

Silicon Integrated Circuit Periodic Table

<p>Metal alloys Melting temperature - °C Resistivity - μ -cm</p> <p>Silicides Formation temperature - °C Max temperature on silicon - °C Resistivity - μ -cm Barrier to N-type and P-type - silicon - eV</p>		<p>TiO₃ k 20-30 BV 1.7x10⁷</p> <p>TiN T_m 2,930 21.7</p> <p>TiW T_m 2,930 21.7</p>	<p>Dopant</p> <p>Al P m 1.07 D 7x10⁻¹³</p> <p>Type - P or N Mismatch - radius divided by silicon radius Diffusivity in silicon @1,000°C - cm²/s</p>	<p>Semiconductor</p> <p>Si Eg 1.12 μ_n 1,450 μ_p 505</p> <p>Energy gap - E_g eV@300K Mobility - μ cm²/V-s@300K except Sn @100K</p>	<p>Inert</p> <p>Ar ArF 193 Ar 126</p> <p>Excimer laser dimer and wavelength - nm</p>	<p>Nitride Dielectric constant Breakdown voltage - V/cm</p> <p>Si₃N₄ k7.5 BV1x10⁷</p> <p>SiO₂ k3.9 B V1x10⁷</p>	<p>Al₂O₃ k 11.4/ 13.2</p>	<p>He DI</p>																			
<p>OX/DP H T_L -253 V 113.6</p>	<p>MI Li</p>	<p>Be</p>	<p>Metal Silicides</p> <table border="1"> <tr> <td>TiSi₂ T_F 650 T_S <900 13-25 E_b 0.6n 0.6p</td> <td>VSi₂ T_F NA T_S NA NA E_b NA</td> <td>CrSi₂ T_F 450 T_S NA 60 E_b 0.57n</td> <td>CoSi₂ T_F 450 T_S <950 18-25 E_b 0.65n, 0.93p</td> <td>NiSi T_F 400 T_S <450 10-15 E_b 0.66- 0.75n</td> <td> <p>Al P m 1.07 D 7x10⁻¹³</p> </td> </tr> <tr> <td>ZrSi₂ T_F 600 T_S NA NA E_b 0.6n 0.6p</td> <td>NbSi₂ T_F NA T_S NA NA E_b NA</td> <td>MoSi₂ T_F 1,000 T_S <1,000 100 E_b 0.55n</td> <td>RhSi T_F 300 T_S NA NA E_b 0.69n, 0.34p</td> <td>Pd₂Si T_F 200 T_S NA NA E_b 0.84n, 0.26p</td> <td> <p>Al OI</p> </td> </tr> </table>					TiSi ₂ T _F 650 T _S <900 13-25 E _b 0.6n 0.6p	VSi ₂ T _F NA T _S NA NA E _b NA	CrSi ₂ T _F 450 T _S NA 60 E _b 0.57n	CoSi ₂ T _F 450 T _S <950 18-25 E _b 0.65n, 0.93p	NiSi T _F 400 T _S <450 10-15 E _b 0.66- 0.75n	<p>Al P m 1.07 D 7x10⁻¹³</p>	ZrSi ₂ T _F 600 T _S NA NA E _b 0.6n 0.6p	NbSi ₂ T _F NA T _S NA NA E _b NA	MoSi ₂ T _F 1,000 T _S <1,000 100 E _b 0.55n	RhSi T _F 300 T _S NA NA E _b 0.69n, 0.34p	Pd ₂ Si T _F 200 T _S NA NA E _b 0.84n, 0.26p	<p>Al OI</p>	<p>Al OI</p>	<p>Cu OI</p>	<p>B P m 1.15 D 2x10⁻¹⁴</p>	<p>C E_g 5.47 μ_n 2,000 μ_p 2,100</p>	<p>N AN/NT T_L -196 V 93</p>	<p>O OX T_L -183 V 115</p>	<p>F Si SiO₂ Si₃N₄ F₂ 157</p>	<p>Ne</p>
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<p>MI Na t 1 μ 1x10⁻⁶</p>	<p>MI Mg E_a ~0.45 4.46 T_m 650</p>	<p>MI Ca</p>	<p>Sc</p>	<p>Ti E_a 1.45 42 T_m 1,668</p>	<p>V E_a ~1.4 26 T_m 1,900</p>	<p>Cr E_a ~1.3 12.9 T_m 1,875</p>	<p>Mn E_a ~0.9 185 T_m 1,245</p>	<p>Fe OI E_a ~1.8 7.1 T_m 2,334</p>	<p>Co E_a 1.5 6.24 T_m 1,493</p>	<p>Ni E_a ~2.1 6.84 T_m 1,453</p>	<p>Cu E_a ~1.35 1.673 T_m 1,083</p>	<p>Zn</p>	<p>Ga P E_a 0.6 2.6548 T_m 660</p>	<p>Ge E_g 0.78 μ_n 3,900 μ_p 1,800</p>	<p>As N m 1.0 D 1x10⁻¹⁵</p>	<p>Se</p>	<p>Br Si Al</p>	<p>Kr KrF 248</p>									
<p>MI Rb μ 6x10⁻¹⁴</p>	<p>MI Sr E_a 0.55 13 T_m 777</p>	<p>MI Y E_a 1.15 50 T_m 1,526</p>	<p>Zr E_a 1.85 41 T_m 1,830</p>	<p>Nb E_a ~1.75 13.1 T_m 2,415</p>	<p>Mo E_a ~2.1 5.2 T_m 2,610</p>	<p>Tc</p>	<p>Ru E_a ~1.8 7.1 T_m 2,334</p>	<p>Rh E_a ~1.45 4.5 T_m 1,960</p>	<p>Pd E_a ~1.12 10.8 T_m 1,554</p>	<p>Ag E_a ~0.95 1.59 T_m 961</p>	<p>Cd</p>	<p>In P m 1.22 D 6x10⁻¹⁵</p>	<p>Sn E_g 0.94 μ_n 1E5 μ_p 1E4</p>	<p>Sb N m 1.15 D 8x10⁻¹⁶</p>	<p>Te</p>	<p>I</p>	<p>Xe</p>										
<p>MI Cs</p>	<p>MI Ba E_a 0.67 61 T_m 920</p>	<p>MI La E_a 1.6 30 T_m 2,130</p>	<p>Hf E_a ~2.3 12.4 T_m 2,996</p>	<p>Ta E_a ~2.5 5.65 T_m 3,410</p>	<p>W</p>	<p>Re</p>	<p>Os</p>	<p>Ir E_a ~1.8 5.3 T_m 2,443</p>	<p>Pt E_a ~1.5 10.6 T_m 1,769</p>	<p>Au E_a 0.7 2.35 T_m 1,063</p>	<p>Hg</p>	<p>Tl</p>	<p>Pb E_a ~0.4 20.65 T_m 327</p>	<p>Bi</p>	<p>Po</p>	<p>At</p>	<p>Rn</p>										

