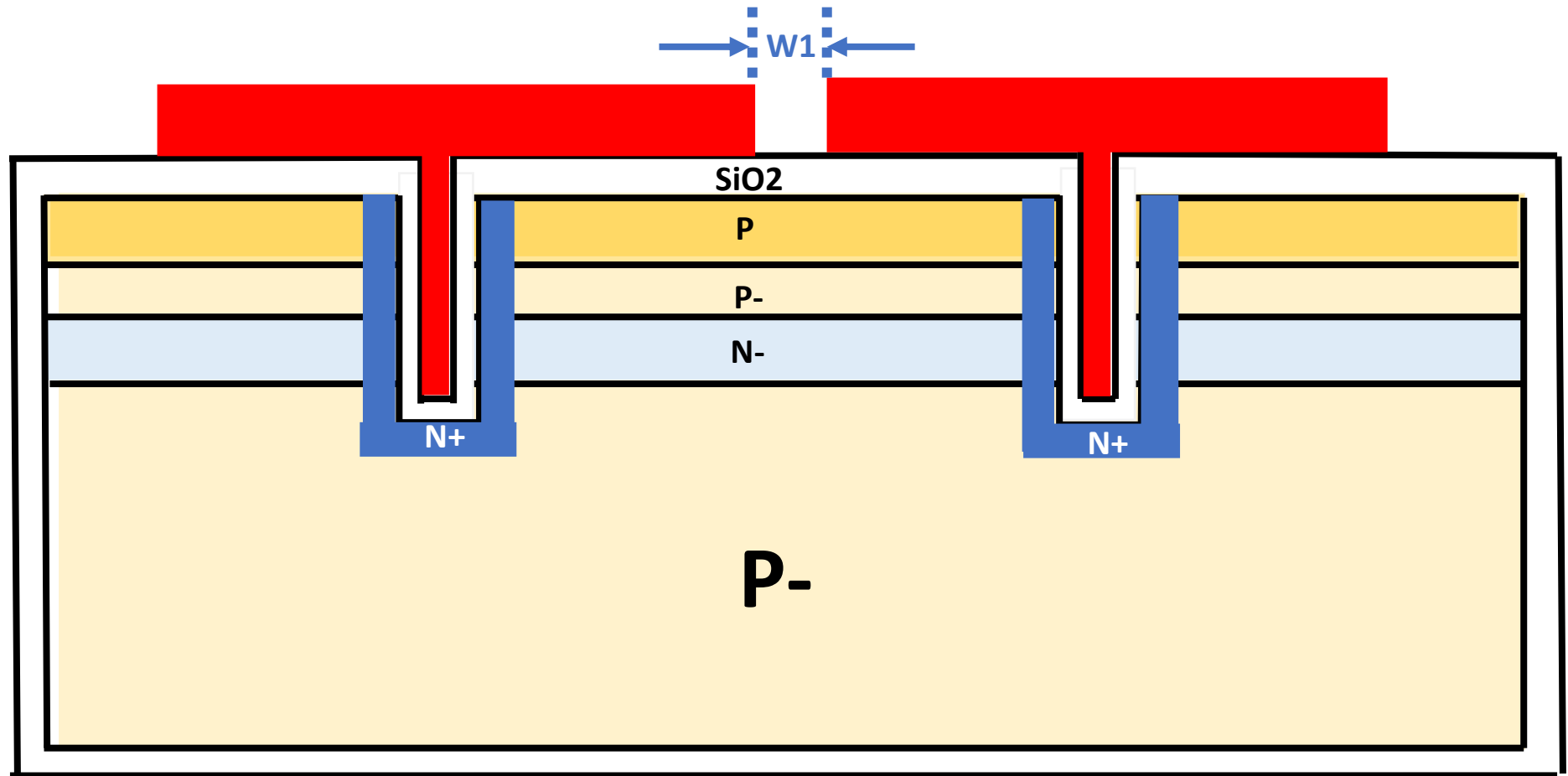
P07 OCD Coating and Thermal N+ Diffusion



