

無機固体化学 2 2 1 3

北川 宏

火曜日 2 限目 化学第 2 講義室

IUPAC Periodic Table of the Elements

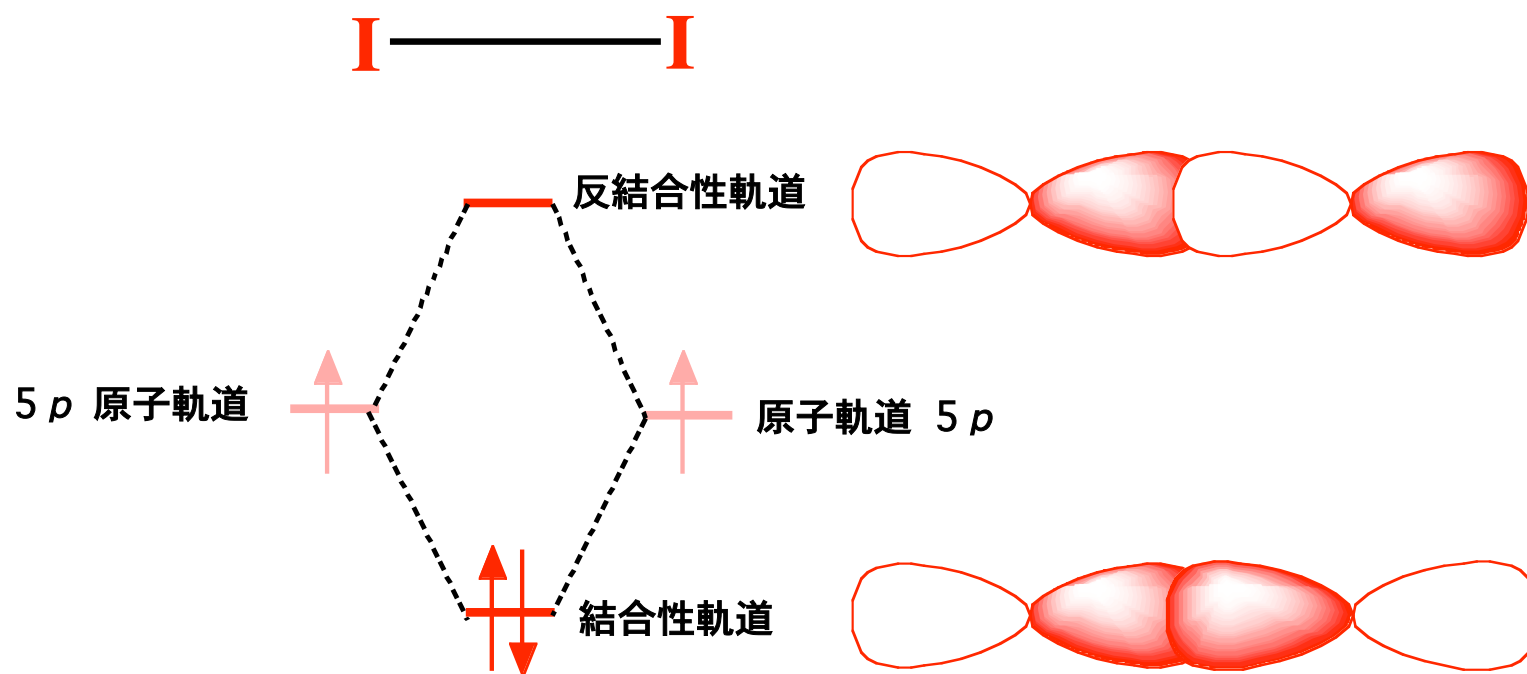
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H hydrogen 1.007 94(7)																	2 He helium 4.002 602(2)
3 Li lithium 6.941(2)	4 Be beryllium 9.012 182(3)											5 B boron 10.811(7)	6 C carbon 12.0107(8)	7 N nitrogen 14.0067(2)	8 O oxygen 15.9994(3)	9 F fluorine 18.998 4032(5)	10 Ne neon 20.1797(6)
11 Na sodium 22.989 770(2)	12 Mg magnesium 24.3050(6)											13 Al aluminium 26.981 538(2)	14 Si silicon 28.0855(3)	15 P phosphorus 30.973 761(2)	16 S sulfur 32.065(5)	17 Cl chlorine 35.453(2)	18 Ar argon 39.948(1)
19 K potassium 39.0983(1)	20 Ca calcium 40.078(4)	21 Sc scandium 44.955 910(8)	22 Ti titanium 47.867(1)	23 V vanadium 50.9415(1)	24 Cr chromium 51.9961(6)	25 Mn manganese 54.938 049(9)	26 Fe iron 55.845(2)	27 Co cobalt 58.933 200(9)	28 Ni nickel 58.6934(2)	29 Cu copper 63.546(3)	30 Zn zinc 65.409(4)	31 Ga gallium 69.723(1)	32 Ge germanium 72.64(1)	33 As arsenic 74.921 60(2)	34 Se selenium 78.96(3)	35 Br bromine 79.904(1)	36 Kr krypton 83.798(2)
37 Rb rubidium 85.4678(3)	38 Sr strontium 87.62(1)	39 Y yttrium 88.905 85(2)	40 Zr zirconium 91.224(2)	41 Nb niobium 92.906 38(2)	42 Mo molybdenum 95.94(2)	43 Tc technetium [97.9072]	44 Ru ruthenium 101.07(2)	45 Rh rhodium 102.905 50(2)	46 Pd palladium 106.42(1)	47 Ag silver 107.8682(2)	48 Cd cadmium 112.411(8)	49 In indium 114.818(3)	50 Sn tin 118.710(7)	51 Sb antimony 121.760(1)	52 Te tellurium 127.60(3)	53 I iodine 126.904 47(3)	54 Xe xenon 131.293(6)
55 Cs caesium 132.905 45(2)	56 Ba barium 137.327(7)	57-71 lanthanoids	72 Hf hafnium 178.49(2)	73 Ta tantalum 180.9479(1)	74 W tungsten 183.84(1)	75 Re rhenium 186.207(1)	76 Os osmium 190.23(3)	77 Ir iridium 192.217(3)	78 Pt platinum 195.078(2)	79 Au gold 196.966 55(2)	80 Hg mercury 200.59(2)	81 Tl thallium 204.3833(2)	82 Pb lead 207.2(1)	83 Bi bismuth 208.980 38(2)	84 Po polonium [208.9824]	85 At astatine [209.9871]	86 Rn radon [222.0176]
87 Fr francium [223.0197]	88 Ra radium [226.0254]	89-103 actinoids	104 Rf rutherfordium [261.1088]	105 Db dubnium [262.1141]	106 Sg seaborgium [266.1219]	107 Bh bohrium [264.12]	108 Hs hassium [277]	109 Mt meitnerium [268.1388]	110 Ds darmstadtium [269]	111 Uuu unununium [272]	112 Uub ununbium [285]		114 Uuq ununquadium [289]		116 Uuh ununhexium [289]		
			57 La lanthanum 138.9055(2)	58 Ce cerium 140.116(1)	59 Pr praseodymium 140.907 65(2)	60 Nd neodymium 144.24(3)	61 Pm promethium [144.9127]	62 Sm samarium 150.36(3)	63 Eu europium 151.964(1)	64 Gd gadolinium 157.25(3)	65 Tb terbium 158.925 34(2)	66 Dy dysprosium 162.500(1)	67 Ho holmium 164.930 32(2)	68 Er erbium 167.259(3)	69 Tm thulium 168.934 21(2)	70 Yb ytterbium 173.04(3)	71 Lu lutetium 174.967(1)
			89 Ac actinium [227.0277]	90 Th thorium 232.0381(1)	91 Pa protactinium 231.035 88(2)	92 U uranium 238.028 91(3)	93 Np neptunium [237.0482]	94 Pu plutonium [244.0642]	95 Am americium [243.0614]	96 Cm curium [247.0704]	97 Bk berkelium [247.0703]	98 Cf californium [251.0796]	99 Es einsteinium [252.0830]	100 Fm fermium [257.0951]	101 Md mendelevium [258.0984]	102 No nobelium [259.1010]	103 Lr lawrencium [262.1097]

Notes

- IUPAC alternative names or spelling exist for the elements aluminium (aluminum) and caesium (cesium) and, in special circumstances, sodium (natrium), potassium (kalium), iron (ferrum), copper (cuprum), silver (argentum), tin (stannum), antimony (stibium), tungsten (wolfram), gold (aurum), mercury (hydrargyrum), and lead (plumbum).
- Relative atomic masses ('atomic weights') of elements with no IUPAC assigned standard values are listed between square brackets. IUPAC 2001 standard values are given for other elements, with uncertainties in the last figure in parentheses [R. Loss, Pure Appl. Chem. 75, 1107-1122 (2003)].
- Element with atomic number 111 has not yet been named. The IUPAC provisional name is shown.
- Claims for the existence of elements with atomic numbers 112, 114, and 116 have not been recognized by IUPAC as of August 2003.

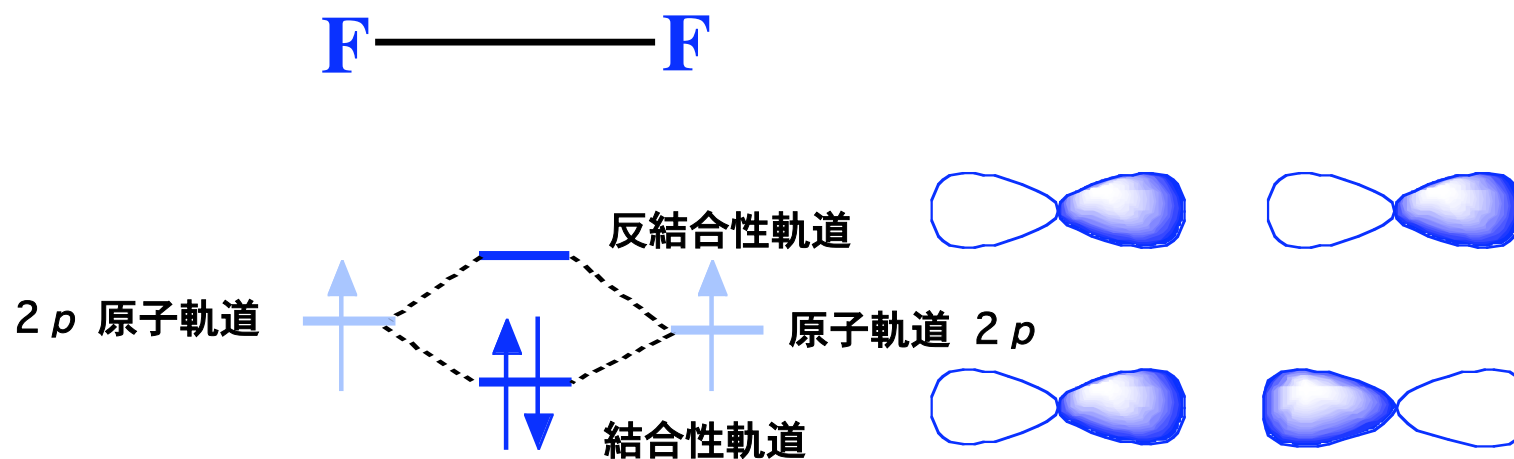
軌道（波動関数）の広がり

共有結合性：大 (I_2)



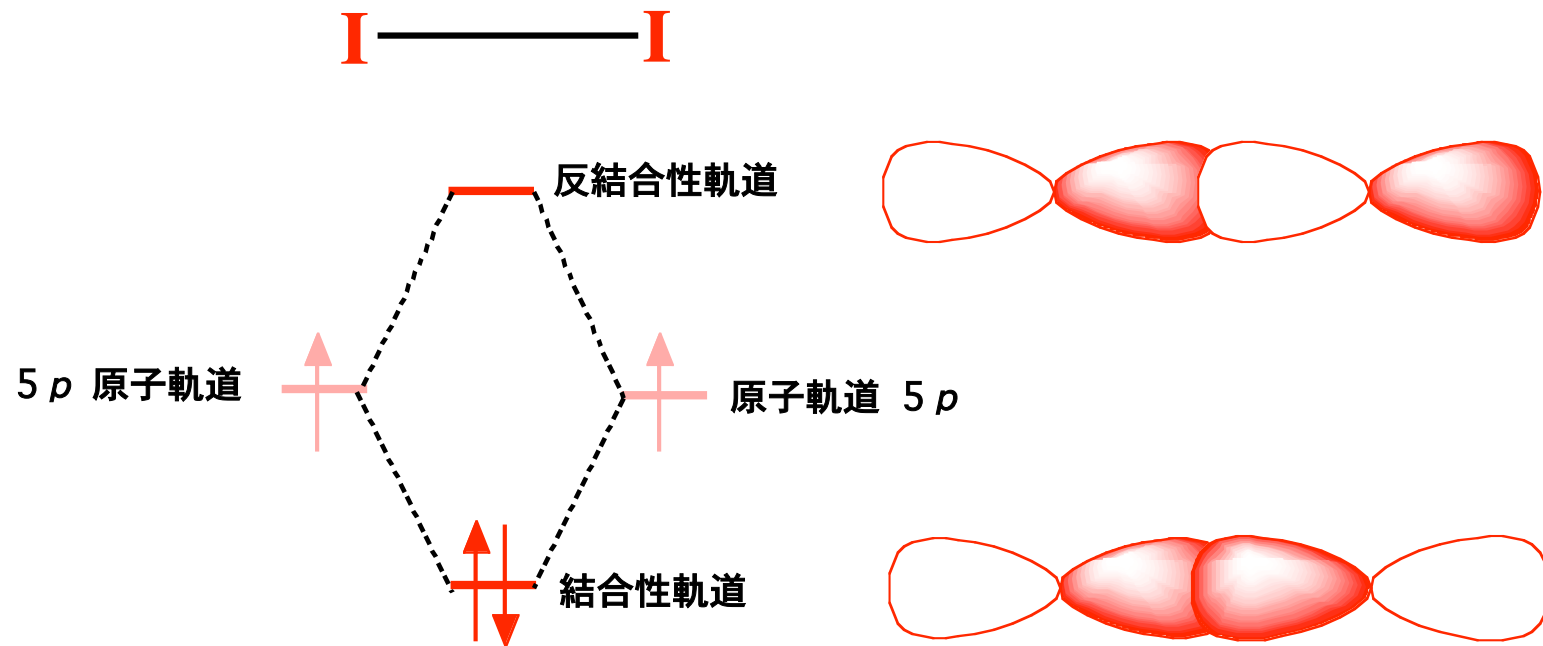
軌道（波動関数）の広がり

共有結合性：小 (F_2)