<p>Oxides that are thermodynamically stable on silicon</p> <p>MgAl₂O₄ k 8.6</p> <p>Y₂O₃ k 14</p> <p>Y₂O₃ - ZrO₂ k 29.7</p> <p>LaAlO₃ k 25.1</p>	<p>HfSi T_F 550 T_S NA 45-50 E_b 0.53n, 0.55</p>	<p>TaSi₂ T_F NA T_S <1,000 35-38 E_b 0.59n,</p>	<p>WSi₂ T_F 650 T_S <1,000 70 E_b 0.65n,</p>	<p>Metal Silicides</p>	<p>IrSi T_F 300 T_S NA NA E_b 0.93n, 0.19p</p>	<p>PtSi T_F NA T_S <750 28-35 E_b NA</p>
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<p>Pb(Zr,Ti)O₃ PZT k 55-700 BV 2x10⁵</p> <p>Pb-La-Ti-O PLT k 1,400</p>	<p>Si F SiO₂ Si₃N₄ F₂ 157</p> <p>Materials the atomic specie will etch Excited dimer and emission wavelength - nm</p>
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<p>Oxides Dielectric constant</p> <p>ZrO₂ k 25</p> <p>HfO₂ k 30-40</p> <p>ZrSiO₄ k 12.4</p>	<p>Contaminants</p> <p>TaN T_m NA NA</p> <p>Ta₂O₃ k 25 BV 1x10⁶</p>
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Na t 1
 μ 1x10⁻⁷

Transit time @ 300K across 100nm SiO₂ for a field of 10⁶ V/cm - s
Mobility in SiO₂ at 200°C - cm²/V-s

Metal oxides
Abbreviation
Dielectric constant
Breakdown voltage - V/cm

SrTiO₃
STO
k 100-600
BV 4.5x10⁶

Ba_{0.5}Sr_{0.5}TiO₃
BST
k 55-600
BV 1x10⁶

Contaminant key
MI - mobile ion in SiO₂
OI - reduces SiO₂ integrity
MCL - reduces minority carrier lifetime

Ni E_a ~2.1
6.84
T_m 1,453

Metal

Electromigration activation energy - E_a eV@300K estimated from T_m
Resistivity - μ -cm
Melting temperature - °C

Use key
AN - annealing
ION - plasma ion generation
OX - oxidation
DP - defect passivation
NT - nitride formation
DI - diluent

Halogen

H OX/DP
T_L -253
V 113.6

Bulk Gas

Use - see key
Liquid temperature - °C
Volume - ft³ gas/gal liquid