



SILICON



Silicon

- Silicon in the Periodic Table
- Natural compounds of Silicon
- Traditional uses
- Modern Silicon chemistry
- Semiconductors and the Silicon Chip
- Solar cells

Main-Group Elements
s Subshell fills

Main-Group Elements
p Subshell fills

	1 IA										18 VIII																									
	1 H 1s ¹										2 He 1s ²																									
1																																				
	2 IIA		Transition Metals d Subshell fills										13 IIIA		14 IVA		15 VA		16 VIA		17 VIIA		18 VIII													
2	3 Li 2s ¹		4 Be 2s ²												5 B 2s ² 2p ¹		6 C 2s ² 2p ²		7 N 2s ² 2p ³		8 O 2s ² 2p ⁴		9 F 2s ² 2p ⁵		10 Ne 2s ² 2p ⁶											
3	11 Na 3s ¹		12 Mg 3s ²		3 IIIB		4 IVB		5 VB		6 VIB		7 VIIB		8 VIII B		9 VIII B		10 VIII B		11 IB		12 IIB		13 Al 3s ² 3p ¹		14 Si 3s ² 3p ²		15 P 3s ² 3p ³		16 S 3s ² 3p ⁴		17 Cl 3s ² 3p ⁵		18 Ar 3s ² 3p ⁶	
4	19 K 4s ¹		20 Ca 4s ²		21 Sc 3d ¹ 4s ²		22 Ti 3d ² 4s ²		23 V 3d ³ 4s ²		24 Cr 3d ⁵ 4s ¹		25 Mn 3d ⁵ 4s ²		26 Fe 3d ⁶ 4s ²		27 Co 3d ⁷ 4s ²		28 Ni 3d ⁸ 4s ²		29 Cu 3d ¹⁰ 4s ¹		30 Zn 3d ¹⁰ 4s ²		31 Ga 4s ² 4p ¹		32 Ge 4s ² 4p ²		33 As 4s ² 4p ³		34 Se 4s ² 4p ⁴		35 Br 4s ² 4p ⁵		36 Kr 4s ² 4p ⁶	
5	37 Rb 5s ¹		38 Sr 5s ²		39 Y 4d ¹ 5s ²		40 Zr 4d ² 5s ²		41 Nb 4d ⁴ 5s ¹		42 Mo 4d ⁵ 5s ¹		43 Tc 4d ⁵ 5s ²		44 Ru 4d ⁷ 5s ¹		45 Rh 4d ⁸ 5s ¹		46 Pd 4d ¹⁰		47 Ag 4d ¹⁰ 5s ¹		48 Cd 4d ¹⁰ 5s ²		49 In 5s ² 5p ¹		50 Sn 5s ² 5p ²		51 Sb 5s ² 5p ³		52 Te 5s ² 5p ⁴		53 I 5s ² 5p ⁵		54 Xe 5s ² 5p ⁶	
6	55 Cs 6s ¹		56 Ba 6s ²		57 La* 5d ¹ 6s ²		72 Hf 5d ² 6s ²		73 Ta 5d ³ 6s ²		74 W 5d ⁴ 6s ²		75 Re 5d ⁵ 6s ²		76 Os 5d ⁶ 6s ²		77 Ir 5d ⁷ 6s ²		78 Pt 5d ⁹ 6s ¹		79 Au 5d ¹⁰ 6s ¹		80 Hg 5d ¹⁰ 6s ²		81 Tl 6s ² 6p ¹		82 Pb 6s ² 6p ²		83 Bi 6s ² 6p ³		84 Po 6s ² 6p ⁴		85 At 6s ² 6p ⁵		86 Rn 6s ² 6p ⁶	
7	87 Fr 7s ¹		88 Ra 7s ²		89 Ac** 6d ¹ 7s ²		104 Db 6d ² 7s ²		105 Jl 6d ³ 7s ²		106 Rf 6d ⁴ 7s ²		107 Bh 6d ⁵ 7s ²		108 Hn 6d ⁶ 7s ²		109 Mt 6d ⁷ 7s ²		Inner-Transition Metals f Subshell fills																	