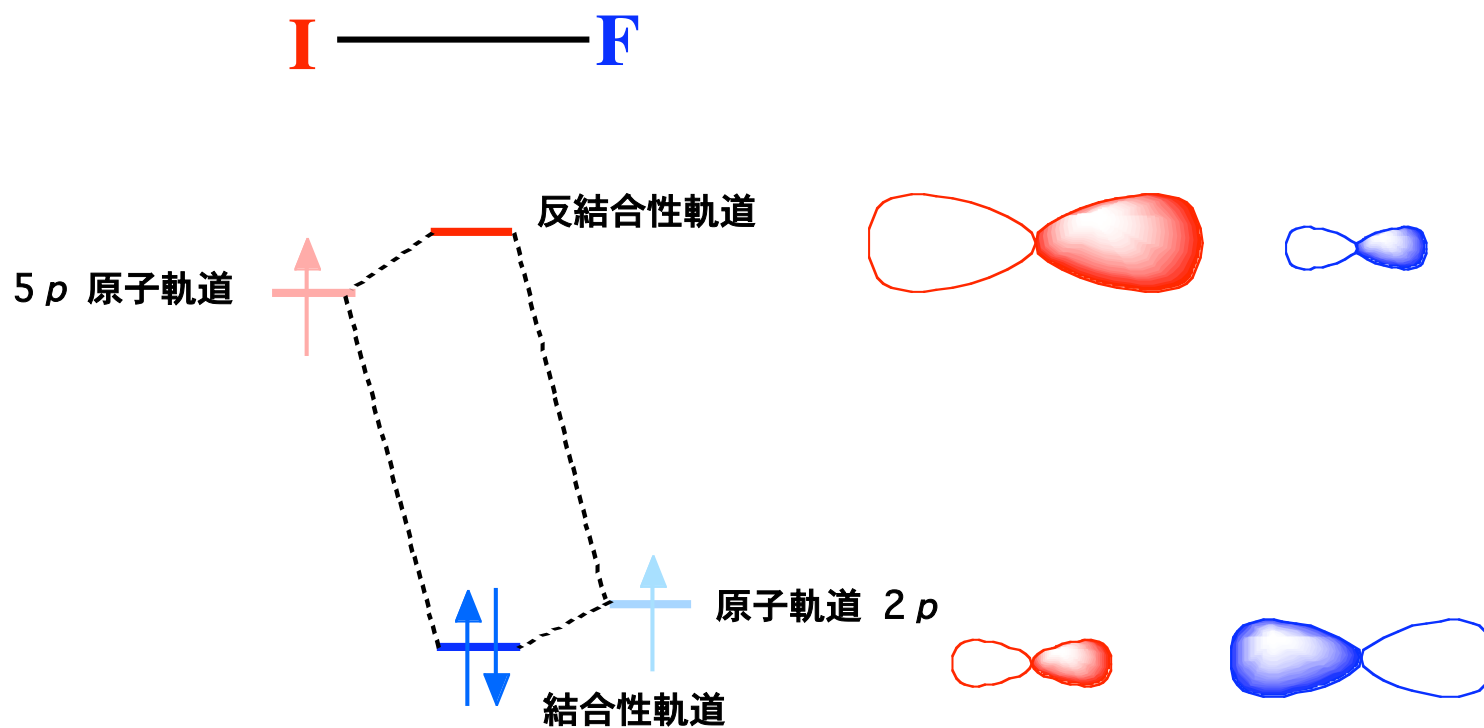
軌道（波動関数）のエネルギー差

共有結合性：大 (I_2)



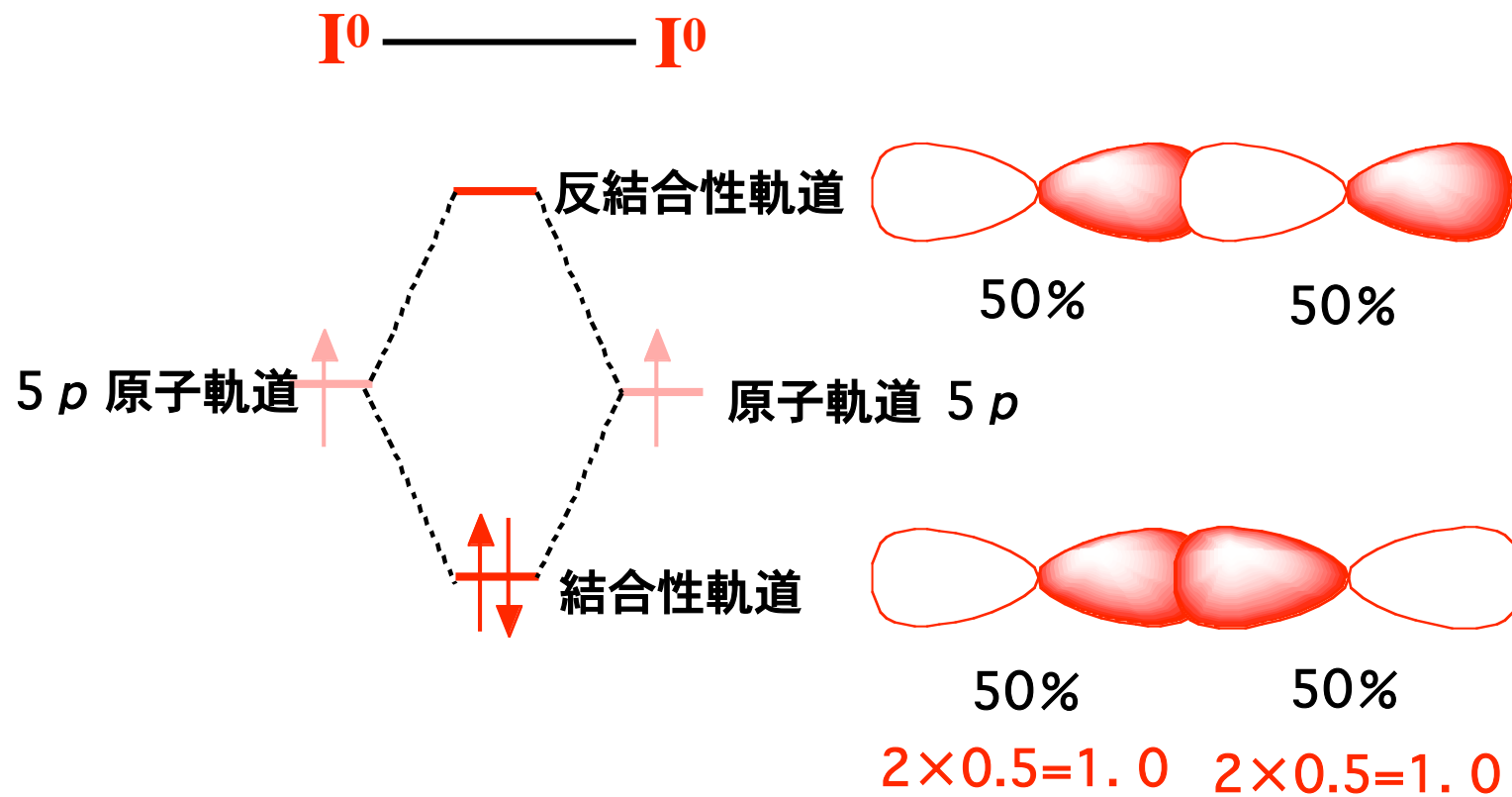
軌道（波動関数）のエネルギー差

共有結合性：小 (I-F)



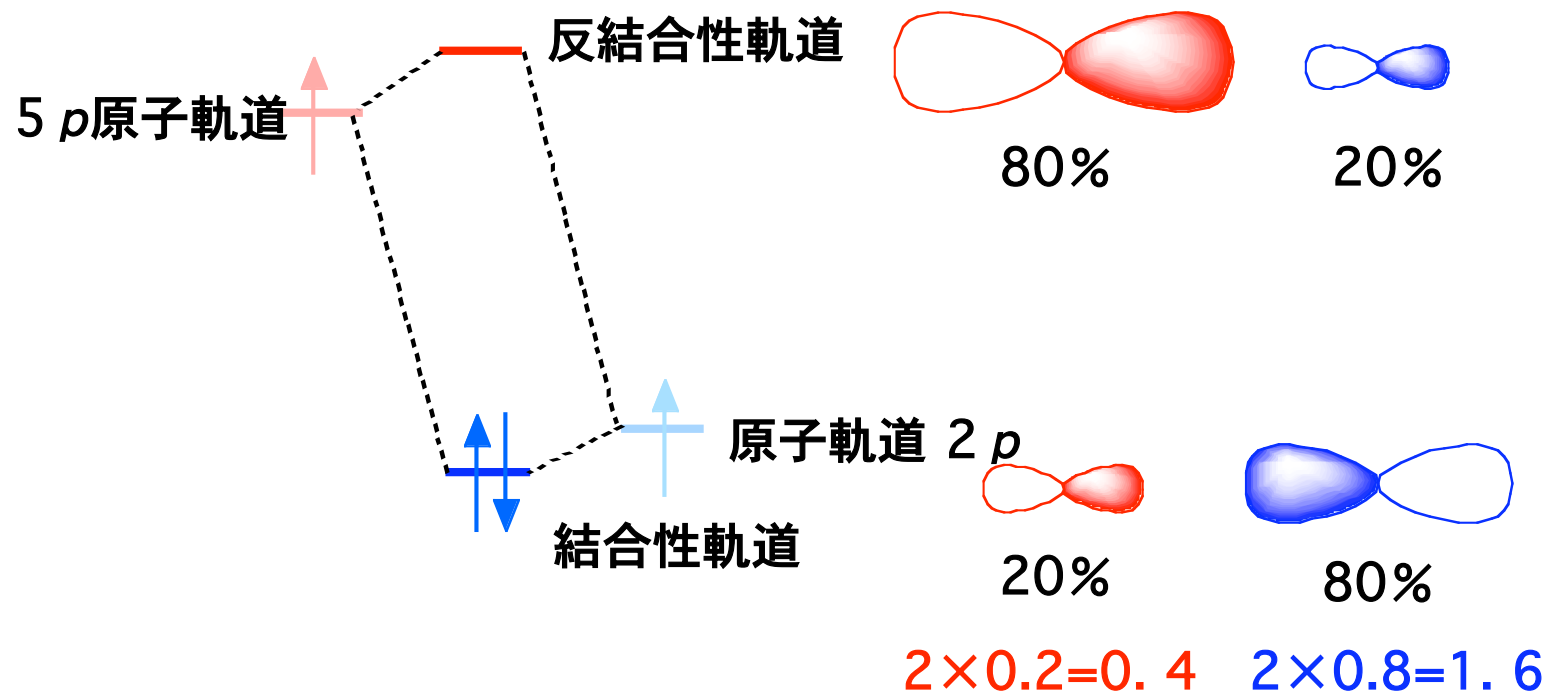
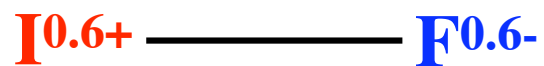
無極性と極性

極性：無 (I_2)

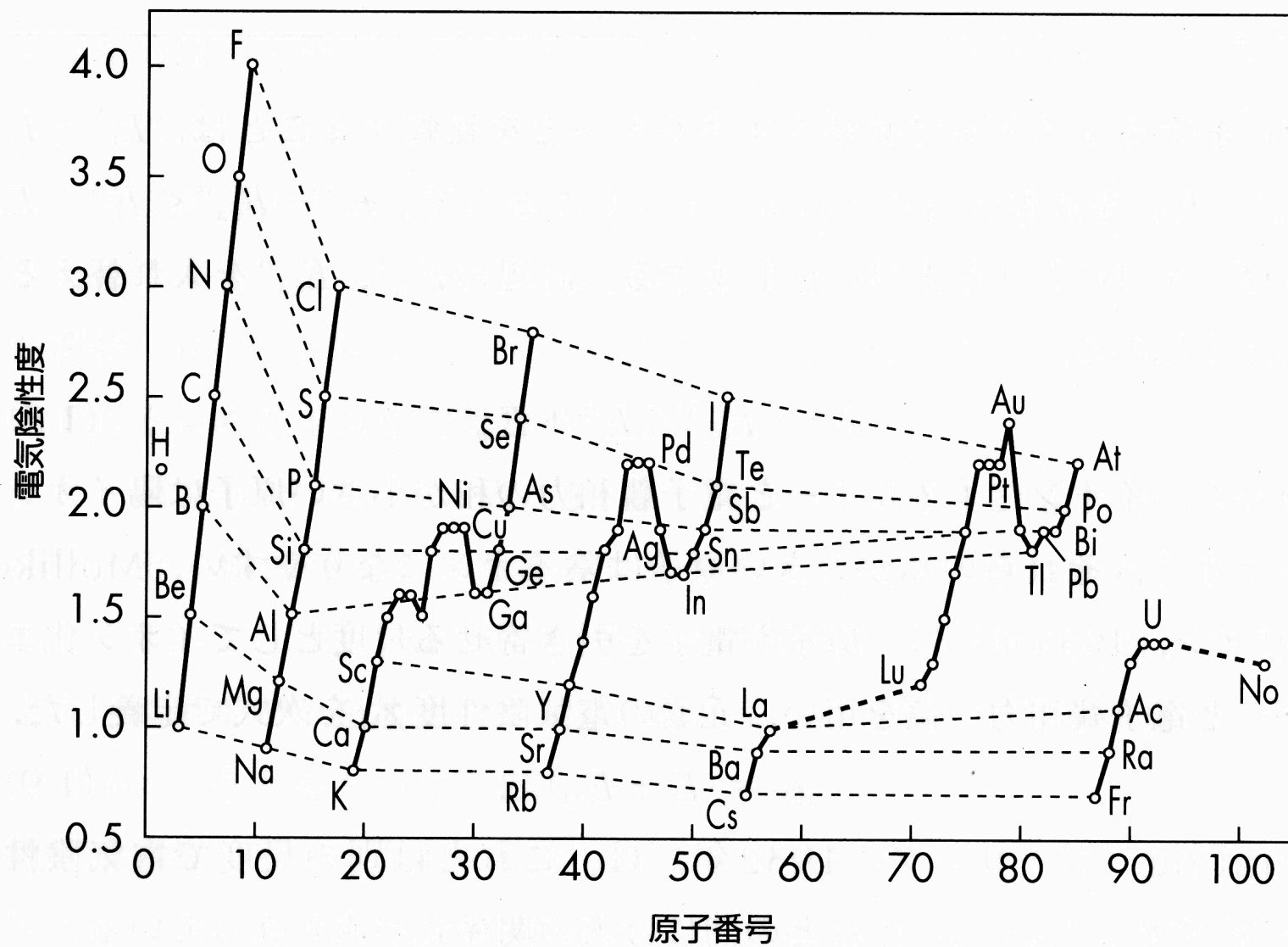


無極性と極性

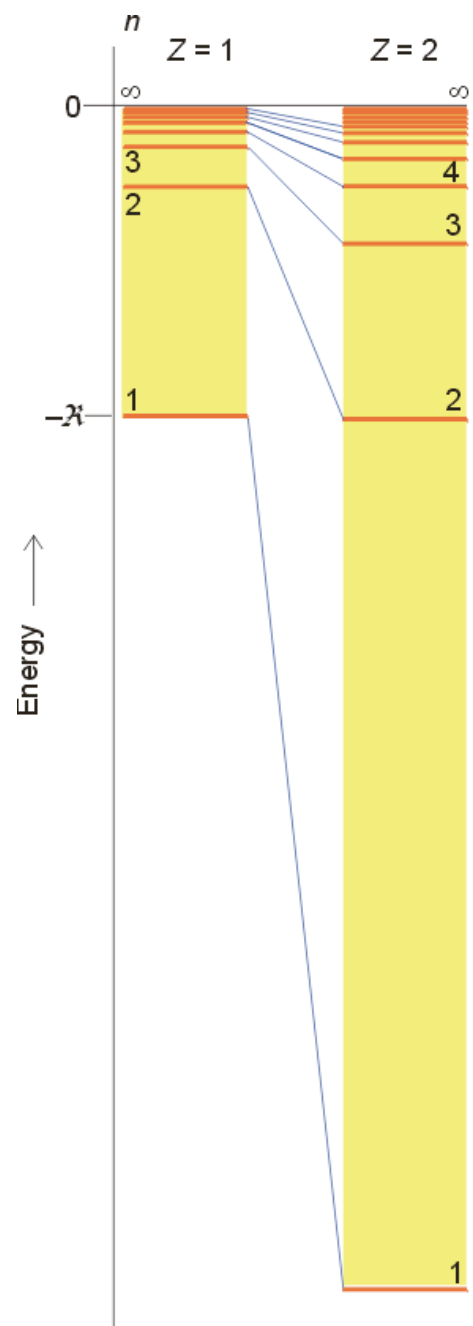
極性：有 (I-F)



原子軌道間のエネルギー差があれば、
結合には必ず極性が生じる



電気陰性度の周期性.