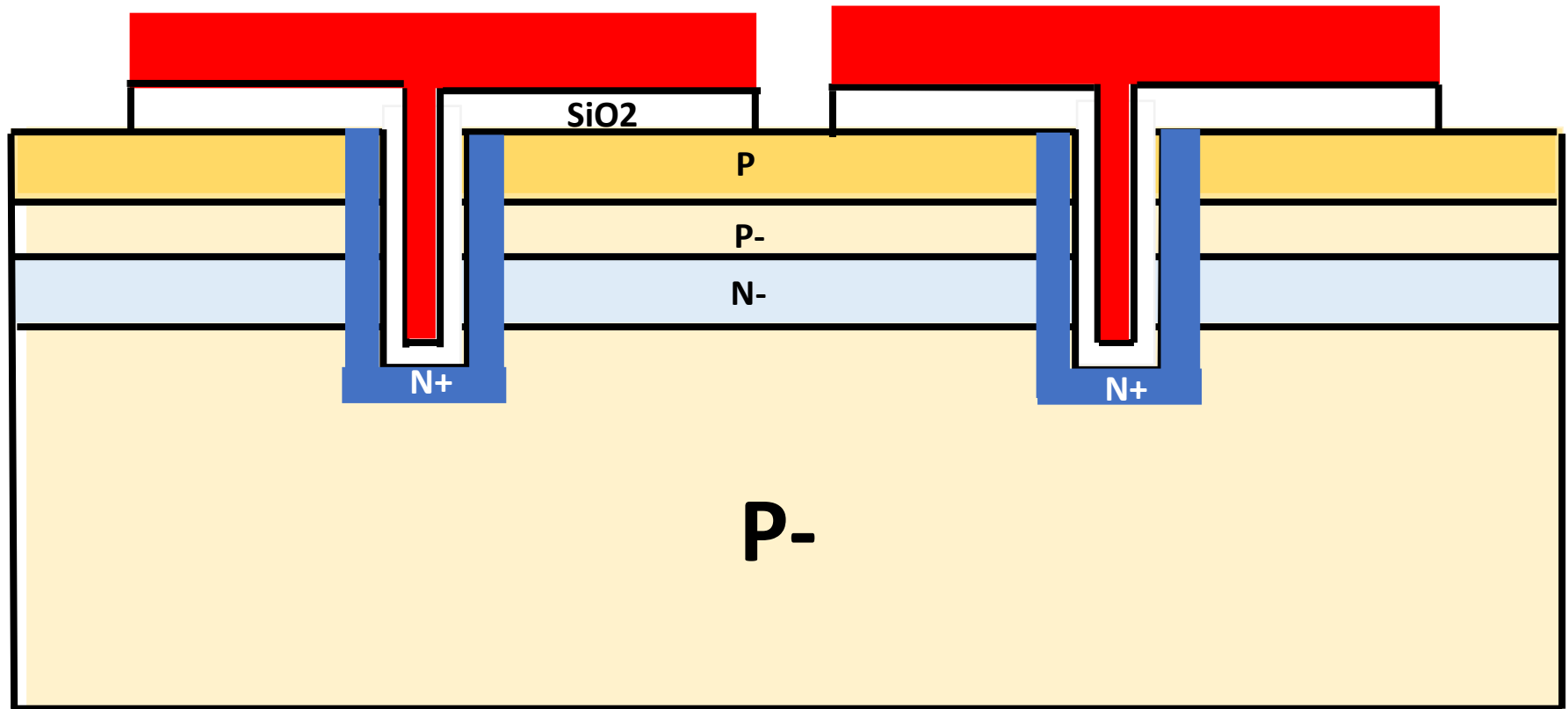
P08 Remove SiO₂ and Second Oxidation



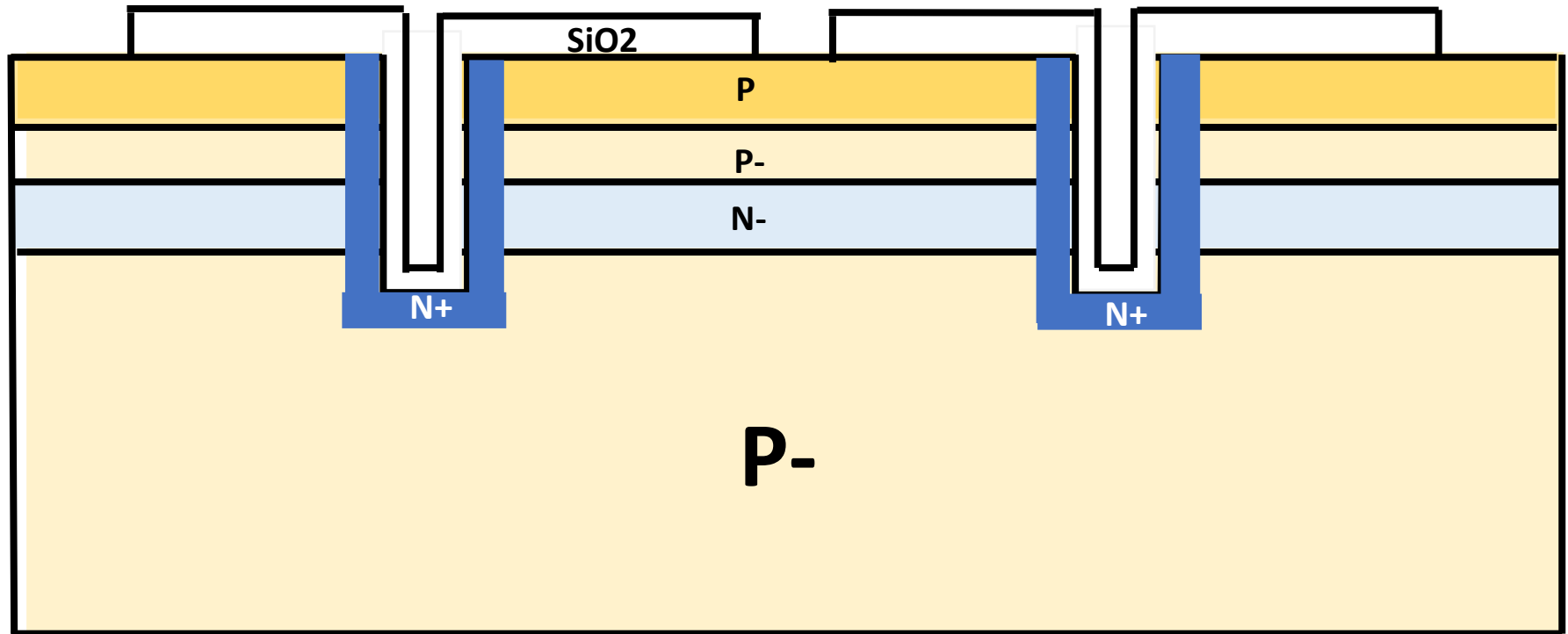
P09 Mask 02 Second Resist Coating and Patterning



