SPOJEVI II

- Halogenidi i nitrati
- Oksidi i hidroksidi
- Karbonati
- Sulfati

Be i spojevi jako otrovni

$Be(OH)_2 + 2\ OH^- \rightarrow Be(OH)_3^-$ $K_a = 10^{-30}$ M

$MgO + MgCl_2$ sorel

- $CaCl_2 \cdot 6\ H_2O$, $CaCl_2$
- CaO
- $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$ vapneni mort
- $CaSO_4 \cdot \frac{1}{2}\ H_2O + 3/2\ H_2O \rightarrow CaSO_4 \cdot 2\ H_2O$

13 SKUPINA ns^2np^1

	B	Al	Ga	In	Tl
• E_i /eV	8.3	6	6	5.8	6.1
• χ	2.0	1.5	1.6	1.7	1.8
• $E^0_{III/I}$ /V		-1.66	-0.53	-0.34	+0.7

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- Raste energija hidratacije

- **B**
- $Na_2[B_4O_5(OH)_4] \cdot 8\ H_2O$

  Boraks
- Stara formula : $Na_2B_4O_7 \cdot 10\ H_2O$
- Dob:
- $Na_2B_4O_7 \xrightarrow{H+} H_3BO_3 \xrightarrow{\text{grijanje}} B_2O_3$
- $B_2O_3 + 3\ Mg \xrightarrow{1900°C} 2\ B + 3\ MgO$

- $2\ BBr_3 + H_2 \xrightarrow{1200°C} 2\ B + 6\ HBr$
- $2\ Cu_2O + 2\ B \rightarrow 6\ Cu + B_2O_3$

- **Al**
- Boksit: AlO(OH) ⌈ bemit
- ⌊ dijaspor
- $Al(OH)_3$ hidrargilit
- Dob Al: dobivanje čistog Al_2O_3
- Elektroliza taline
- **Bayerov postupak**
- $Al(OH)_3 + OH^- \overset{160\ °C,\ 3.5\ MPa}{\underset{Razr}{\Leftrightarrow}} [Al(OH)_4]^-$
- $SiO_2 + 2\ NaOH + 2\ Al(OH)_3 \rightarrow Na_2Al_2SiO_6 + 4\ H_2O$
- $2\ Al(OH)_3 \overset{1200°C}{\rightarrow} Al_2O_3 + 3\ H_2O$

- ***Redukcija glinice***
- Al_2O_3 $t_t \approx 2000\ °C$
- Na_3AlF_6 $t_t \approx 1000\ °C$