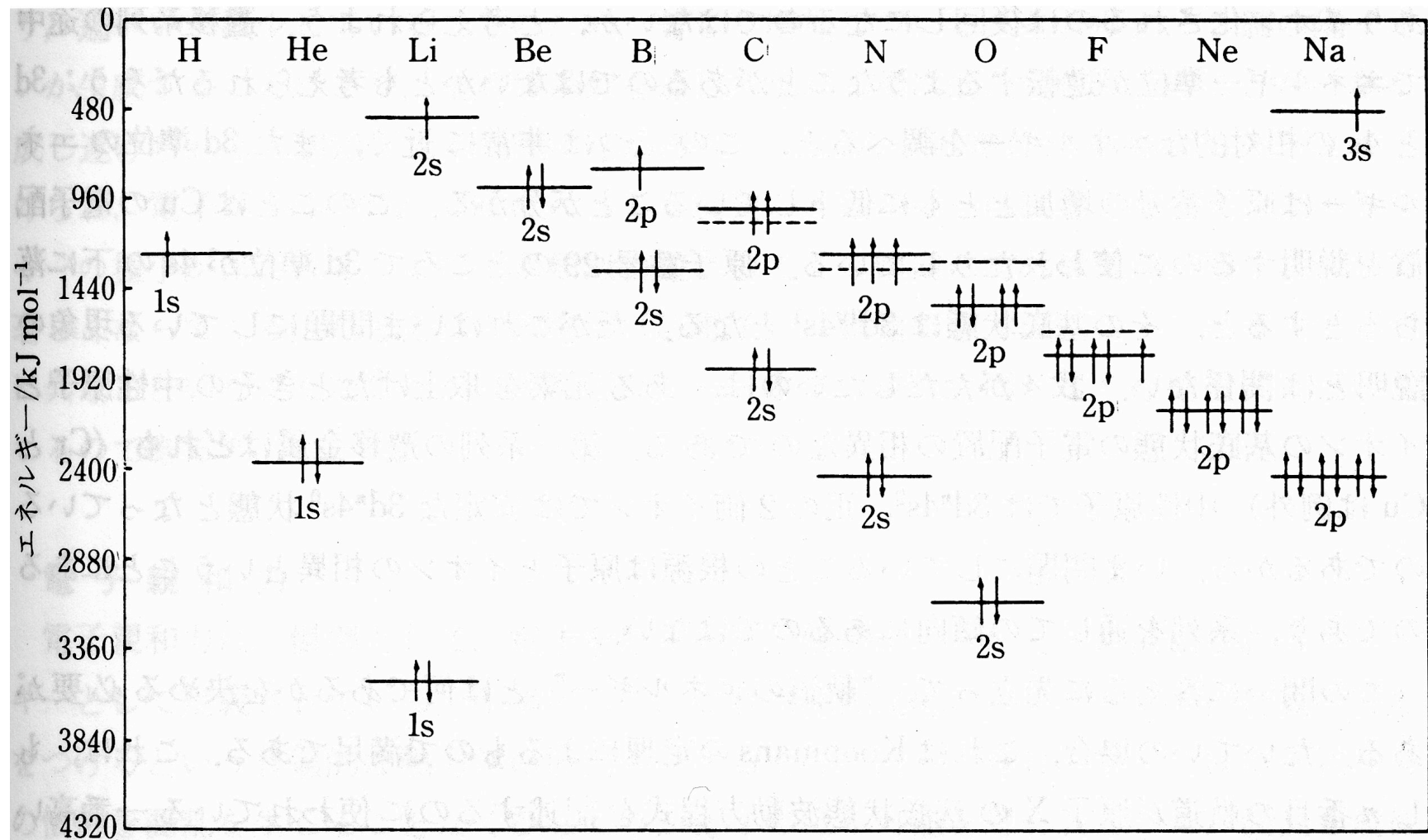
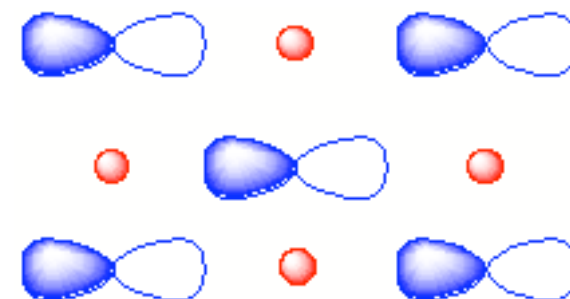
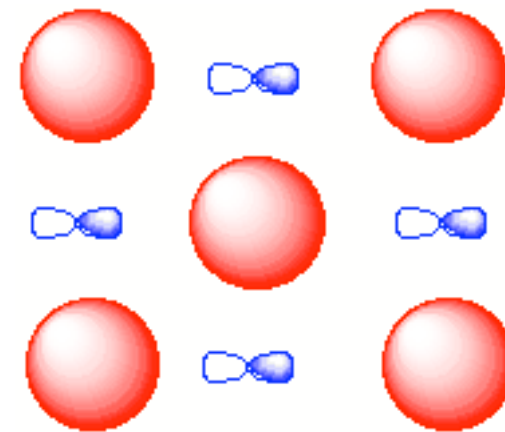
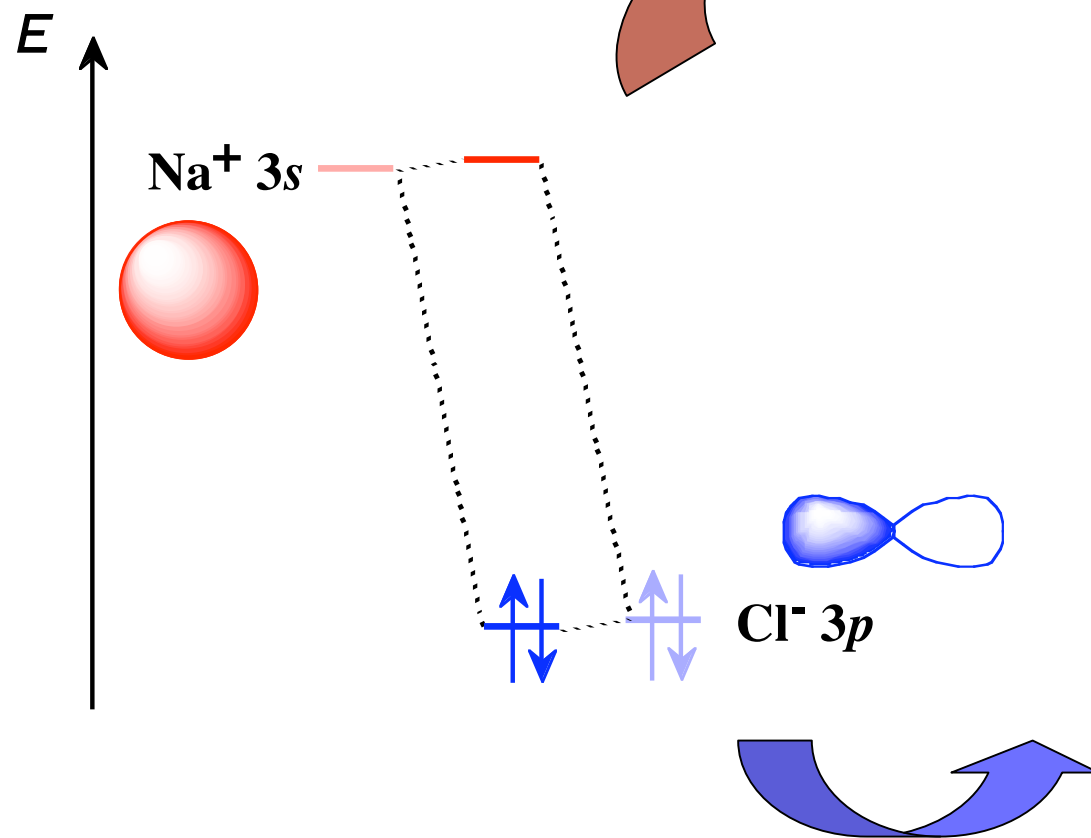
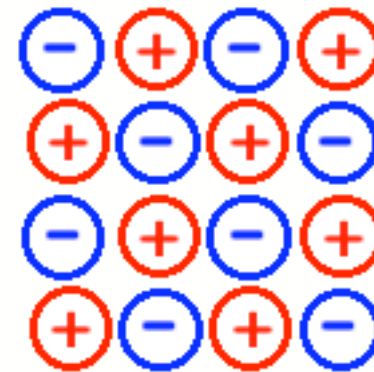
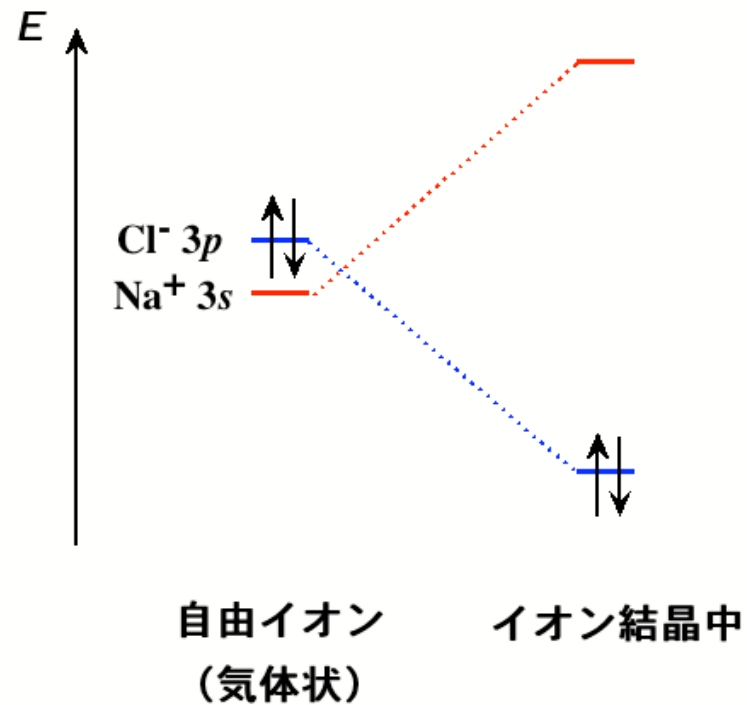


図 2・14 水素からナトリウムまでの軌道エネルギーの相対値。実線は一電子軌道エネルギーを示す。点線は実測されたイオン化エネルギーを示す。後者は電子-電子の相互作用のため実線で示されたものと異なっている

イオン結合：
静電相互作用（クーロン相互作用）



イオン結合：
静電相互作用（クーロン相互作用）



マードルングポテンシャル

電荷移動相互作用(charge-transfer interaction)とは？

電荷移動錯体(charge-transfer complex; CT complex)

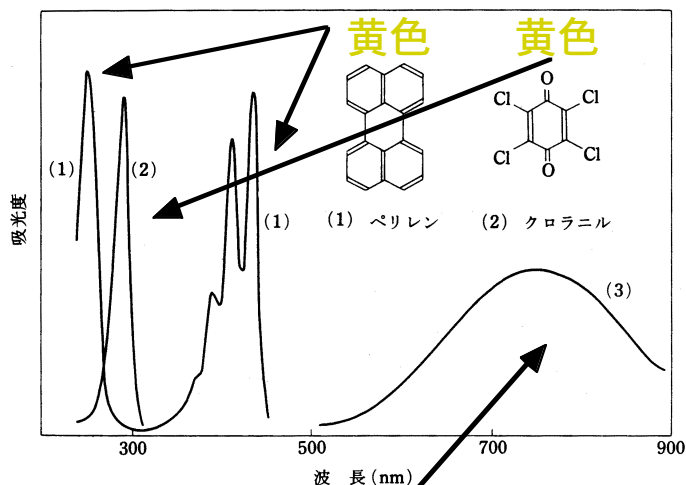


図 3.24 (1) ペリレン, (2) クロラニル, (3) ペリレンとクロラニルの1:1混合物の溶液(溶媒はいずれもクロロホルム)の吸収スペクトル。縦軸の吸光度は吸収ピークの形状を明確にするため任意スケールにしてある。とくに, (3)は吸光係数が小さいので, ほかのものにくらべ, 数十倍に拡大して描いてある。