*Lanthanides

**Actinides

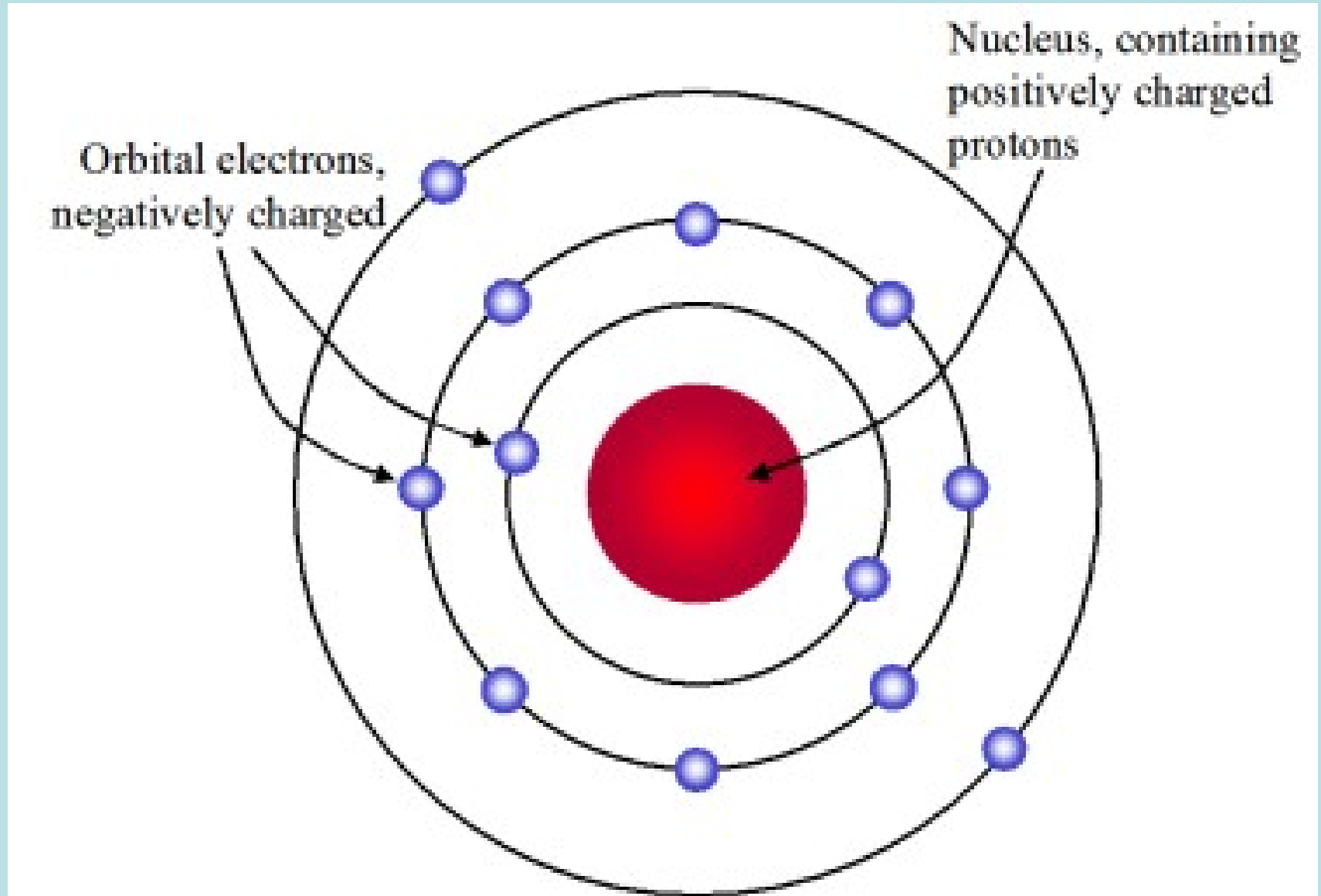
58 Ce 4f ¹ 5d ¹ 6s ²	59 Pr 4f ³ 6s ²	60 Nd 4f ⁴ 6s ²	61 Pm 4f ⁵ 6s ²	62 Sm 4f ⁶ 6s ²	63 Eu 4f ⁷ 6s ²	64 Gd 4f ⁷ 5d ¹ 6s ²	65 Tb 4f ⁹ 6s ²	66 Dy 4f ¹⁰ 6s ²	67 Ho 4f ¹¹ 6s ²	68 Er 4f ¹² 6s ²	69 Tm 4f ¹³ 6s ²	70 Yb 4f ¹⁴ 6s ²	71 Lu 4f ¹⁴ 5d ¹ 6s ²
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- Metal
- Metalloid
- Nonmetal