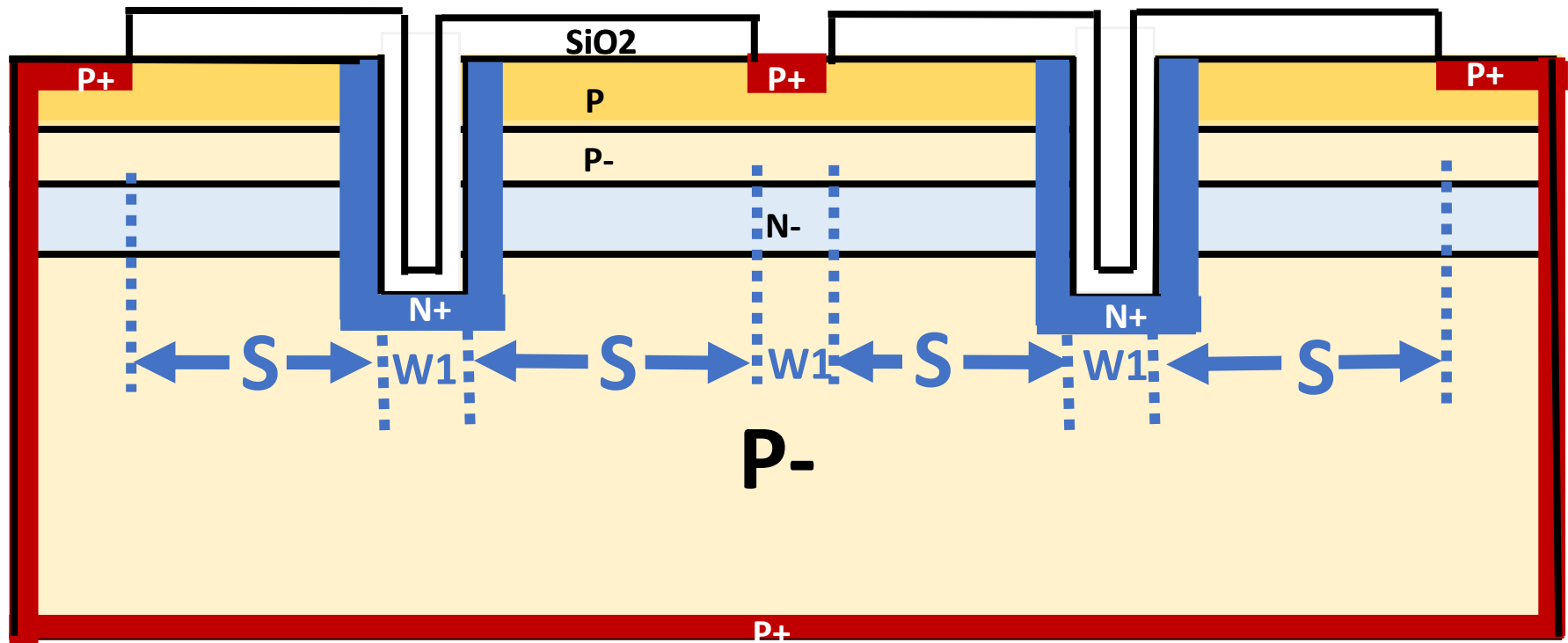
P10 Second SiO₂ Etching



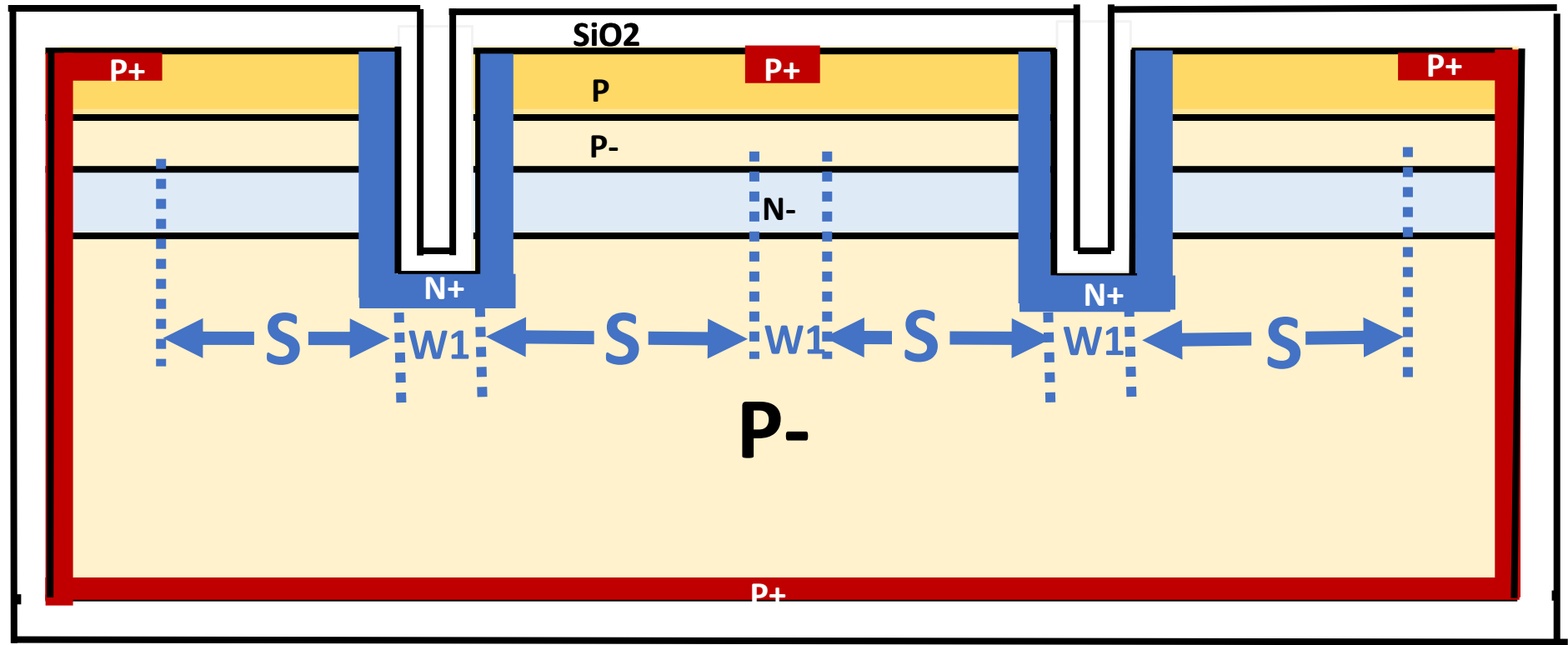
P11 Remove Resist