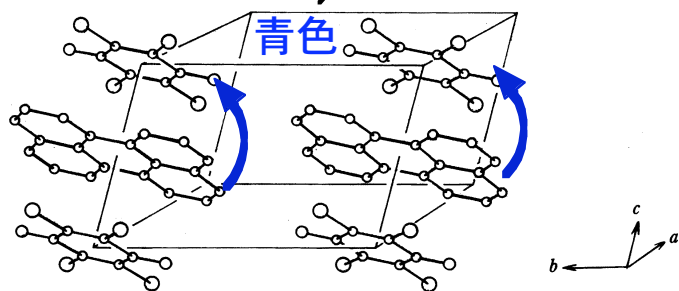
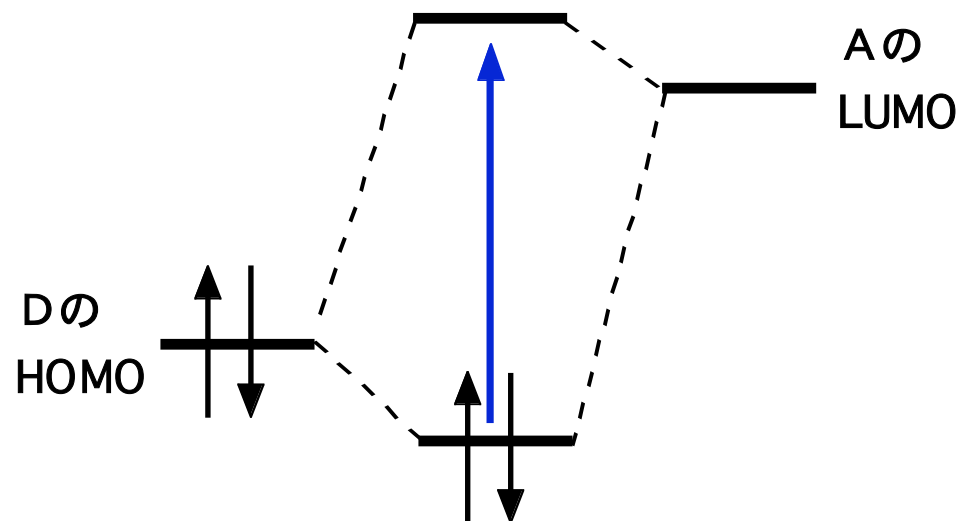


図 3.25 ペリレン-クロラニル錯体(三斜晶系)の結晶構造。
c 軸(成長軸)方向にペリレン分子とクロラニル分子が交互に積み重なっている。

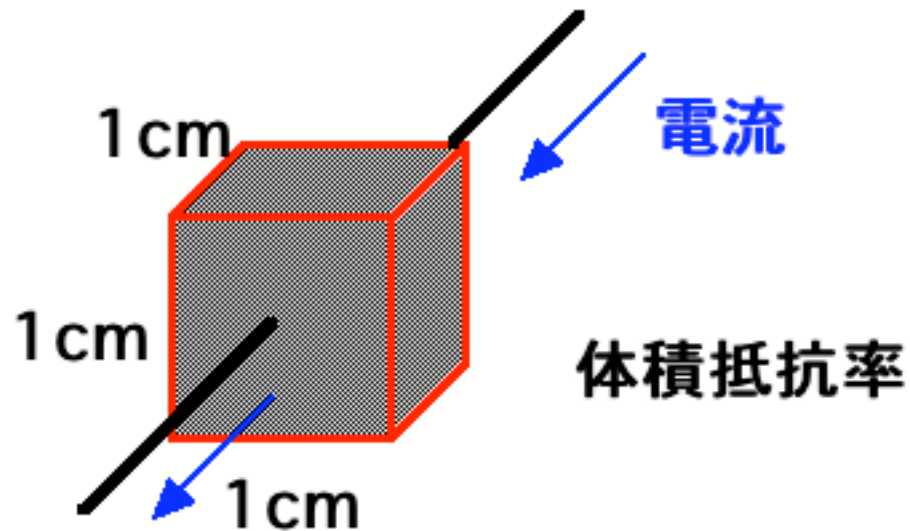
ドナー (D) : 電子供与体 --- ペリレン
アクセプター (A) : 電子受容体 --- クロラニル

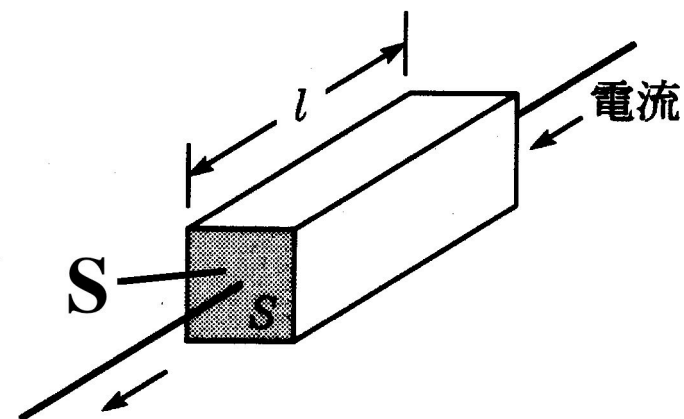
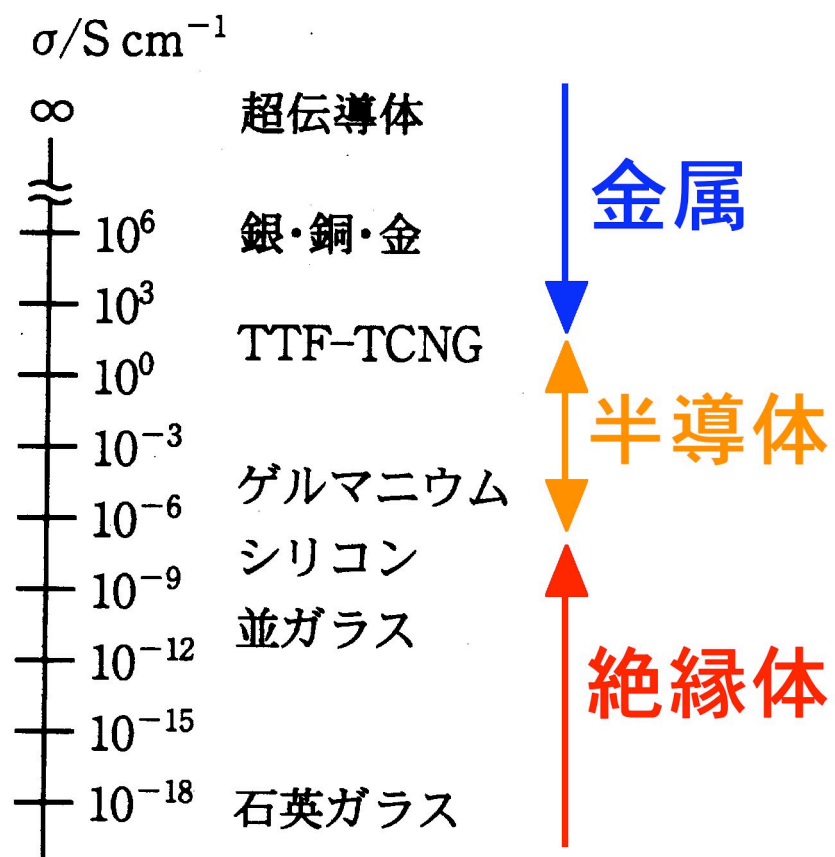


金属(metal)、半導体(semiconductor)、
絶縁体(insulator)とは？

電気抵抗率： ρ (Ωcm)

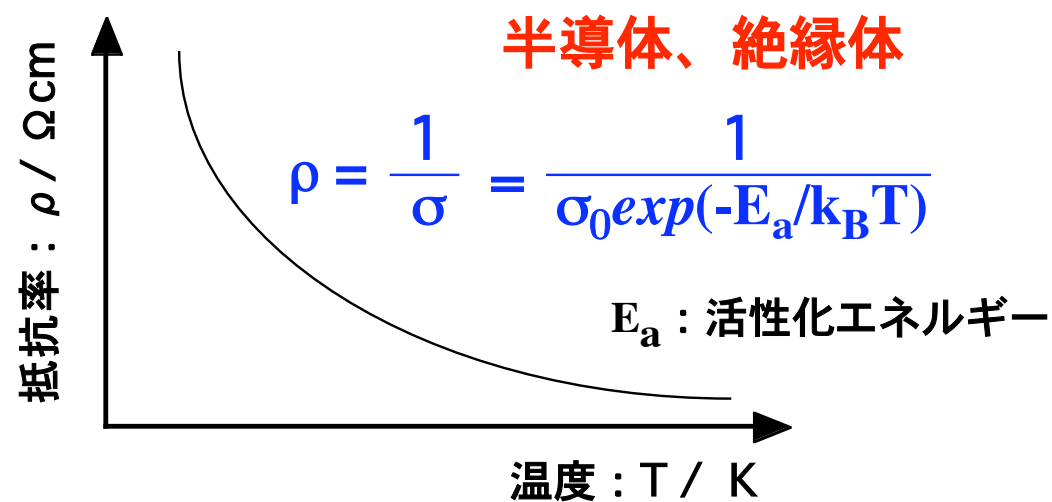
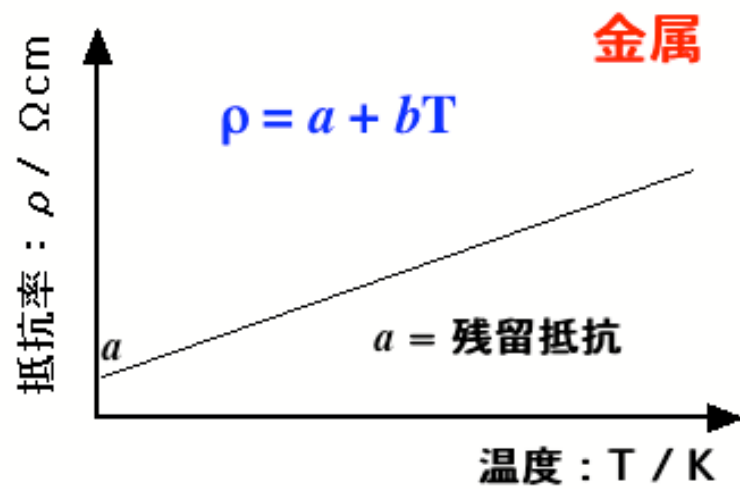
電気伝導度： σ ($\Omega^{-1}\text{cm}^{-1} = \text{S cm}^{-1}$) = ρ^{-1}