SILICON & ITS NEIGHBOURS

	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIII
2	5 B $2s^2 2p^1$	6 C $2s^2 2p^2$	7 N $2s^2 2p^3$	8 O $2s^2 2p^4$	9 F $2s^2 2p^5$	10 Ne $2s^2 2p^6$
3	13 Al $3s^2 3p^1$	14 Si $3s^2 3p^2$	15 P $3s^2 3p^3$	16 S $3s^2 3p^4$	17 Cl $3s^2 3p^5$	18 Ar $3s^2 3p^6$
4	31 Ga $4s^2 4p^1$	32 Ge $4s^2 4p^2$	33 As $4s^2 4p^3$	34 Se $4s^2 4p^4$	35 Br $4s^2 4p^5$	36 Kr $4s^2 4p^6$
5	49 In $5s^2 5p^1$	50 Sn $5s^2 5p^2$	51 Sb $5s^2 5p^3$	52 Te $5s^2 5p^4$	53 I $5s^2 5p^5$	54 Xe $5s^2 5p^6$
6	81 Tl $6s^2 6p^1$	82 Pb $6s^2 6p^2$	83 Bi $6s^2 6p^3$	84 Po $6s^2 6p^4$	85 At $6s^2 6p^5$	86 Rn $6s^2 6p^6$

Atomic Model (Magnesium)



Main-Group Elements
s Subshell fills

Main-Group Elements
p Subshell fills

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- Metal
- Metalloid
- Nonmetal

Natural compounds of silicon

- Sand and clay
- . Minerals such as talc, mica, feldspar, nepheline, olivine, vermiculite, perlite asbestos kaolinite and zeolites.
- Gemstones opal, amethyst, peridot.



Traditional uses of silicon compounds

- Glass - from sand (silica)
- Ceramics - from kaolinite
- Silica Gel - dessicant
- Moissanite - Silicon Carbide - abrasive
- Building materials

Modern Silicon Chemistry

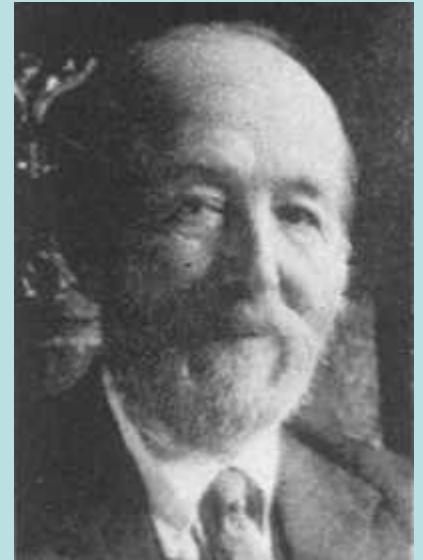
- Silicon aerogel, fumed-silica, silica fume
- Metal alloys
- Organosilicon compounds
- Silicides
- Silicones and Silanes
- Synthetic Zeolites