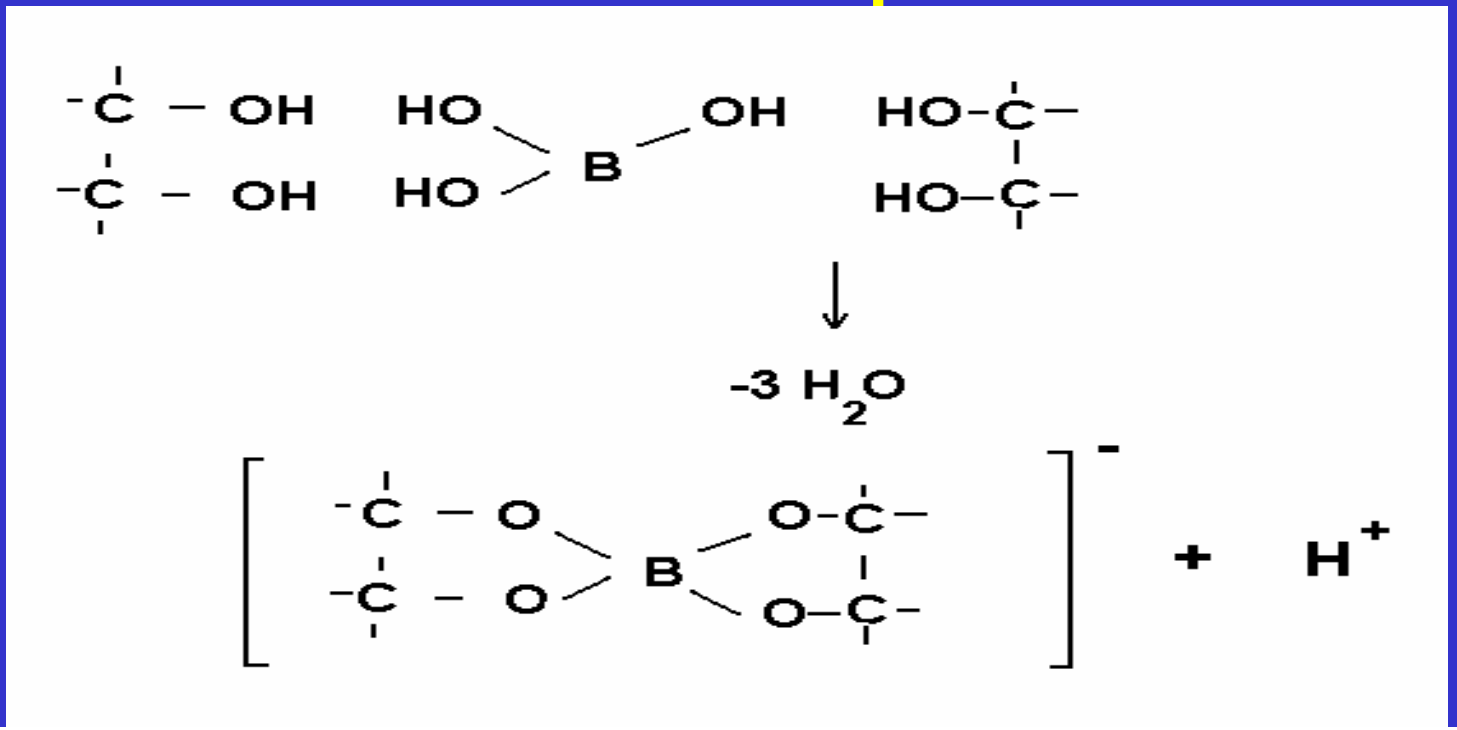
- K: $2\ Al_2O_3 + 6\ e^- \rightarrow 2\ Al + 2\ AlO_3^{3-}$
- A: $2\ AlO_3^{3-} + 3\ C \rightarrow 3\ CO + 6\ e^- + Al_2O_3$
- $Al_2O_3 + 3\ C \rightarrow 2\ Al + 3\ CO$

- **Kem. Svojstva**
- $2\ Al + 3\ Hg^{2+} \rightarrow 2\ Al^{3+} + 3\ Hg$
- $Al + Hg \rightarrow Al(Hg)$
- $2\ Al(Hg) + 3/2\ O_2 \rightarrow Al_2O_3 + 2\ Hg$
- $2\ Al(Hg) + 6\ H_2O \rightarrow 2\ Al(OH)_3 + 3\ H_2 + 2\ Hg$
- $Al + 3\ H^+ + 6\ H_2O \rightarrow [Al(H_2O)_6]^{3+} + 3/2\ H_2$
- $Al + 3\ H_2O + OH^- \rightarrow [Al(H_2O)_4]^- + 3/2\ H_2$
- $2\ Al + 3/2\ O_2 \rightarrow Al_2O_3 + h\nu \quad \Delta_r H = -1670\ kJ/mol$
- $Cr_2O_3 + 2\ Al \rightarrow 2\ Cr + Al_2O_3 \qquad \Delta_r H < 0$
- $Fe_2O_3 + 2\ Al \rightarrow 2\ Fe + Al_2O_3 \qquad \Delta_r H < 0$