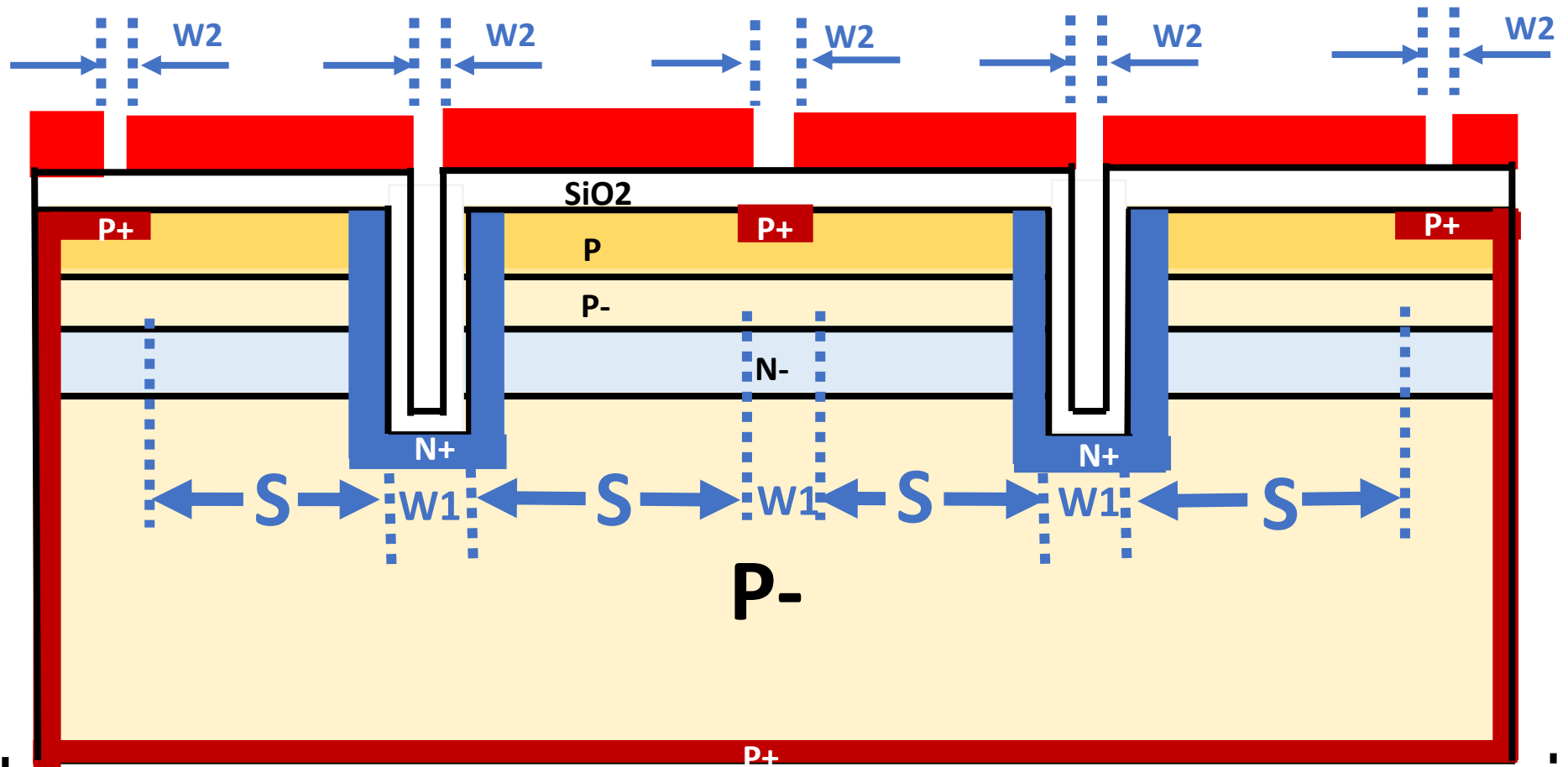
P12 PBF Coating and P+ Diffusion



P13 Remove SiO₂ and Third Oxidation