ORGANOSILICON COMPOUNDS

SILICONES

Inert, heat-resistant, rubber-like polymers

Gaskets and seals, greases and oils, coatings (hydrophobic), bakeware and moulds, dry-cleaning and de-foaming, smart-phone / tablet cases, toys (silly-putty)



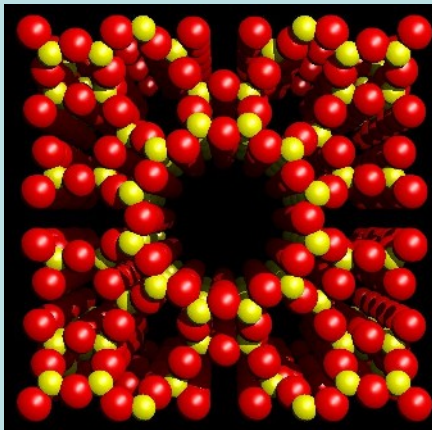
Frederick Kipping



ZEOLITES



Richard Barrer



Micro-porous crystals

Catalysts, surfactants
(washing powder etc.),

air-conditioning,

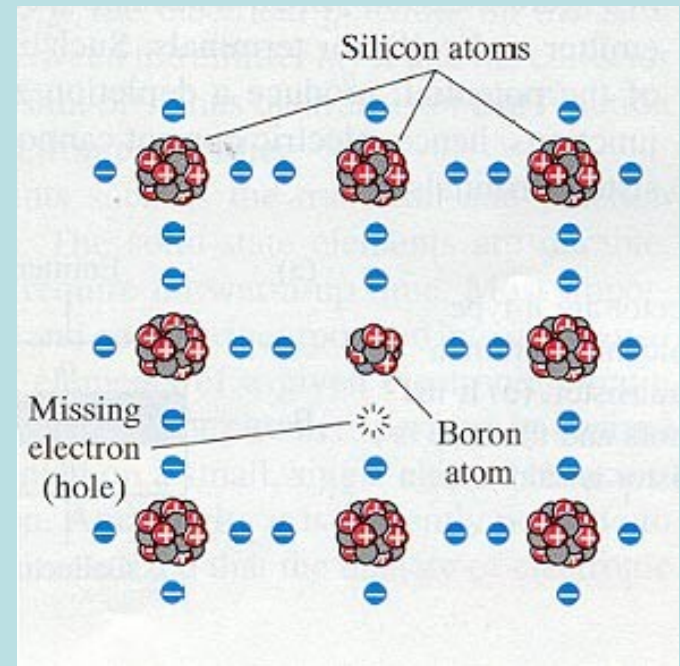
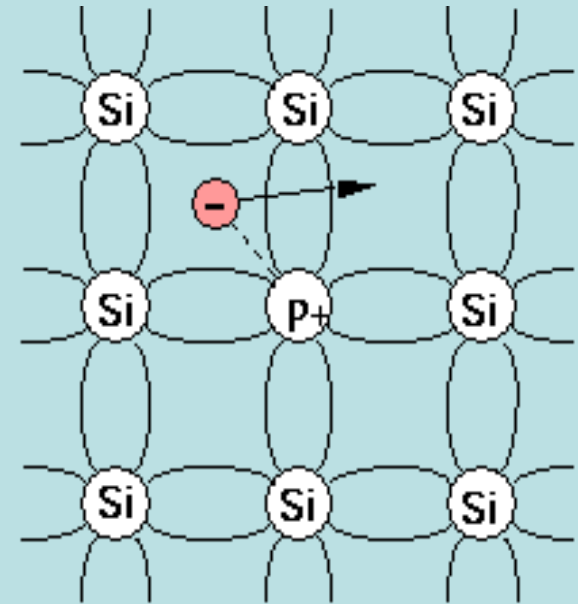
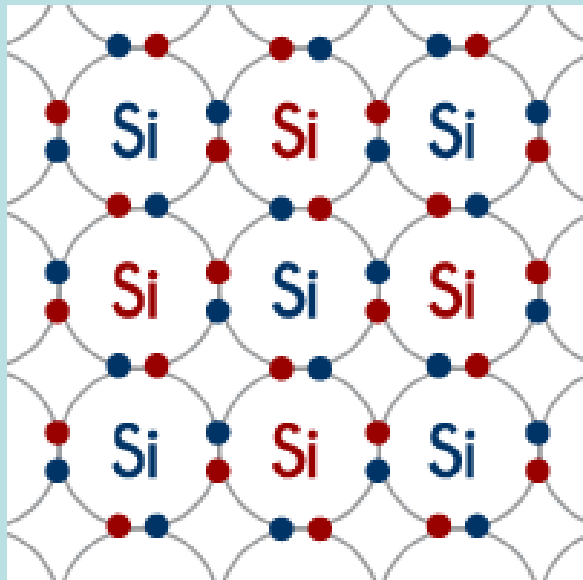
water-purification