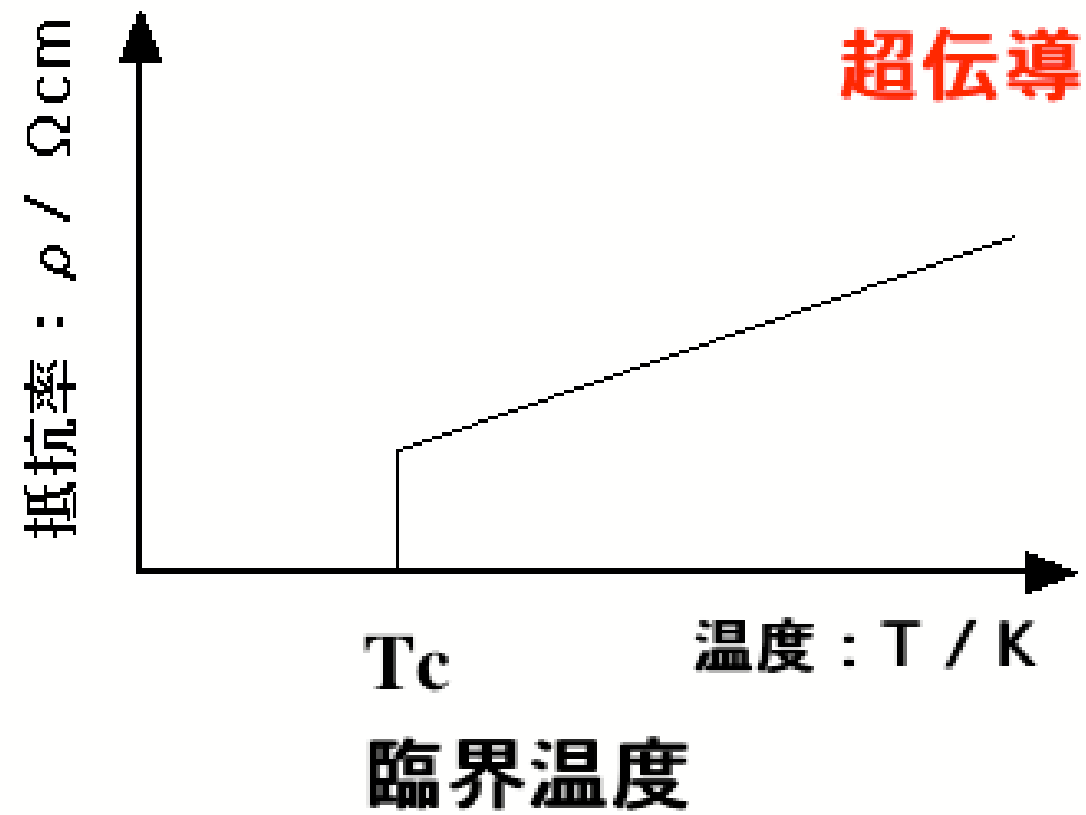


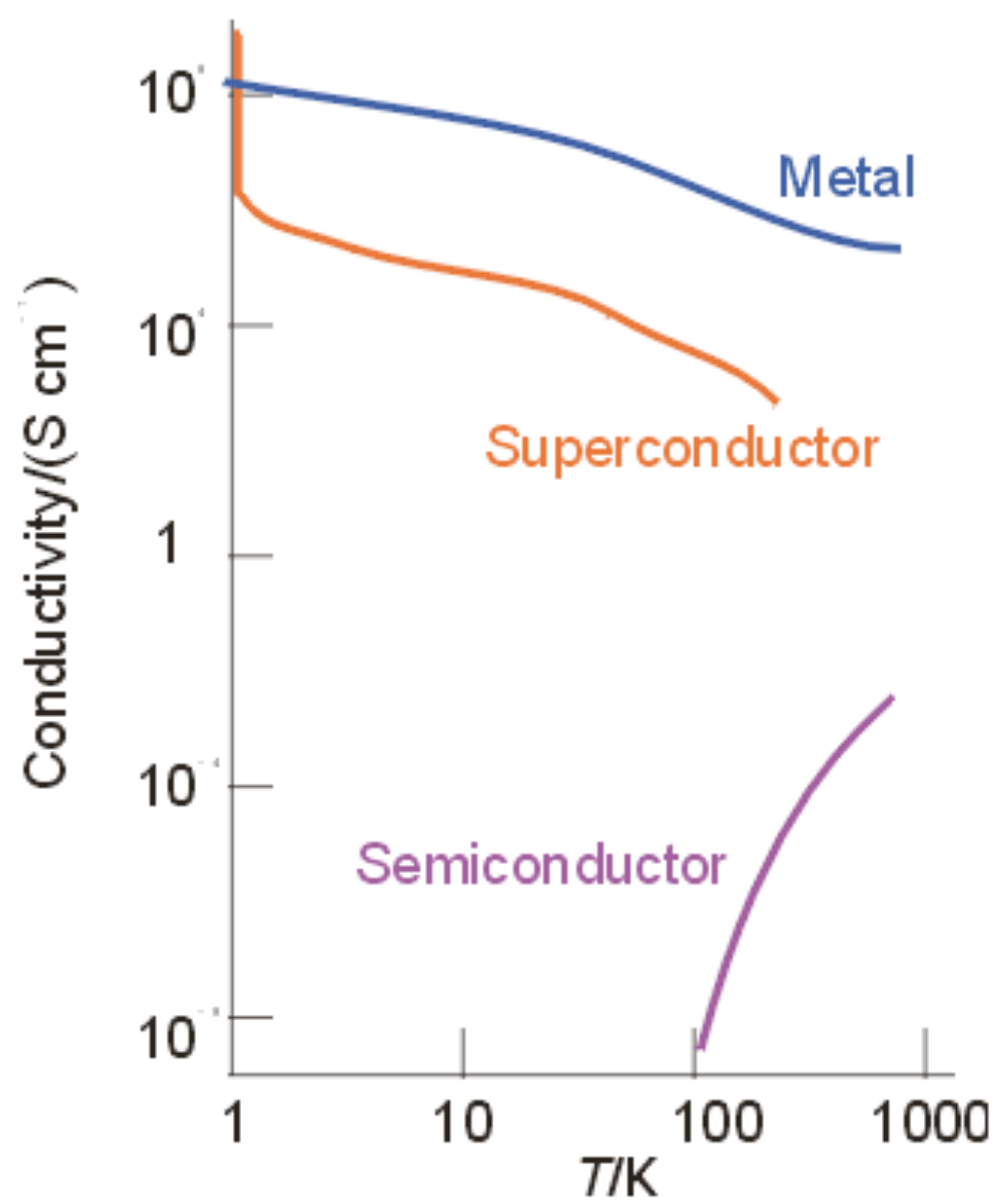


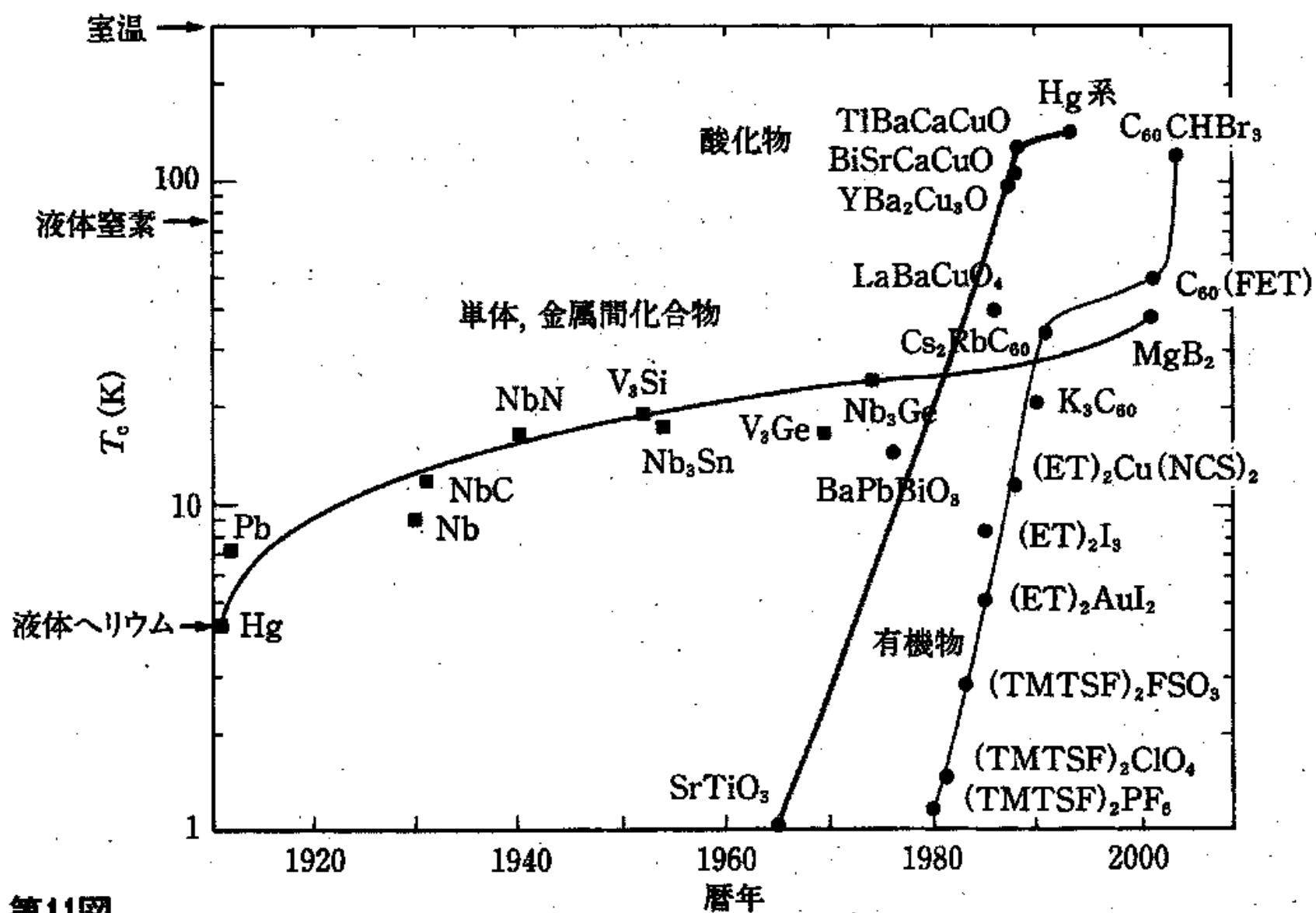
$$\rho = R \times \frac{S}{l}$$

$$= \frac{V}{I} \times \frac{S}{l}$$





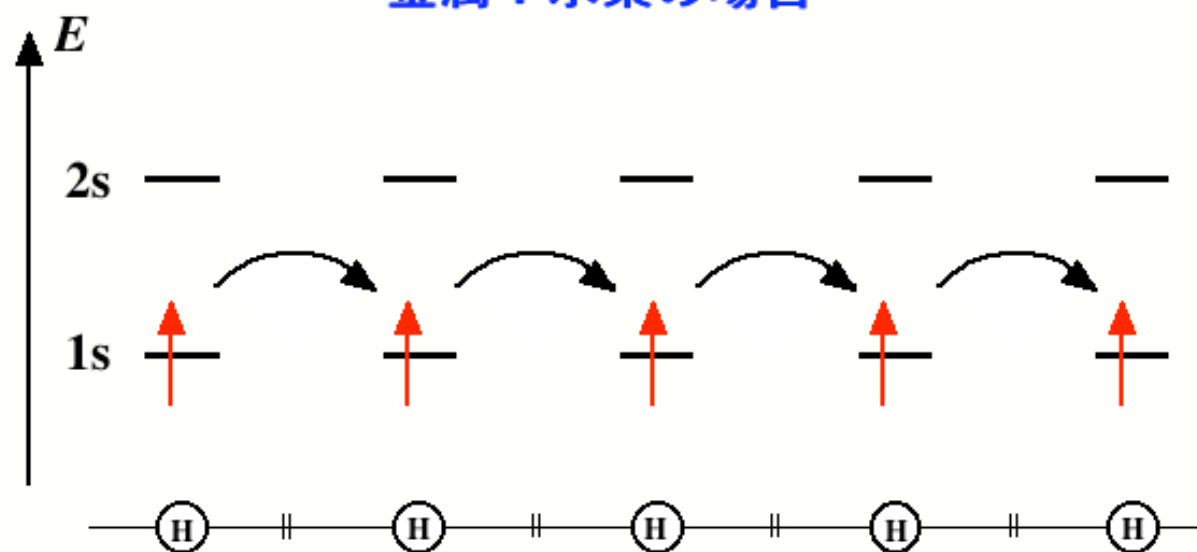




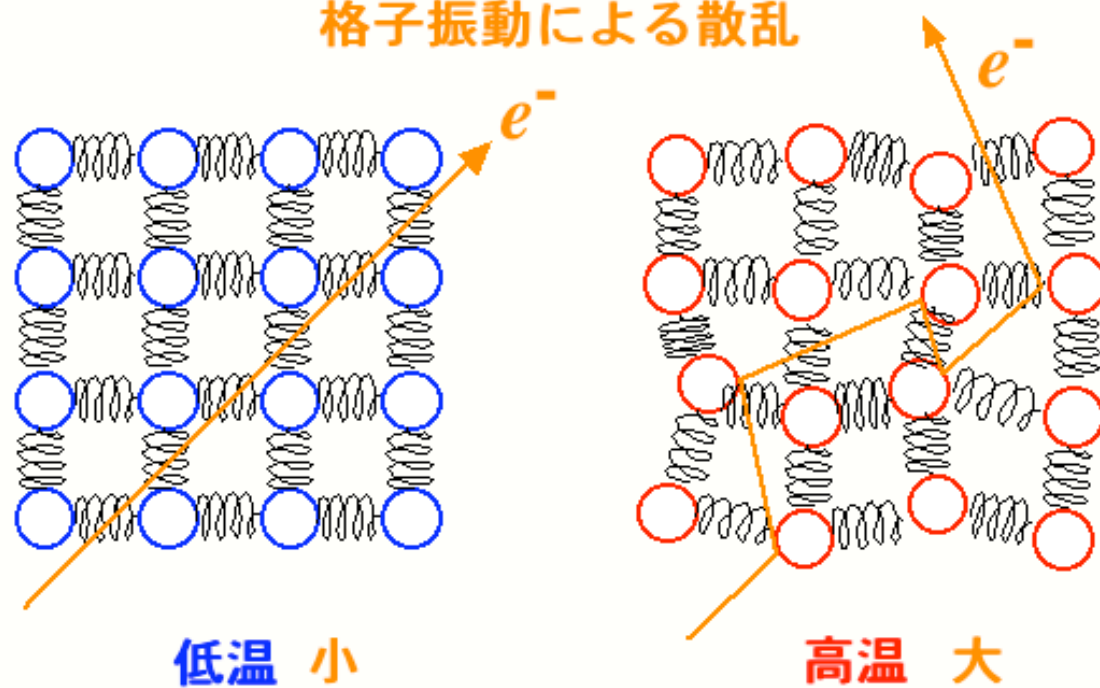
第11図

様々なカテゴリーの物質の超伝導転移温度が年(横軸)とともに上昇する様子。

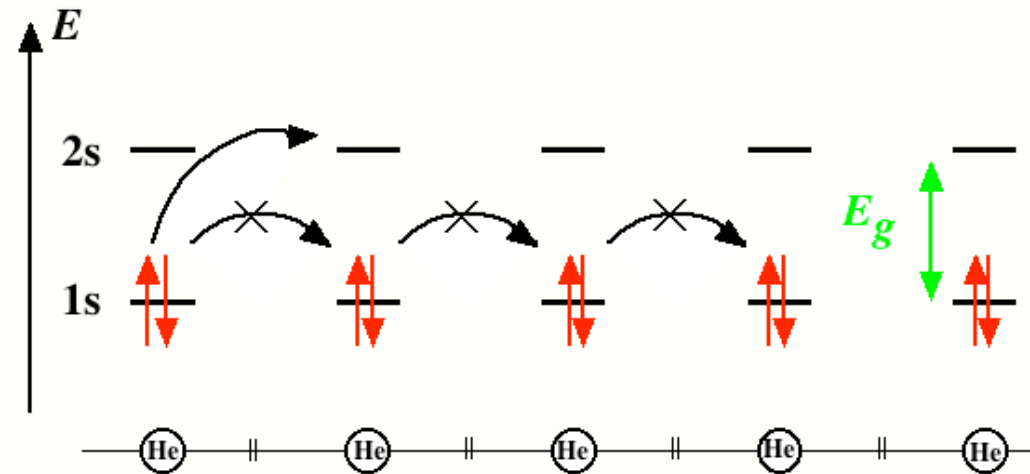