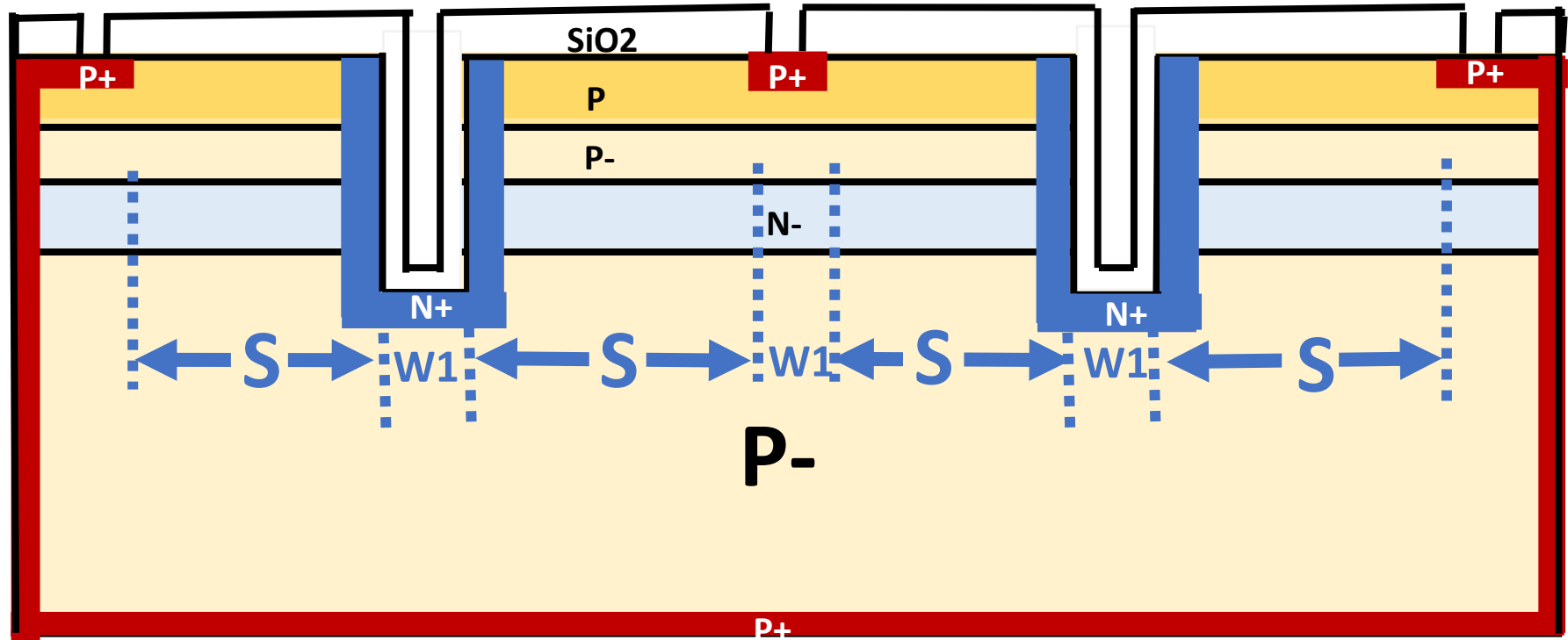


P14 Mask03 Third Resist Coating and Patterning

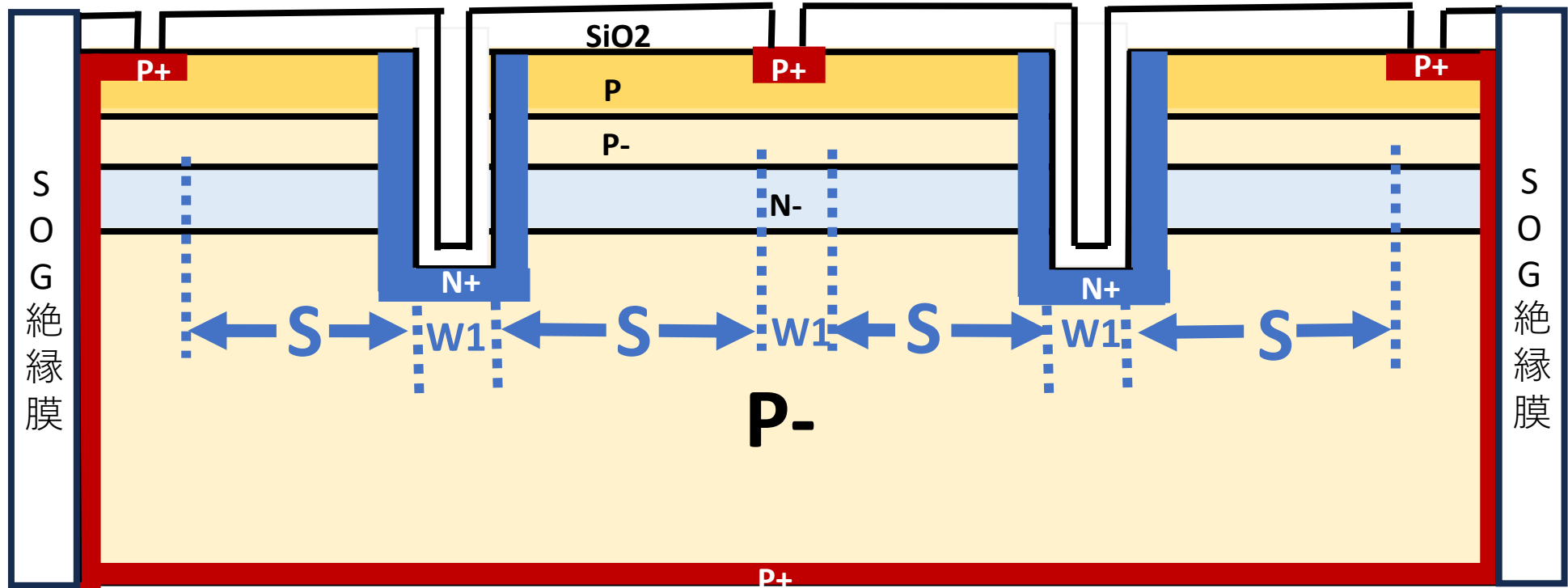


[illegible]