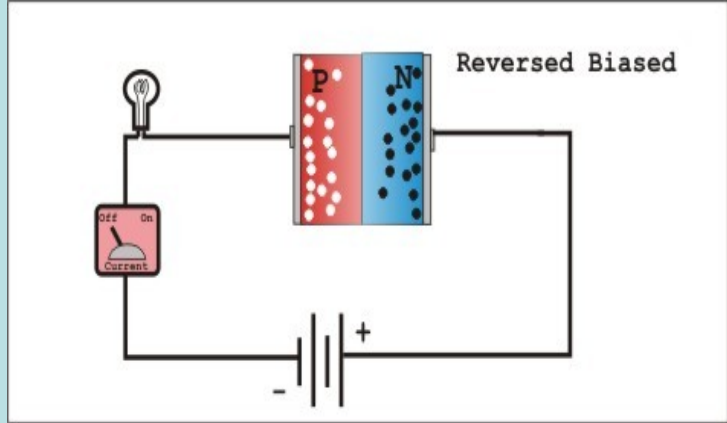
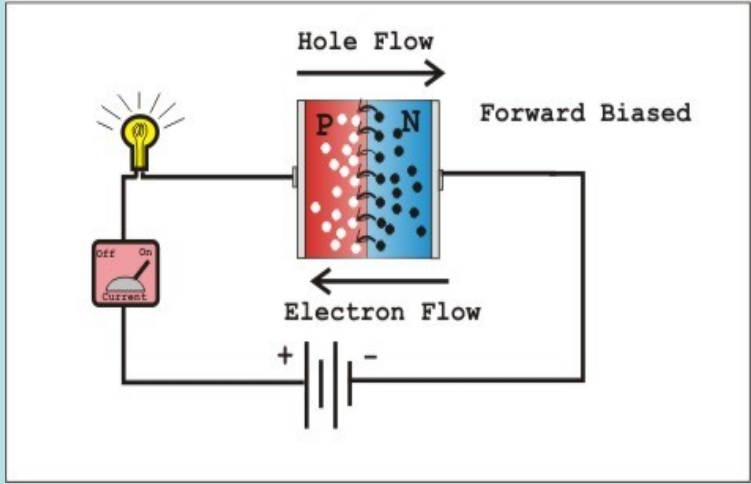
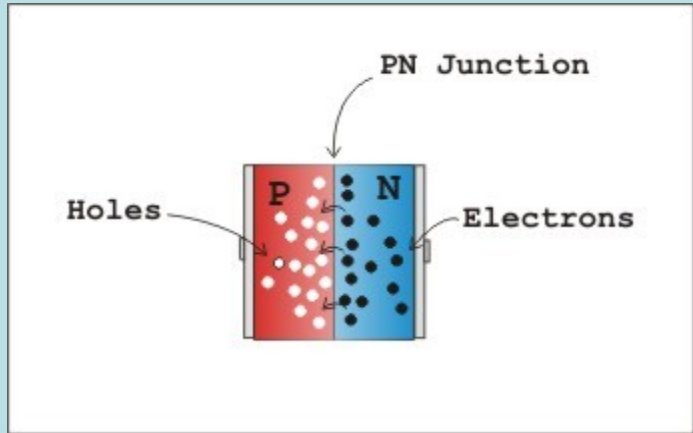
- and fringe medicine!