金属：水素の場合



格子振動による散乱



半導体：ヘリウムの場合



伝導度： $\sigma = n e \mu$

n ：キャリアー数

e ：電気素量

μ ：移動度

E_g の存在：熱活性型

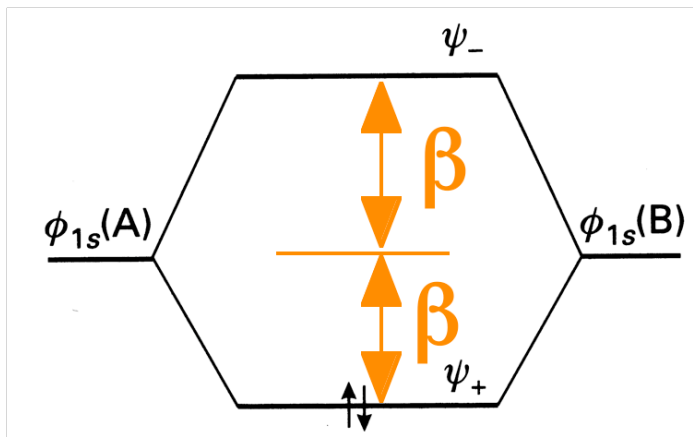
キャリアー数

低温：少

高温：多

バンドとは

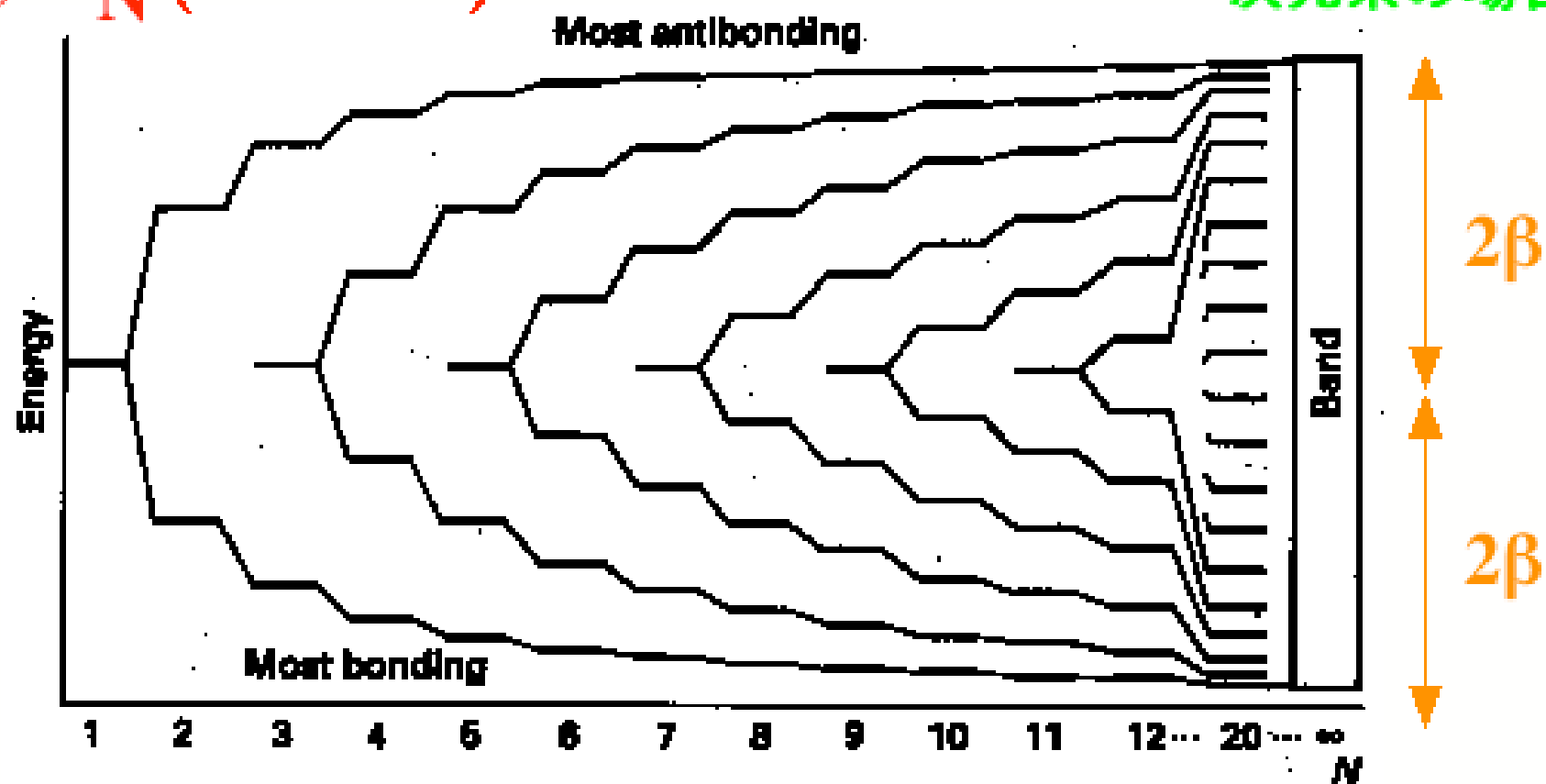
(1) H_2

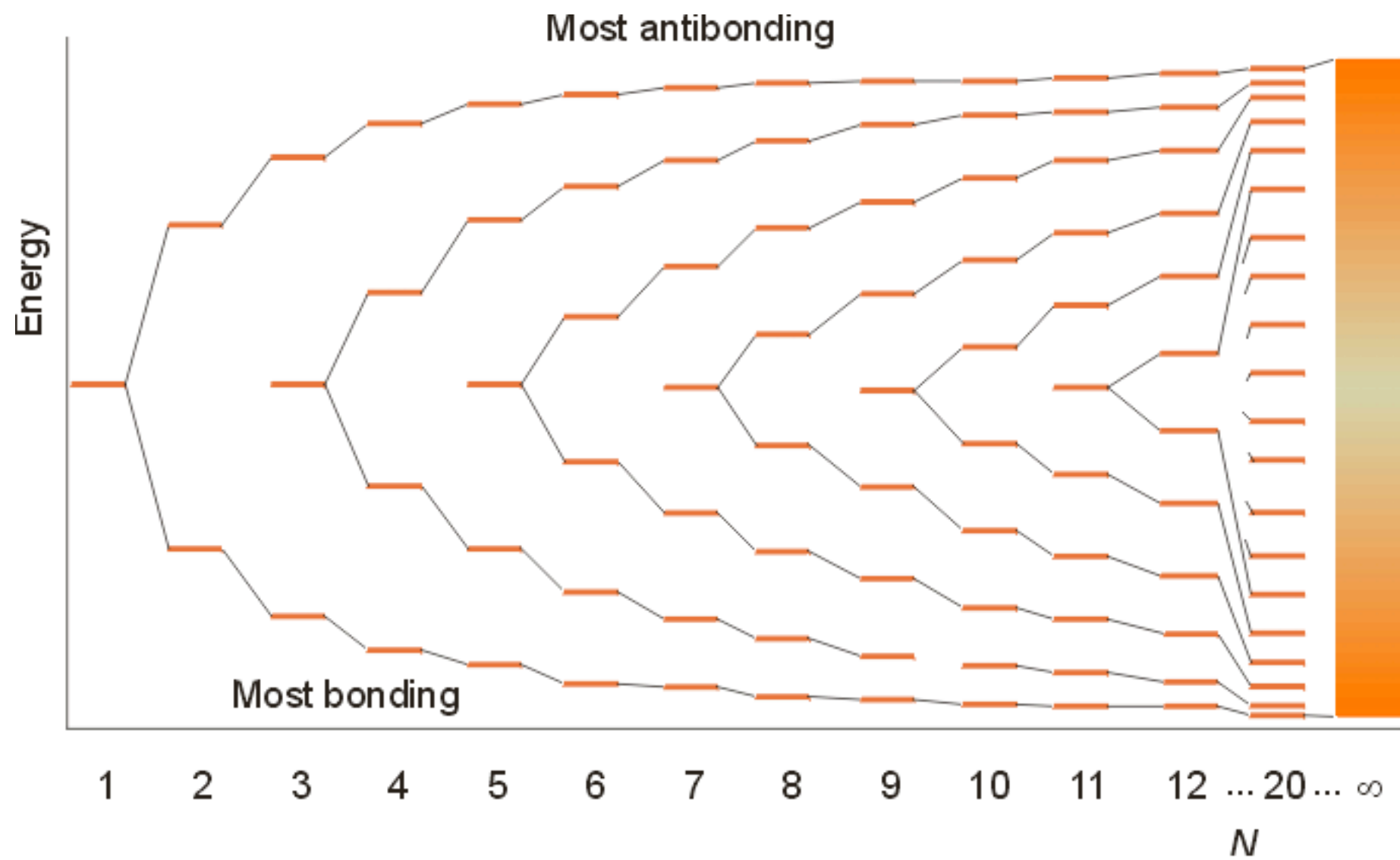


β : 相互作用(共鳴)積分

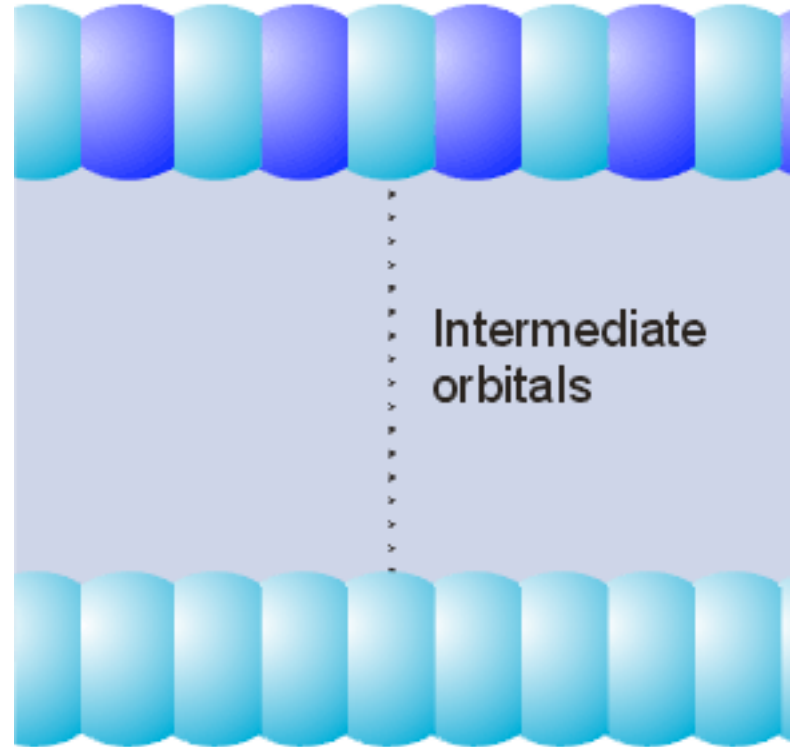
(2) H_N ($N=1 \sim \infty$)