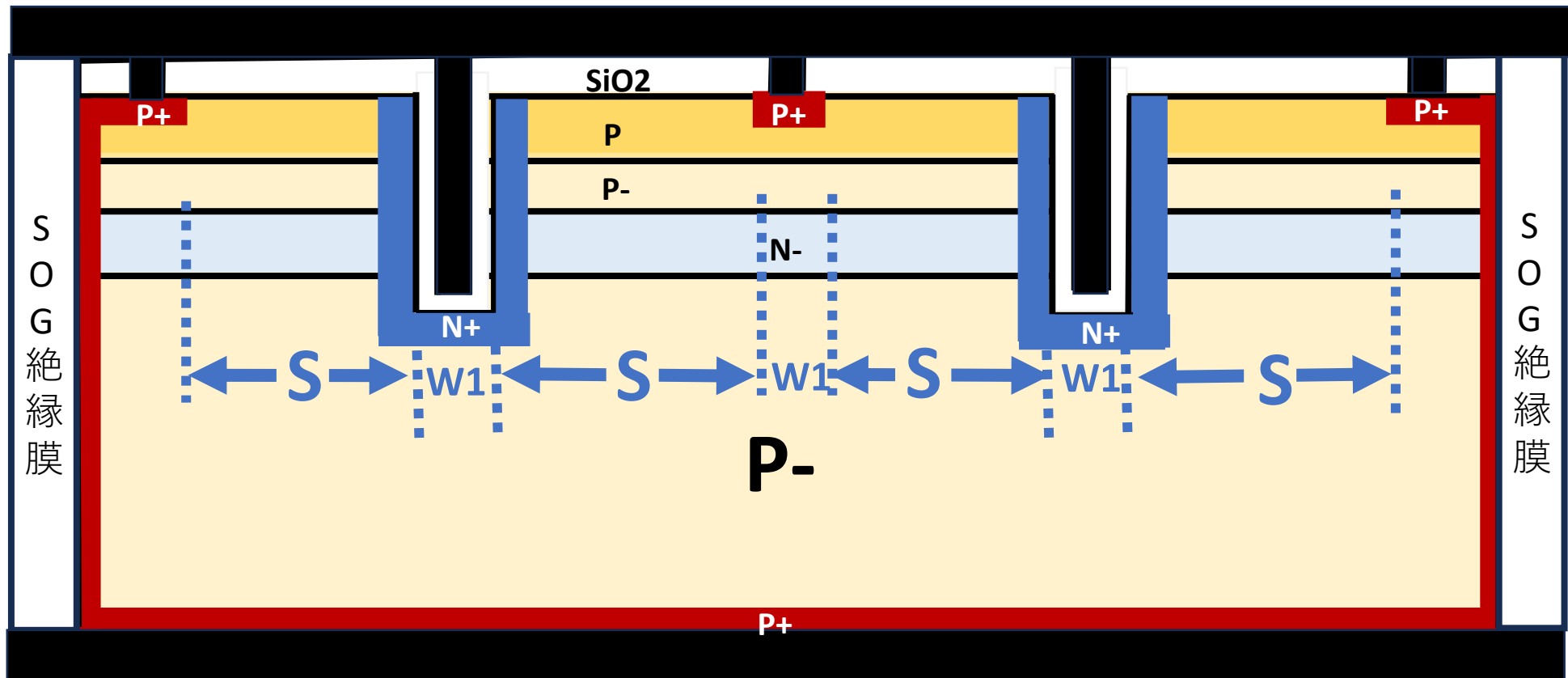
P16 Remove Resist



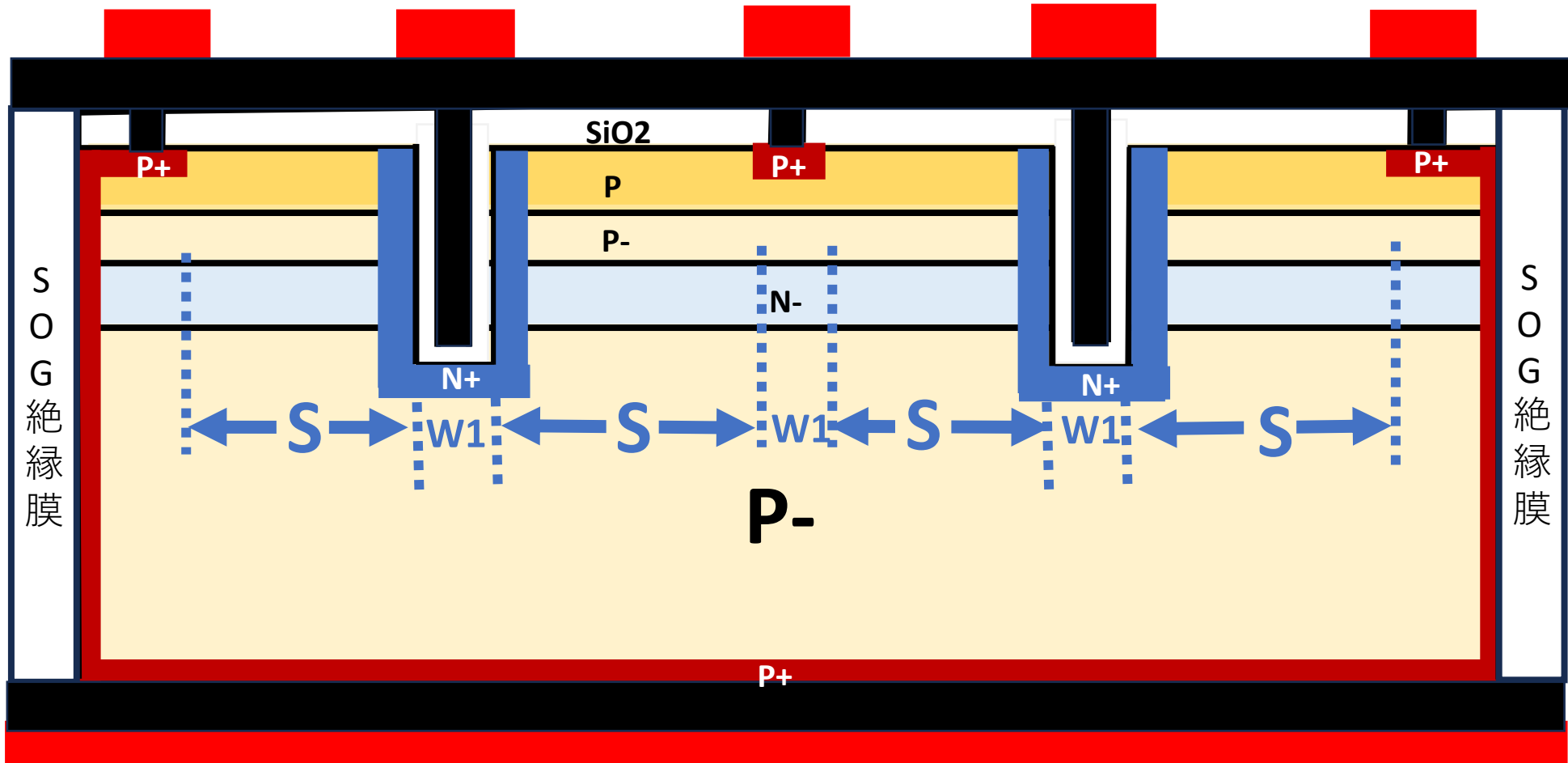
P17 SOG Side Coating