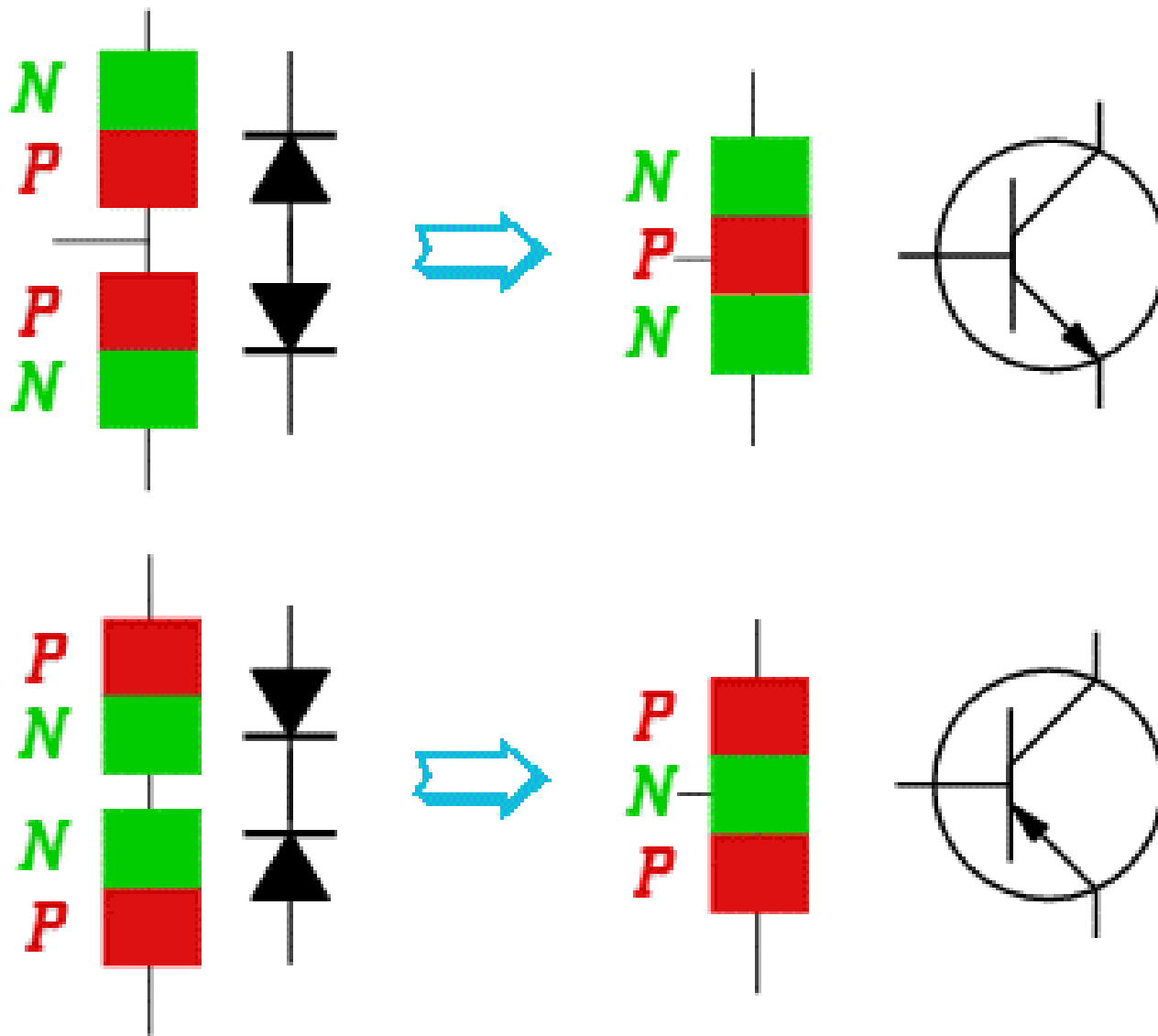


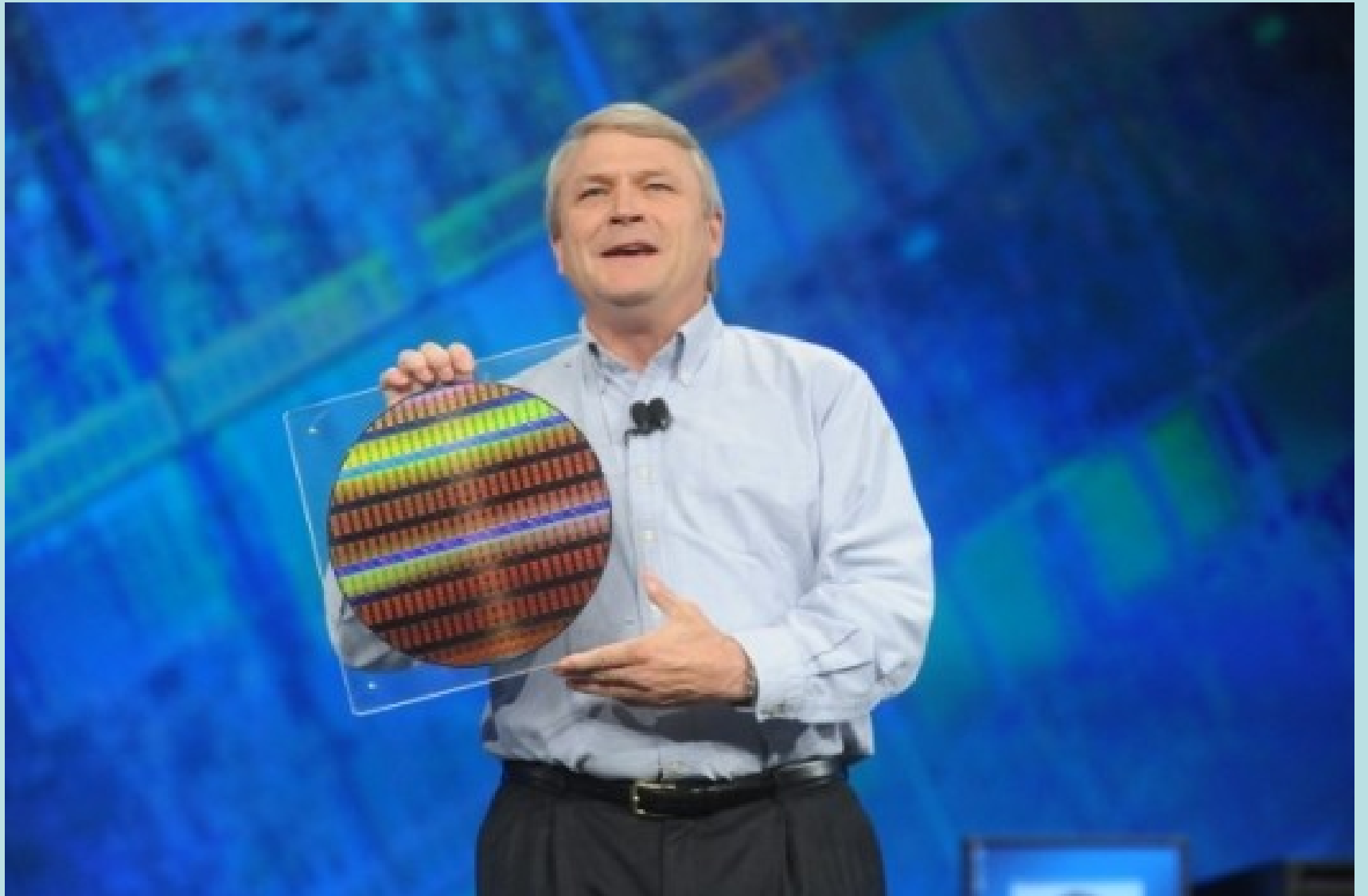
SILICON
AND
SEMICONDUCTORS

Mono-crystalline Silicon - and Doping