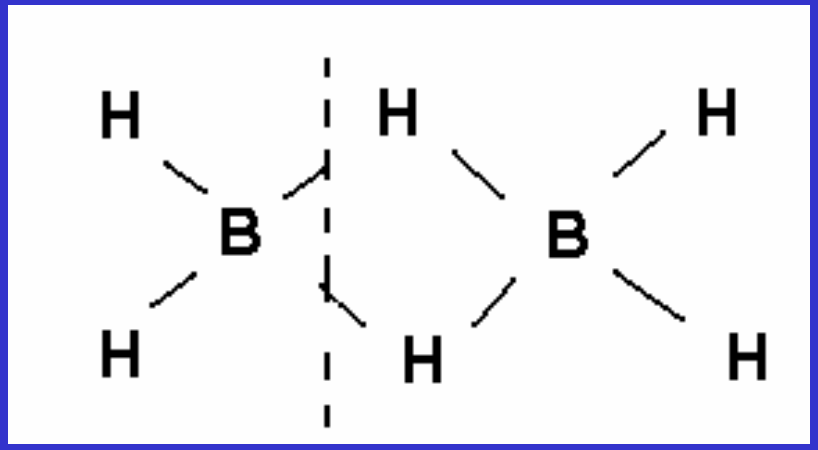
Pregled reakcija

- $2\ M + 3\ X_2 \rightarrow 2\ MX_3$ osim TlX, X = halogen
- $3\ M + 3\ O_2 \rightarrow 2\ M_2O_3$ osim TlO_2
- $2\ M + 3\ S \rightarrow M_2S_3$ Tl_2S kod viših temp.
- $2\ M + N_2 \rightarrow 2MN$ samo B, Al kod viših t.
- $2\ M + 6\ H^+ \rightarrow 2\ M^{3+} + 3\ H_2$ Al, Ga, In, Tl $\rightarrow Tl^+$
- $M + OH^- + 3\ H_2O \rightarrow [M(OH)_4]^- + 3/2\ H_2$, Al, Ga

- $B_2O_3 + 3\ H_2O \rightarrow H_3BO_3$
- $Na_2B_4O_7 + 2\ H^+ + 5\ H_2O \rightarrow 4\ H_3BO_3 + 2\ Na^+$
- $Na_2B_4O_5(OH)_4 + 2\ H^+ + 3\ H_2O \rightarrow 4\ H_3BO_3 + 2\ Na^+$
- $H_3BO_3 \Leftrightarrow H^+ + H_2BO_3^-$ $\quad K_a = 6 \cdot 10^{-10}\ \text{moldm}^{-3}$
- $H_2BO_3^- + H_2O \rightarrow [B(OH)_4]^-$ jače hidratizirani oblik sp^3



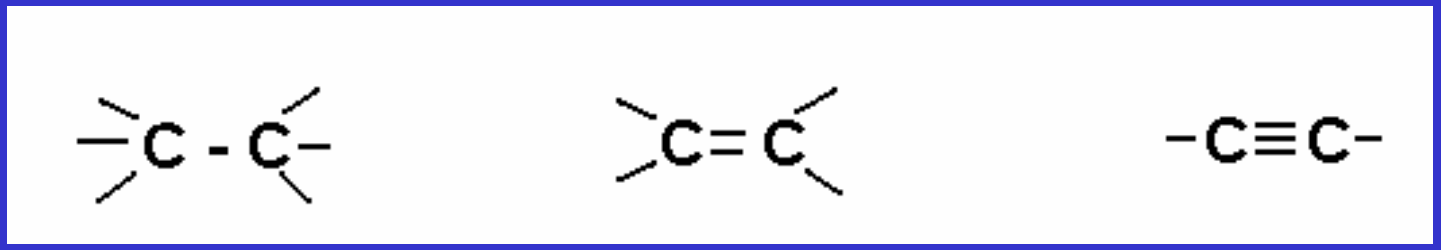
- **Borani** B_2H_6, B_4H_{10} …… $B_{10}H_{14}$
- $B_2H_6 + 6\ H_2O \rightarrow 2\ H_3BO_3 + 6\ H_2$
- $2\ Mg_3B_3 + 12\ H^+ \rightarrow 6\ Mg^{2+} + B_4H_{10} + H_2$
-
  - boranati
  - borhidridi