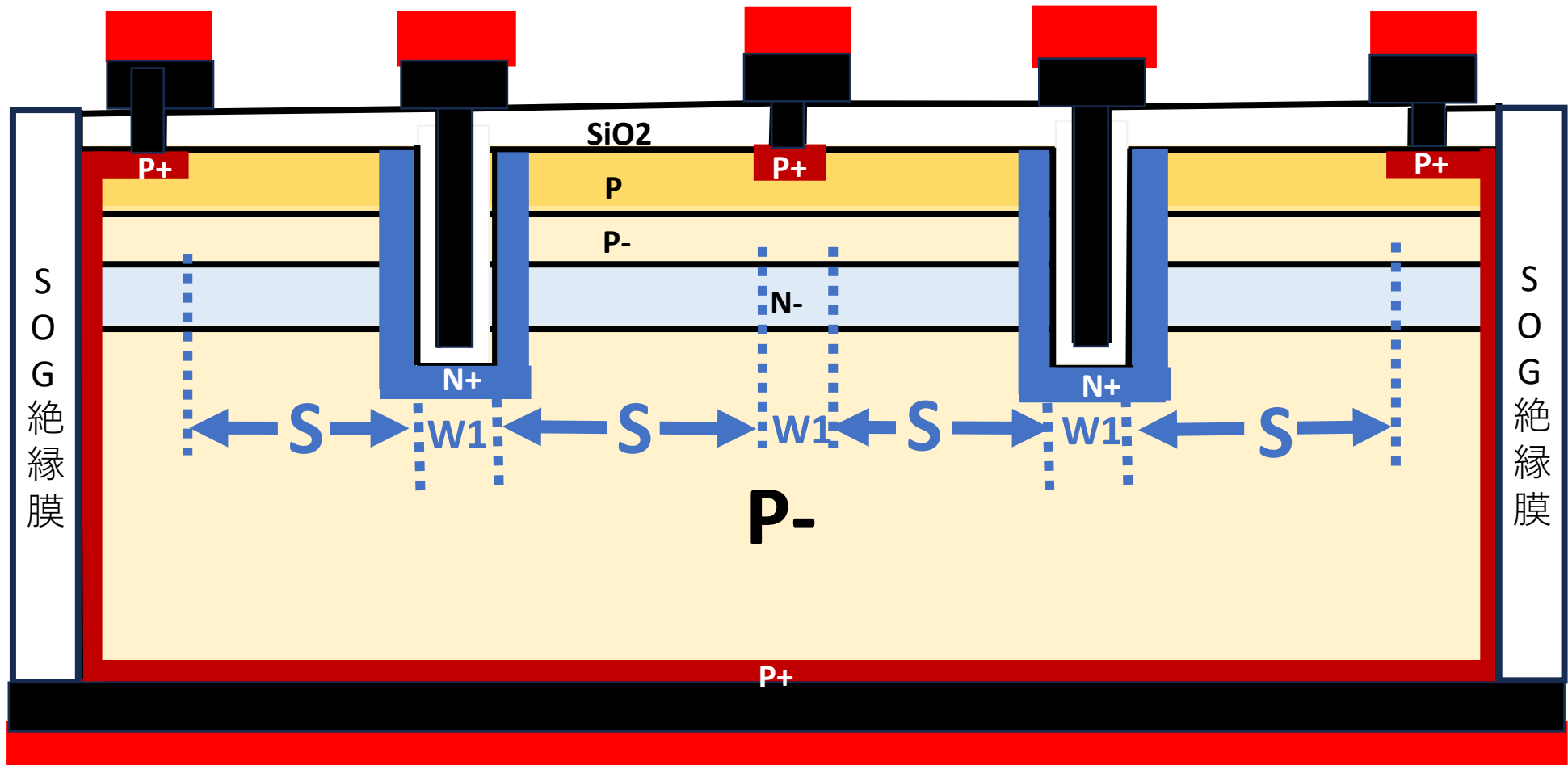
P18 Metal Deposit



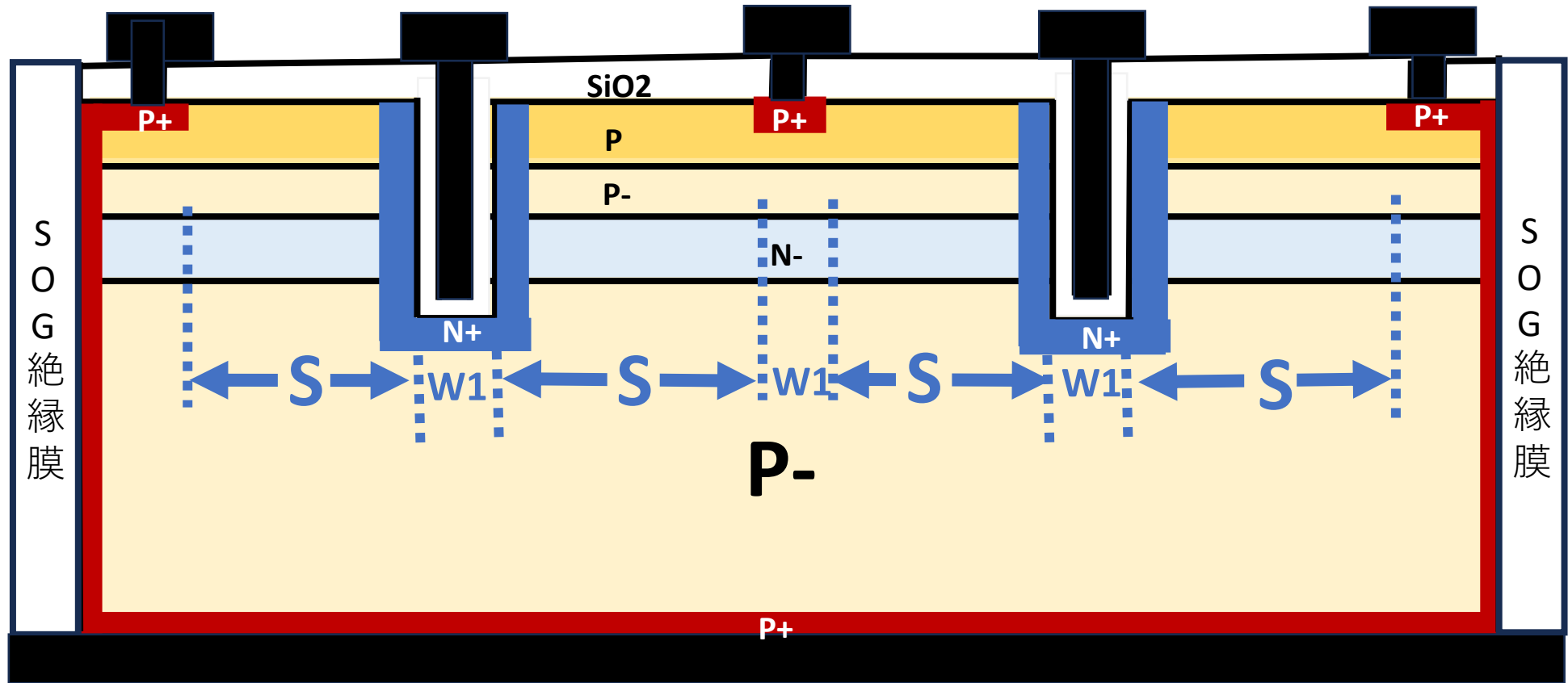
P19 MASK04 Resist Coating and Patterning



P20 Metal Etching



P21 Remove Resist



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