一次元系の場合

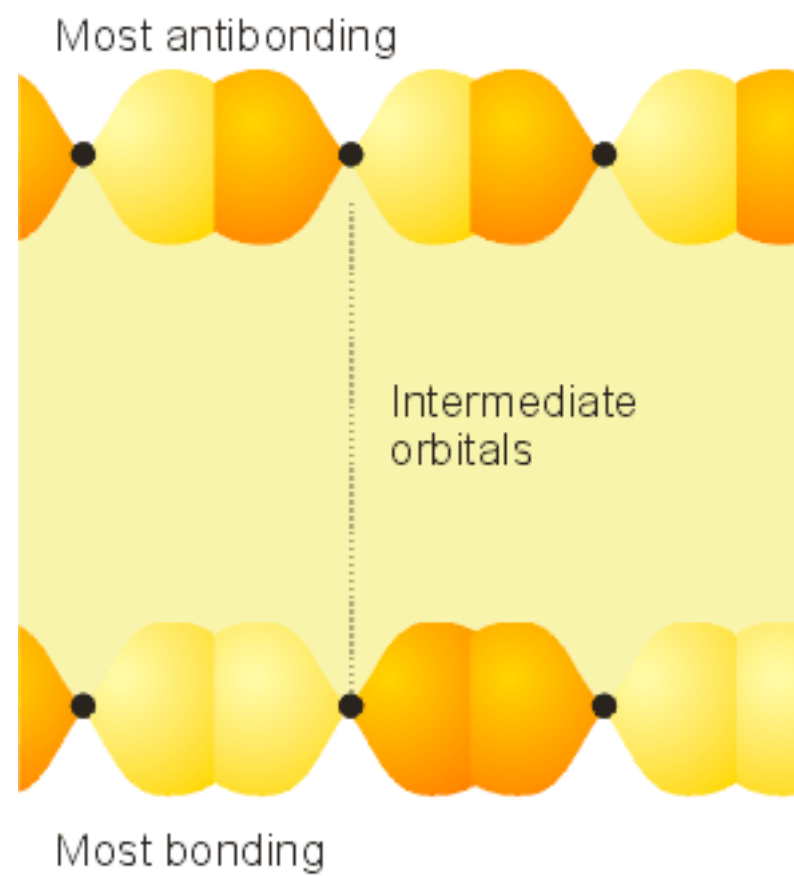


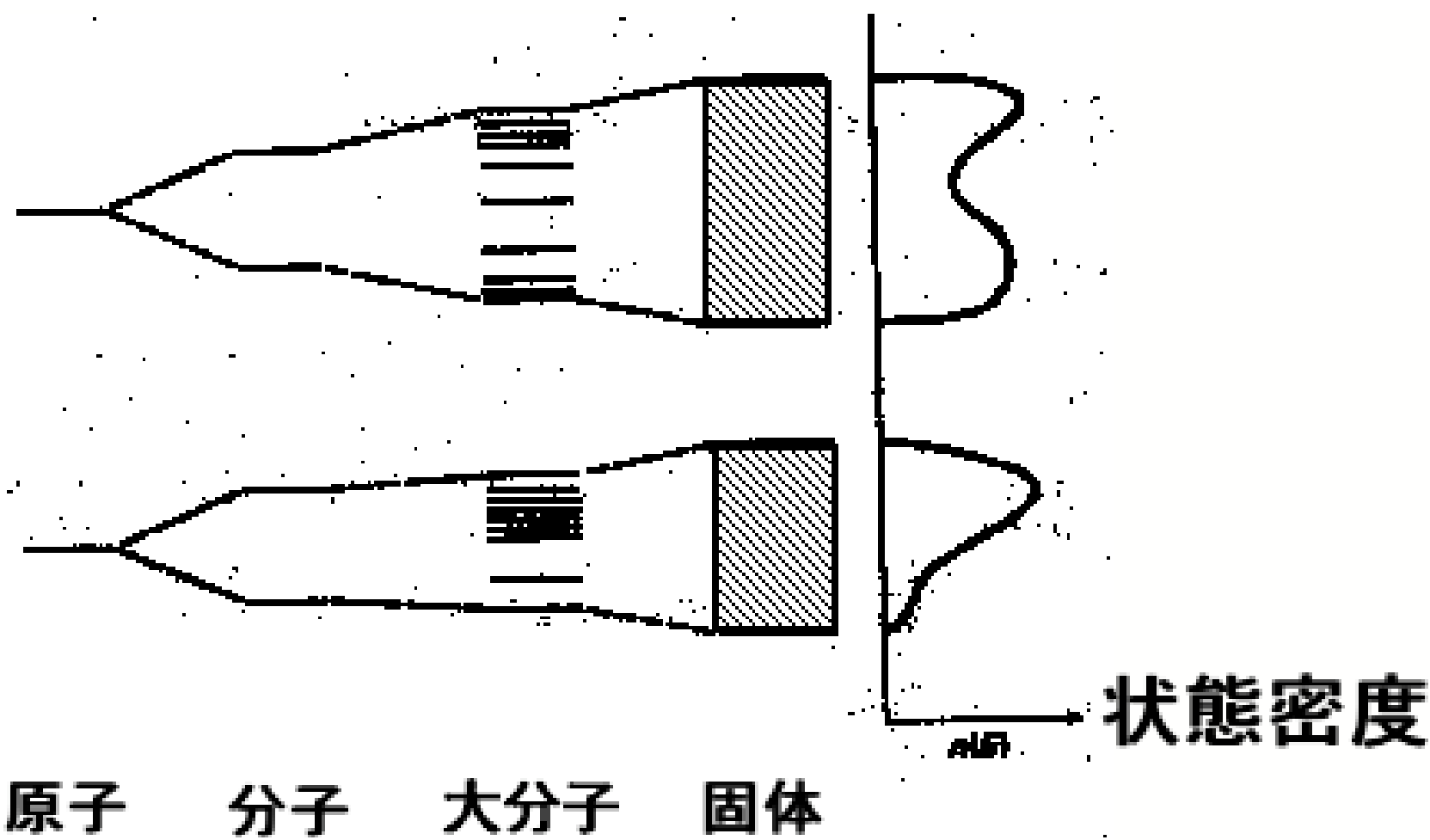


Most antibonding

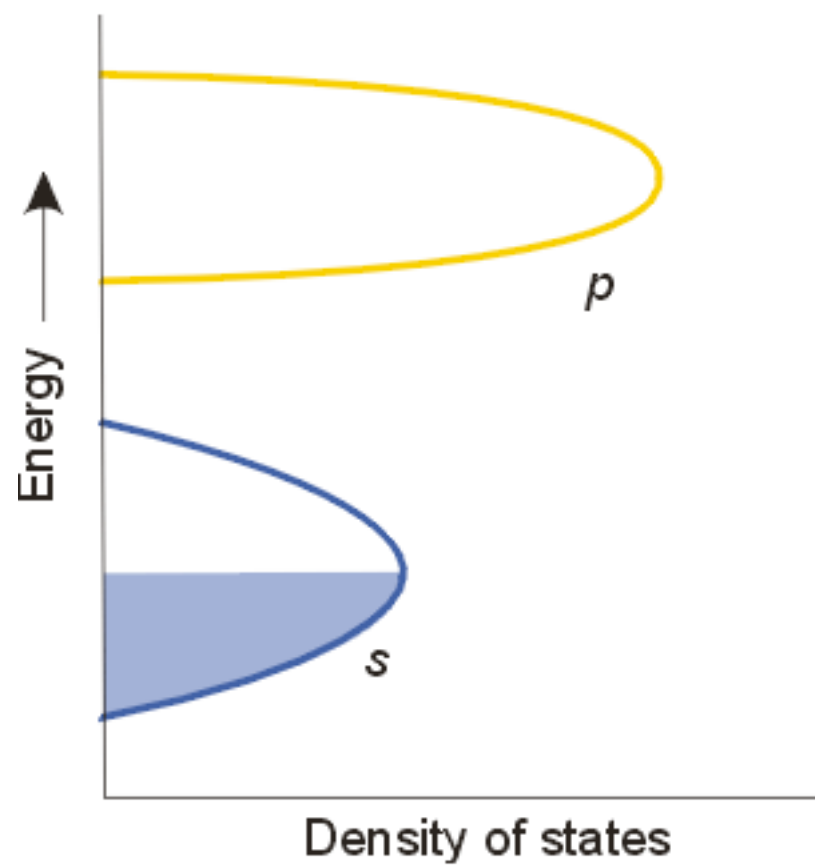


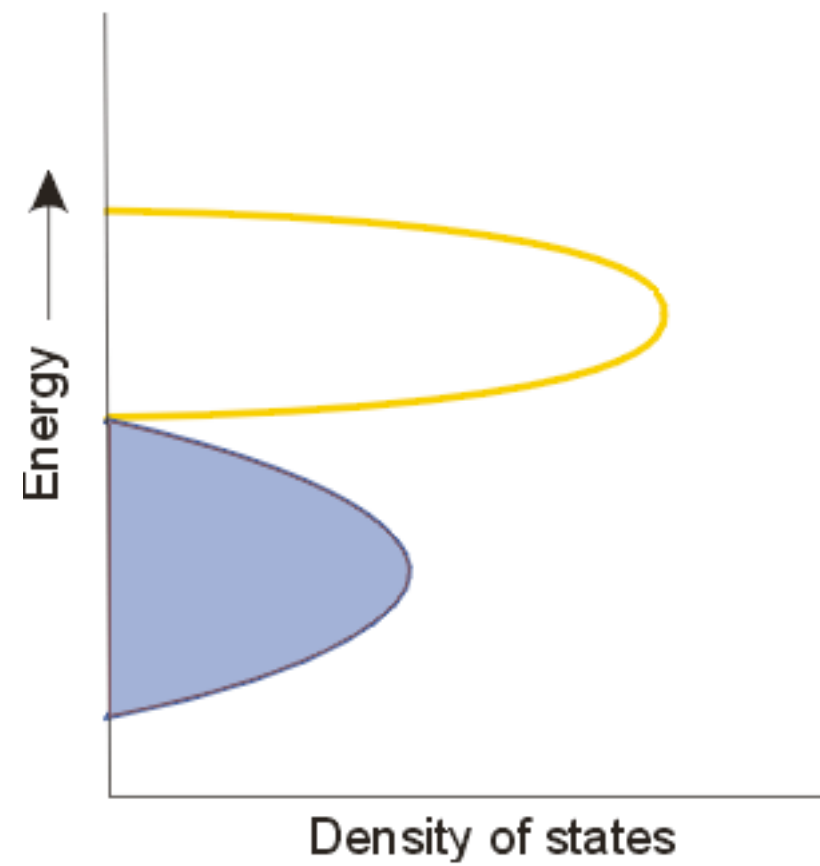
Most bonding

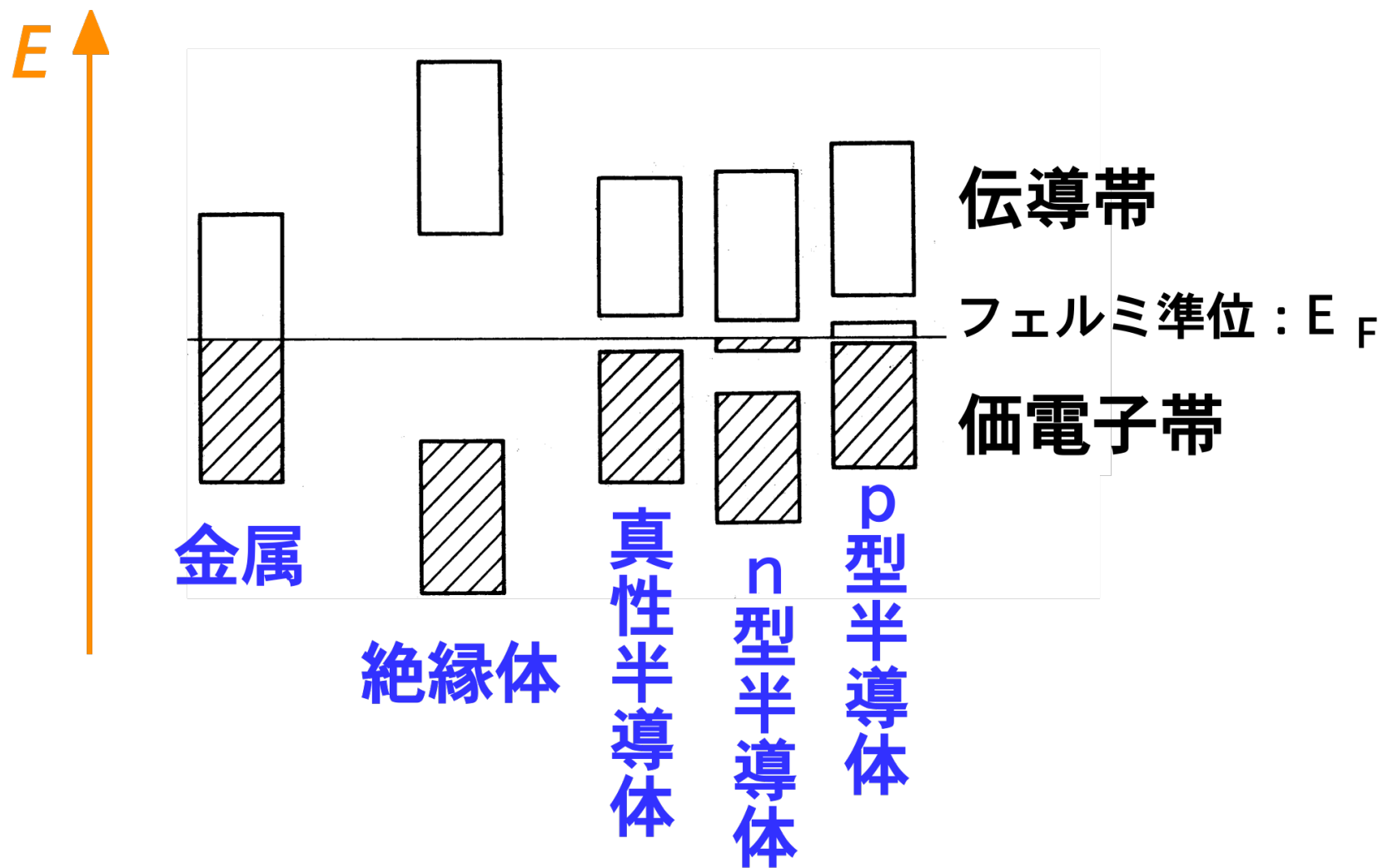


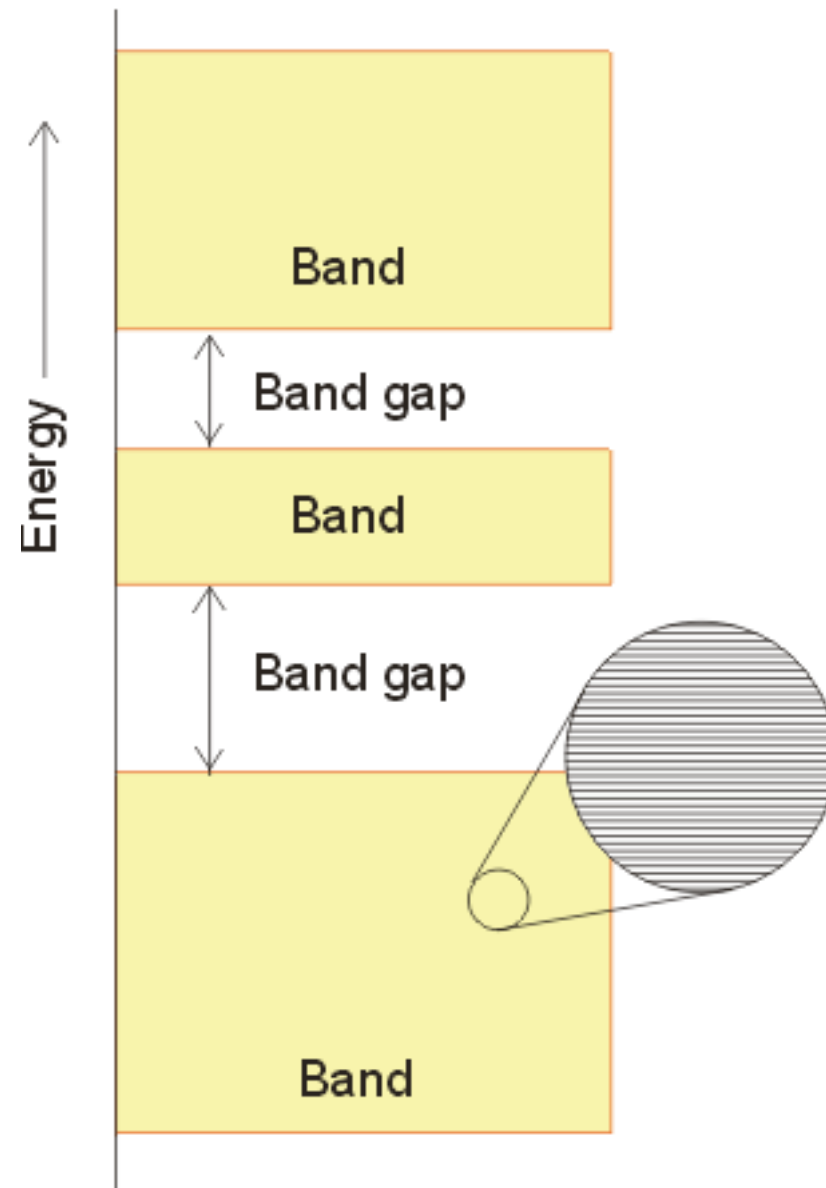




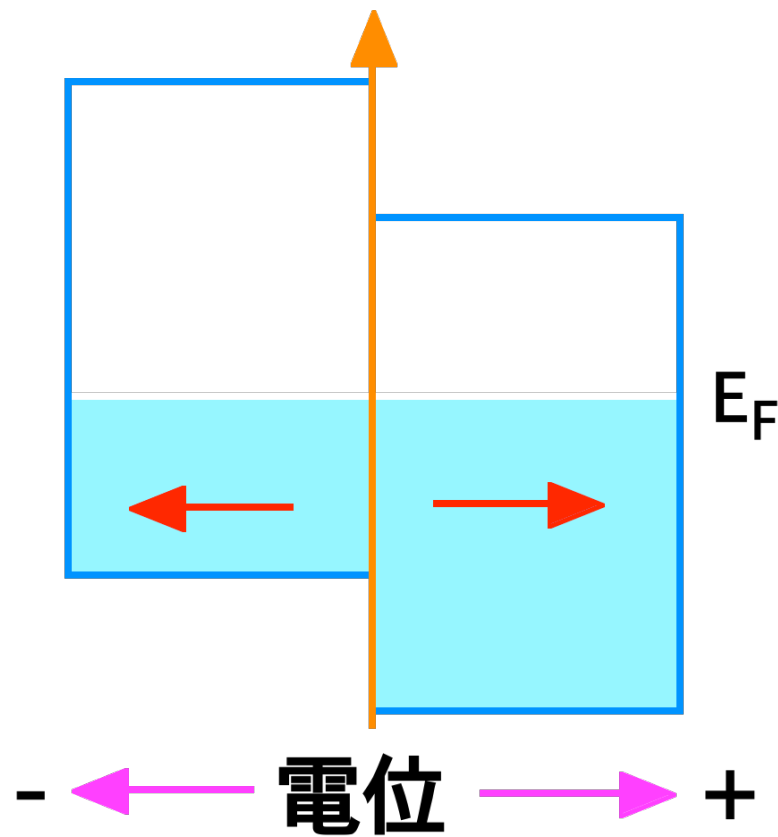
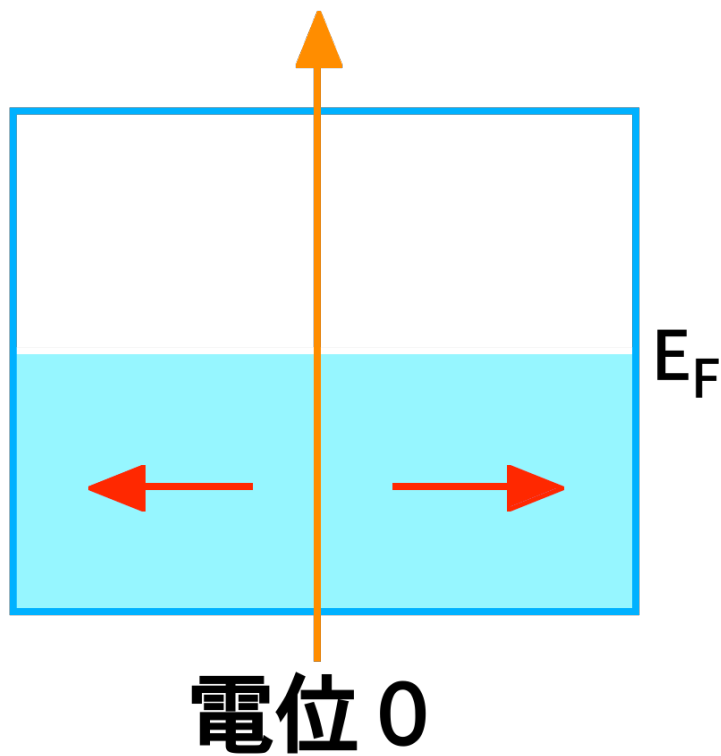