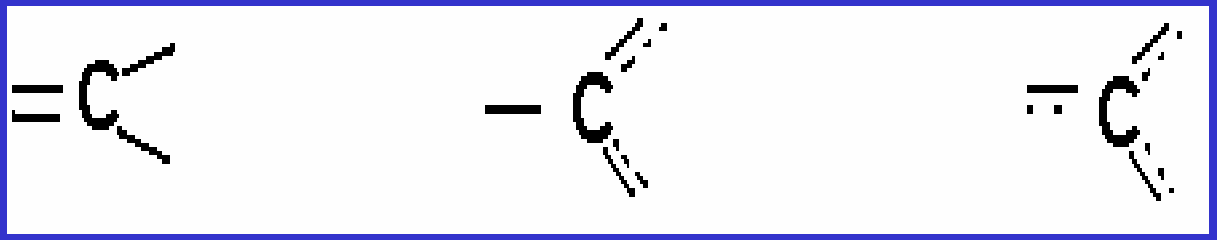
- **Aluminij**
- **Halogenidi** $2\ Al + 3\ X_2 \rightarrow 2\ AlX_3$
- AlF_3 $AlCl_3$ $AlBr_3$ AlI_3
- s ionska ionska
- l ionska kovalentna
  kovalentna
- g (ionska) kovalentna
- $H_2O \rightarrow$ ionizirani Al^{3+} hidroliza
- $2\ AlCl_3(s) \rightarrow Al_2Cl_3\ (l)$ pad: vodljivosti
- gustoće

14 S K U P I N A ns^2np^2

–	C	Si	Ge	Sn	Pb	
• E_i/eV	11.3	8.2	8.1	7.3	7.4	
• χ	2.5	1.8	1.8	1.8	1.8	
• $E^0_{IV\,/\,II}$			-0.2	0.15	1.5	V
• $E^0_{II\,/\,0}$	0.2	-0.86	-0.1	-0.14	-0.13	V