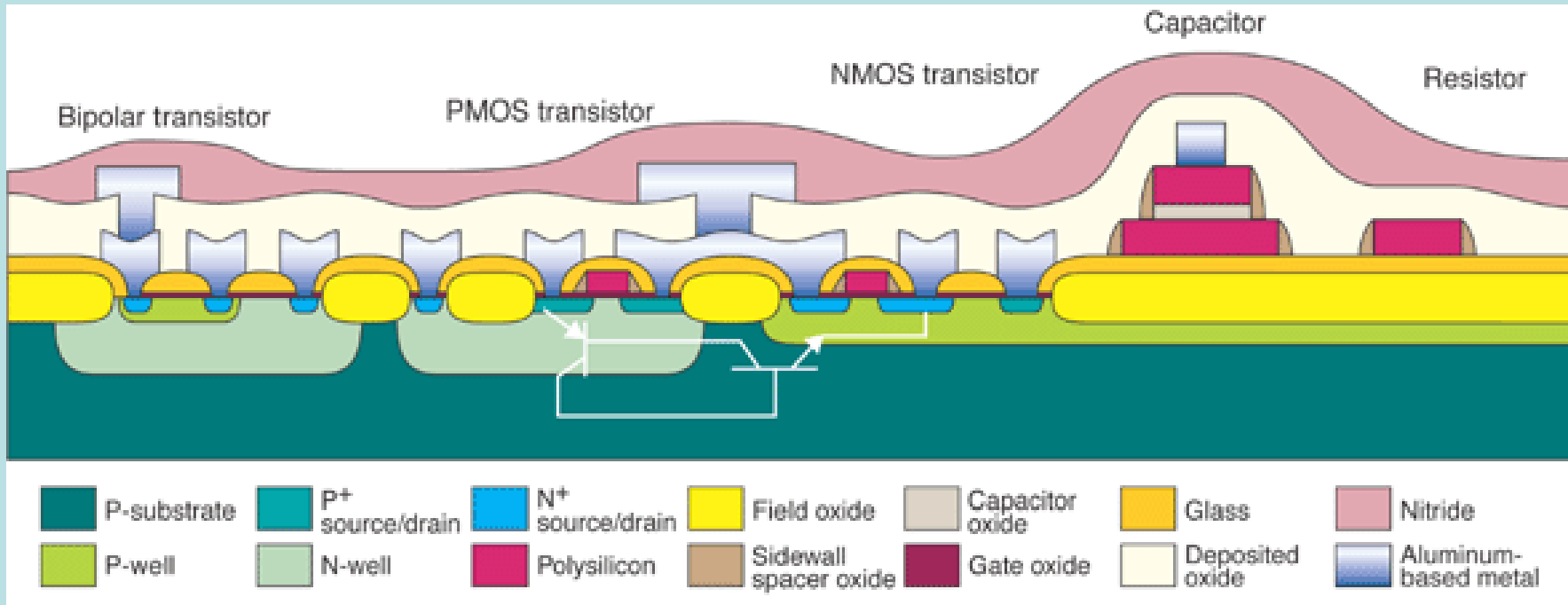








LAYERS OF A SILICON INTEGRATED CIRCUIT



Forms of crystalline silicon

Metallurgical grade - alloys

Monocrystalline - electronics

Polycrystalline - electronics & solar panels

UMG - solar panels

Porous silicon - opto-electronics



SILICON