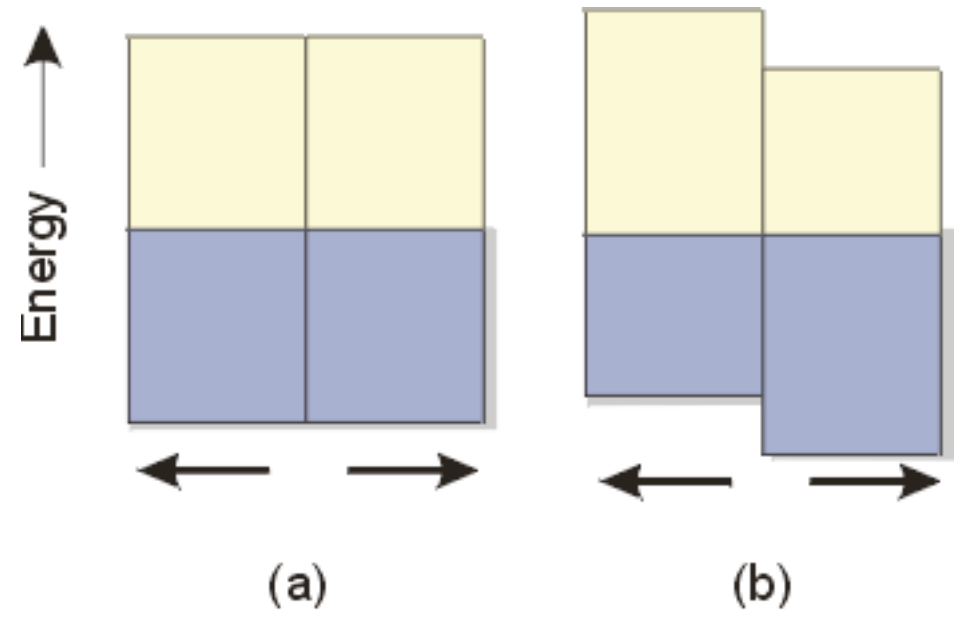




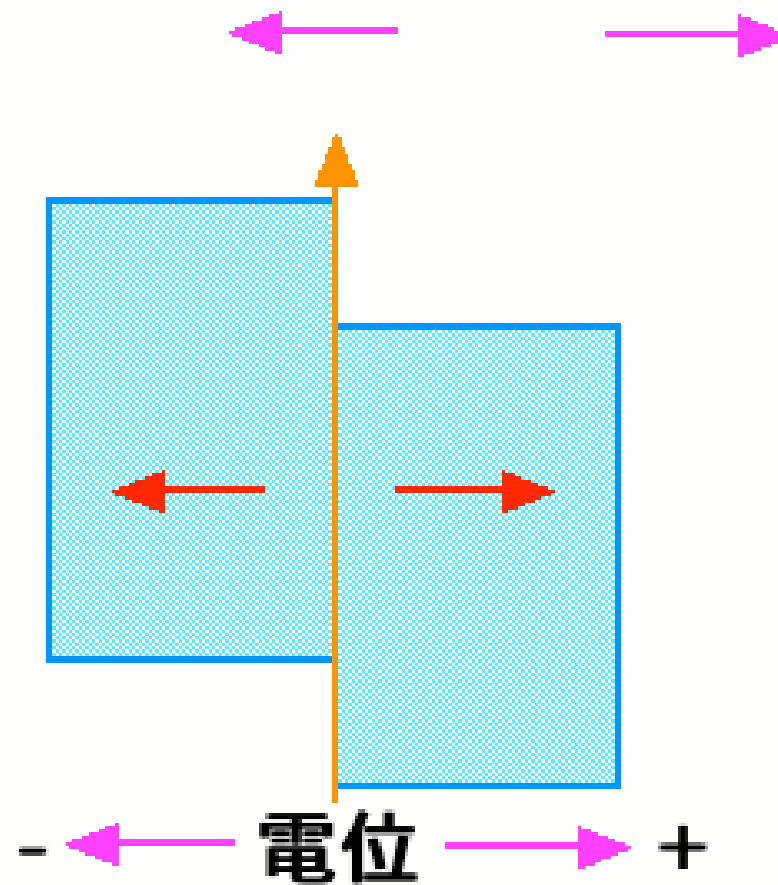


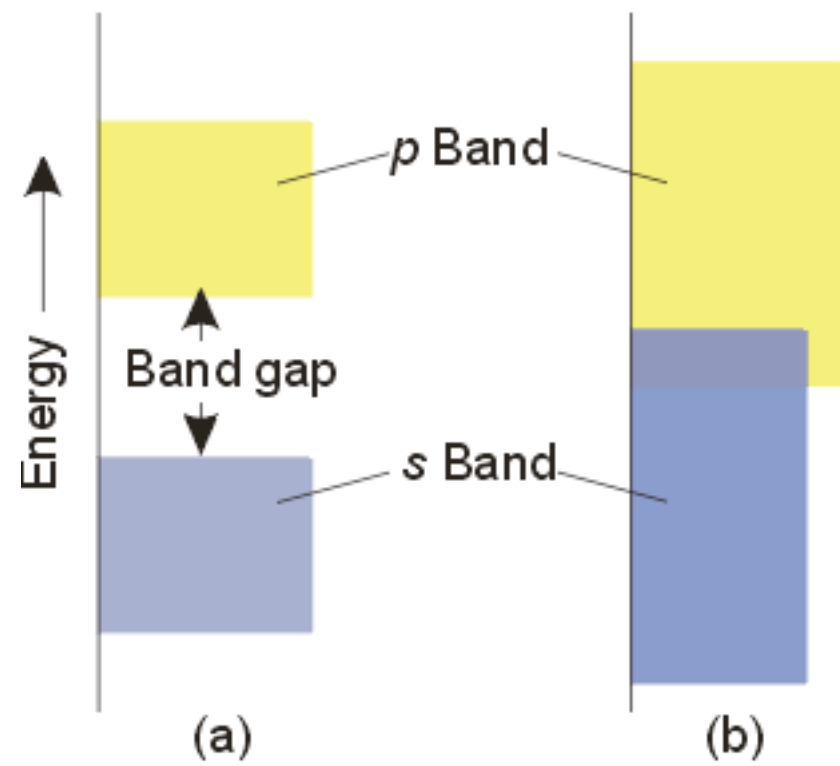
(1) 金属の場合

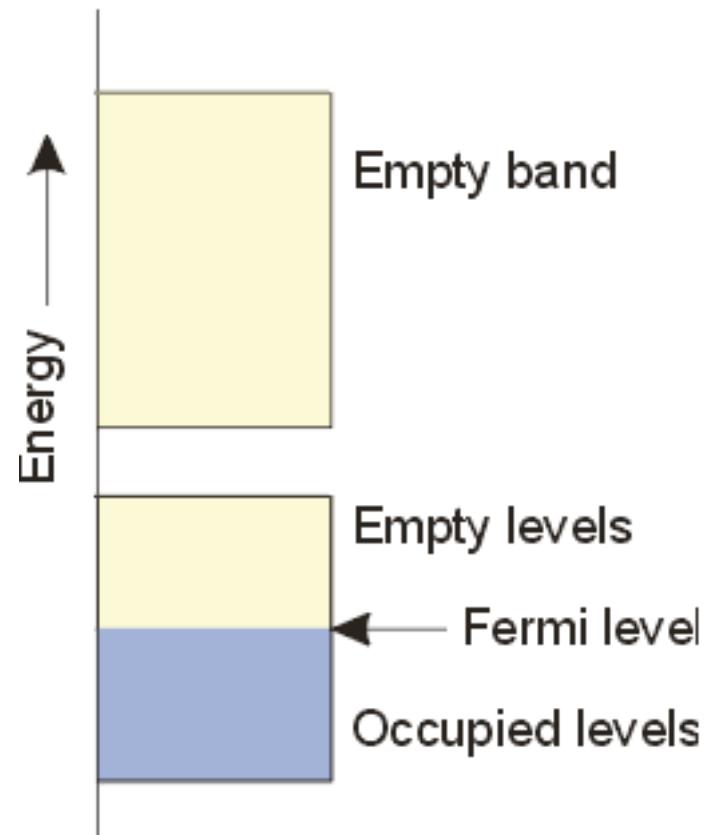


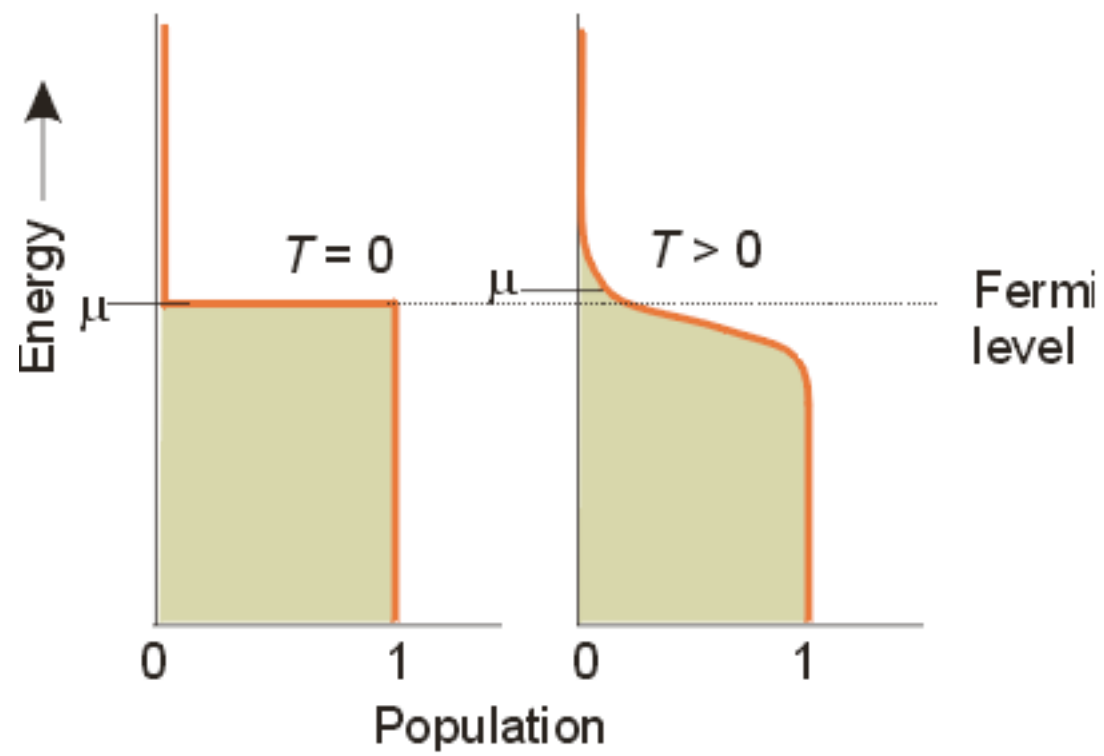


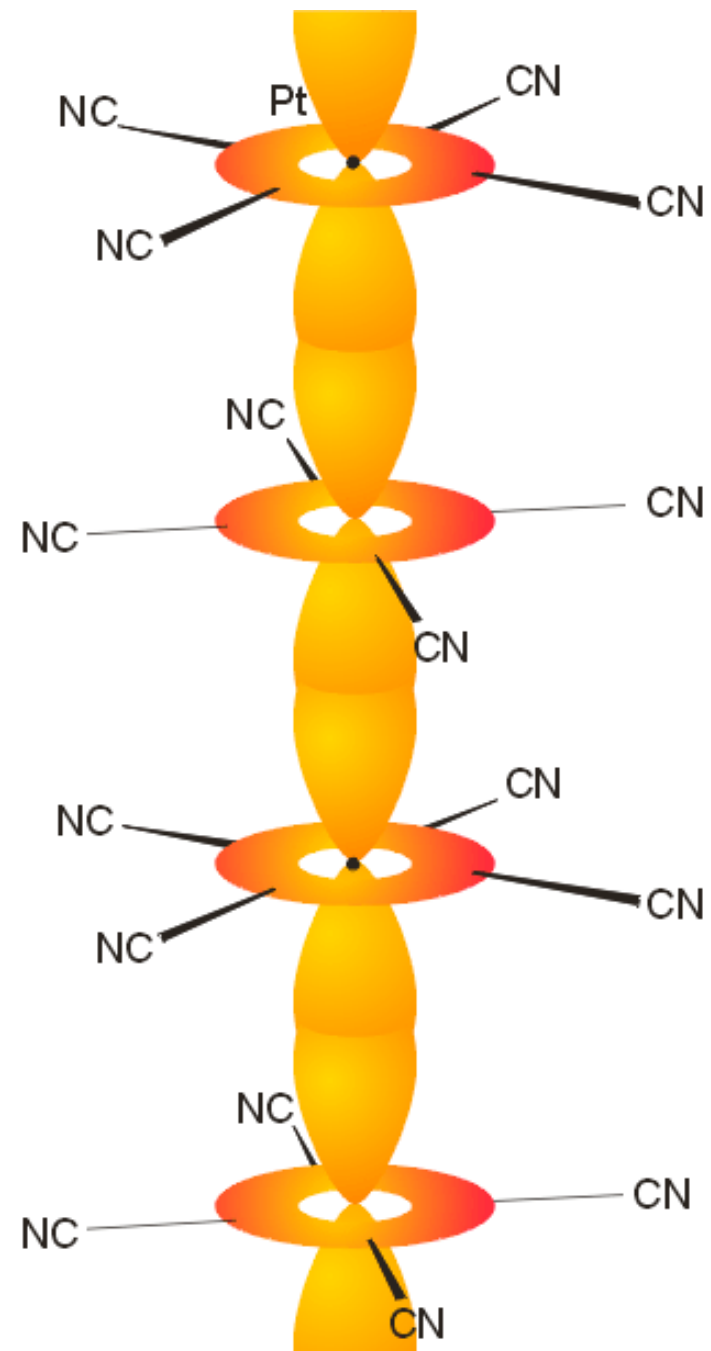
(2) 絶縁体の場合

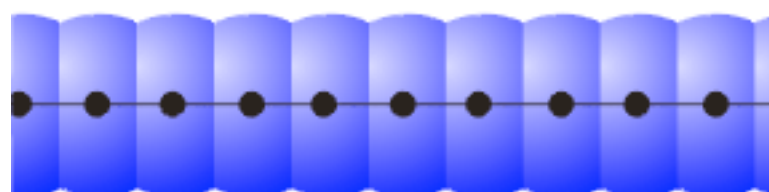




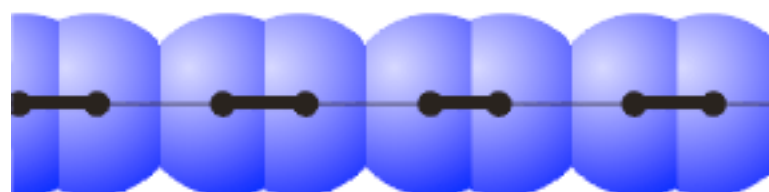








(a)



(b)