kJ/mol	334	615	841
	1	x 1,84	x 2.52

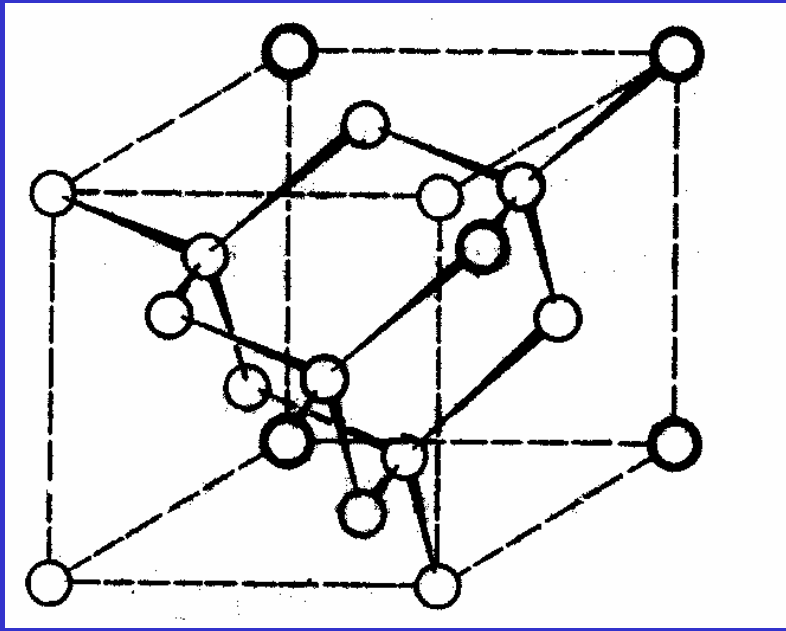


	sp^3	sp^2	sp

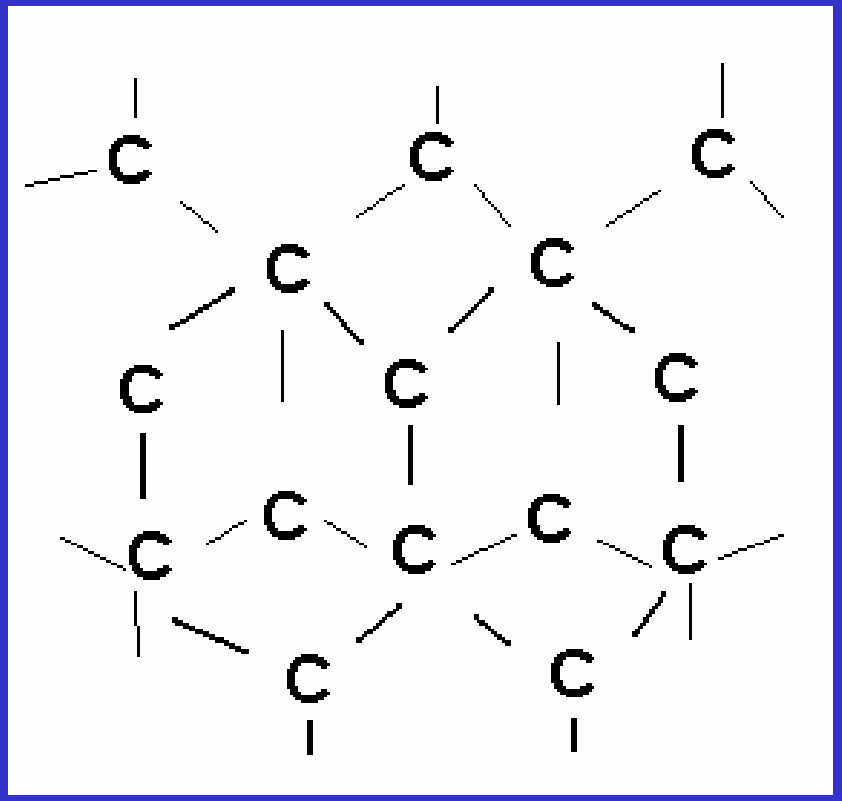
ELEMENTARNE TVARI

	C	Si	Ge	Sn	Pb
T_t/ °C	*3550*	1420	959	232	327
	kovalentna veza				met. Rešetka

- Dijamant
- ρ = 3.51 g/cm^3 , $\Delta_r H^0$ = *2.1 kJ/mol*



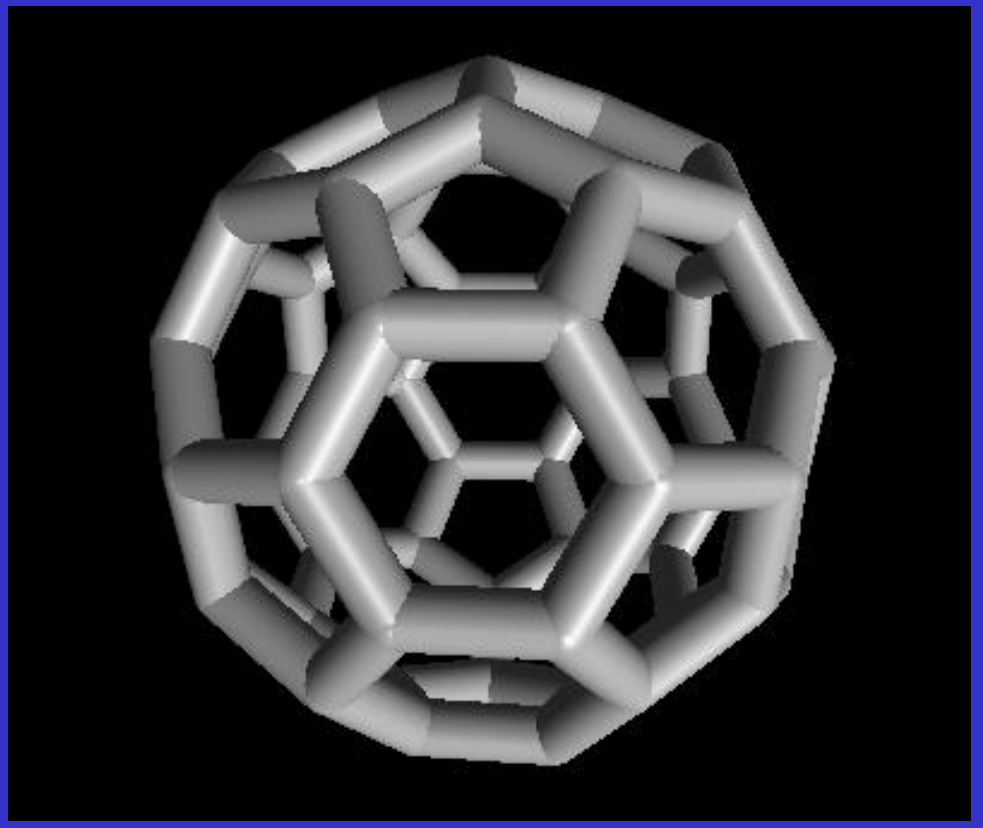
GRAFIT



ρ = 2,27 g/mol

$\Delta_r H^0$ = 0 kJ/mol

FULLERENE



C_{60}

- $C_{dij} \Leftrightarrow C_{graf}$ $\Delta_r H = -2.1$ kJ/mol
- **grafit**
-
- **Dob:** $SiO + 2\,C \xrightarrow{\text{el peć}} Si + 2\,CO$
- (Achenson)
- $Si + C \rightarrow SiC \rightarrow Si + C_{graf.}$
- $K_2SiF_6\,(l) + 4\,K(l) \rightarrow Si\,(l) + 6\,KF\,(l)$
- $3\,SiO_2 + 4\,Al \rightarrow 3\,Si + 2\,Al_2O_3$
- višak
- $SiCl_4 + 2\,Zn \rightarrow Si + 2\,ZnCl_2$
- zonsko taljenje
-
- **FEROSILICIJ**

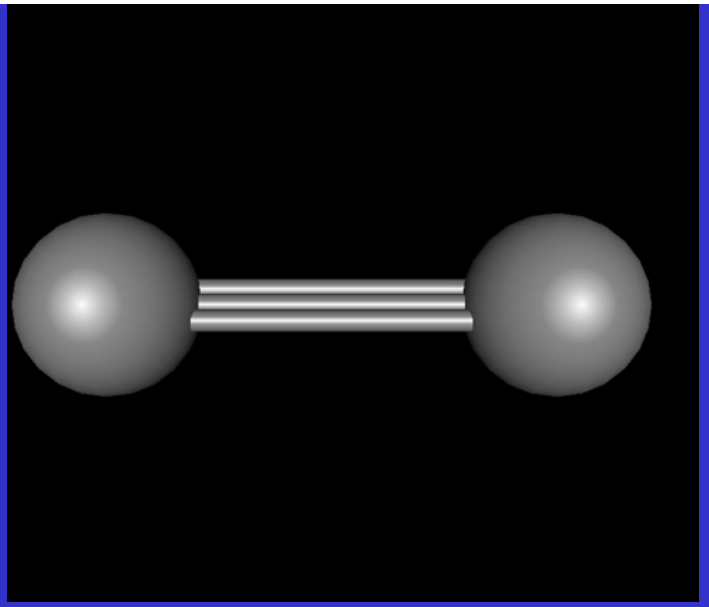
- **Sn:** $Sn_{met.} \rightarrow Sn_{sivi}$
- $SnO_2 + 2\,C \rightarrow Sn + 2\,CO$

- **Pb:** $2\,PbS + 3O_2 \rightarrow 2\,PbO + 2\,SO_2$
- $PbS + 2\,O_2 \rightarrow PbSO_4$
- $2\,PbO + C \rightarrow 2\,Pb + CO$

PREGLED REAKCIJA

- $M + 2\ X_2 \rightarrow MX_4$ PbI_2, osim C
- $M + O_2 \rightarrow MO_2$ PbO, Pb_3O_4
- $M + 2\ S \rightarrow MS_2$ PbS
- $M + 2\ H^+ \rightarrow M^{2+} + H_2$, samo Pb, Sn
- $3\ M + 4\ HNO_3 \rightarrow 3\ MO_2 + 4\ NO + 2\ H_2O$, Pb^{2+}
- $M + 2\ OH^- + H_2O \rightarrow MO_3^{2-} + 2\ H_2$ samo Si, Ge

- IV
- Karbidi *(-IV do I)*
- Silicidi
- Organski spojevi ugljika
- Karbidi :
- - *solnog karaktera*
- -
- - I i II Al_4C_3 (*CH_4*)
- - Na_2C_2, CaC_2, Mg_2C_3
- - C_2H_2 C_3H_4
- *kovalentnog karaktera*
- SiC
- B_4C struktura dijamanta

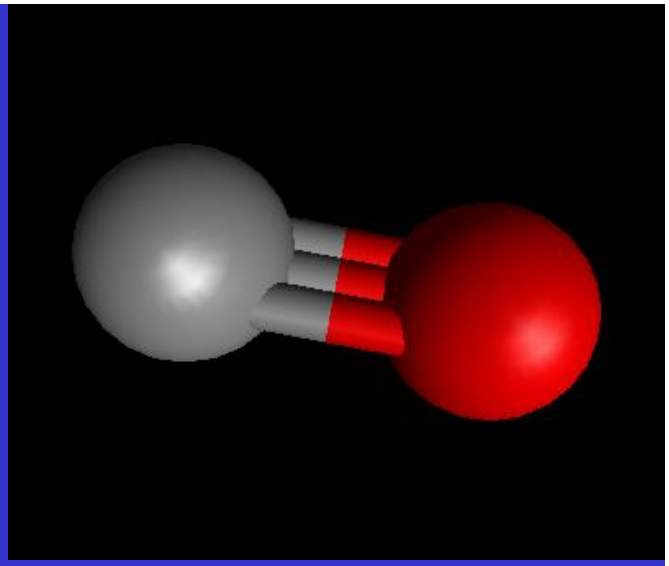


- metalni karbidi
- WC, W_2C, Fe_3C

- $\underline{CaC_2}$
- Dob.: $CaO + 3\ C \rightarrow CaC_2 + CO$ $\Delta_r H > 0$
- $CaC_2 + 2\ H_2O \rightarrow \underline{H_2C_2} + Ca(OH)_2$
- $CaC_2 + N_2 \rightarrow CaCN_2 + C$ $\Delta_r H < 0$

- Silicidi $CaSi_2$, Ca_2Si_2 ,Ca_2Si
- Silani Si_nH_{2n+2}
- $CaO + 2\ SiO_2 + 5\ C \rightarrow CaSi_2 + 5\ CO$
- $Ca_2Si_2 + 3\ O_2 \rightarrow CaSiO_3$
- Silikokalcij
- $Mg_2Si + 4\ HCl \rightarrow MgCl_2 + SiH_4$
- Si_2H_6
- Si_3H_8
- $SiH_4 + 2\ O_2 \rightarrow SiO_2 + 2\ H_2O$

- II CO
- -vrlo otrovan
- Dobivanje:
- Lab. $HCOOH \xrightarrow[H_2SO_4]{-H_2O} CO$
- Industrijsko:
- $C + O_2 \rightarrow CO_2$
- $CO_2 + C \Leftrightarrow 2\,CO \quad \Delta_r H > 0$
- BOUDOURDOVA



- **CO_2 Dobivanje**
- Lab.: $CaCO_3 + 2\ H^+ \rightarrow Ca^{2+} + CO_2 + H_2O$
- Ind: $CaCO_3 \Leftrightarrow CaO + CO_2$
- $C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2$
- $K_2CO_3 + CO_2 + H_2O \Leftrightarrow 2\ KHCO_3$
- kuhanje
-
- $CO_2 + 2\ Mg \rightarrow 2\ MgO + C$