

PERIODA	LJUSKA	NEPOPUNJENE ORBITALE			POPUNJAVAJU SE ORBITALE	
1	K				1 s	
2	L			2 s	2 p	
3	M	3 d		3 s	3 p	
4	N	4 d	4 f	4 s	3 d	4 p
5	O	5 d	5 f	5 s	4 d	5 p
6	P	6 d		6 s	4 f i	5d 6 p
7	Q				7 s	5 f i 6 d

	He	$1s^2$
1.)BLOK PLEMENITIH PLINOVA		ns^2np^6
2.)BLOK s-ELEMENATA (SKUPINE 1,2)		ns^{1-2}
3.)BLOK p-ELEMENATA (SKUPINE 13 - 18)		$ns^2 np^{1-5}$
4.)BLOK d-ELEMENATA (SKUPINE 3 - 12)		$(n-1)d^{1-10} ns^2$
5.)BLOK f - ELEMENATA (SKUPINE DIO 3)		$(n-2) f^{1-14} ns^2$

- ***VRIJEDI OPĆENITO ZA ELEKTRONE U OSNOVNOM STANJU UZ POJEDINAČNA Odstupanja u d i f - BLOKU***

POTPUNE ELEKTRONSKE KONFIGURACIJE

		l			
n		1	2	3	4
1	K	$1s^2$			
2	L	$2s^2$	$2p^6$		
3	M	$3s^2$	$3p^6$	$3d^{10}$	
4	N	$4s^2$	$4p^6$	$4d^{10}$	$4f^{14}$
5	O	$5s^2$	$5p^6$	$5d^{10}$	$5f^{14}$
6	P	$6s^2$	$6p^6$	$6d^?$	
7	Q	$7s^2$			

NE PRODIRU U UNUTARNJE LJUSKE

PRAVILO DIAGONALA

- **ODSTUPANJA:**



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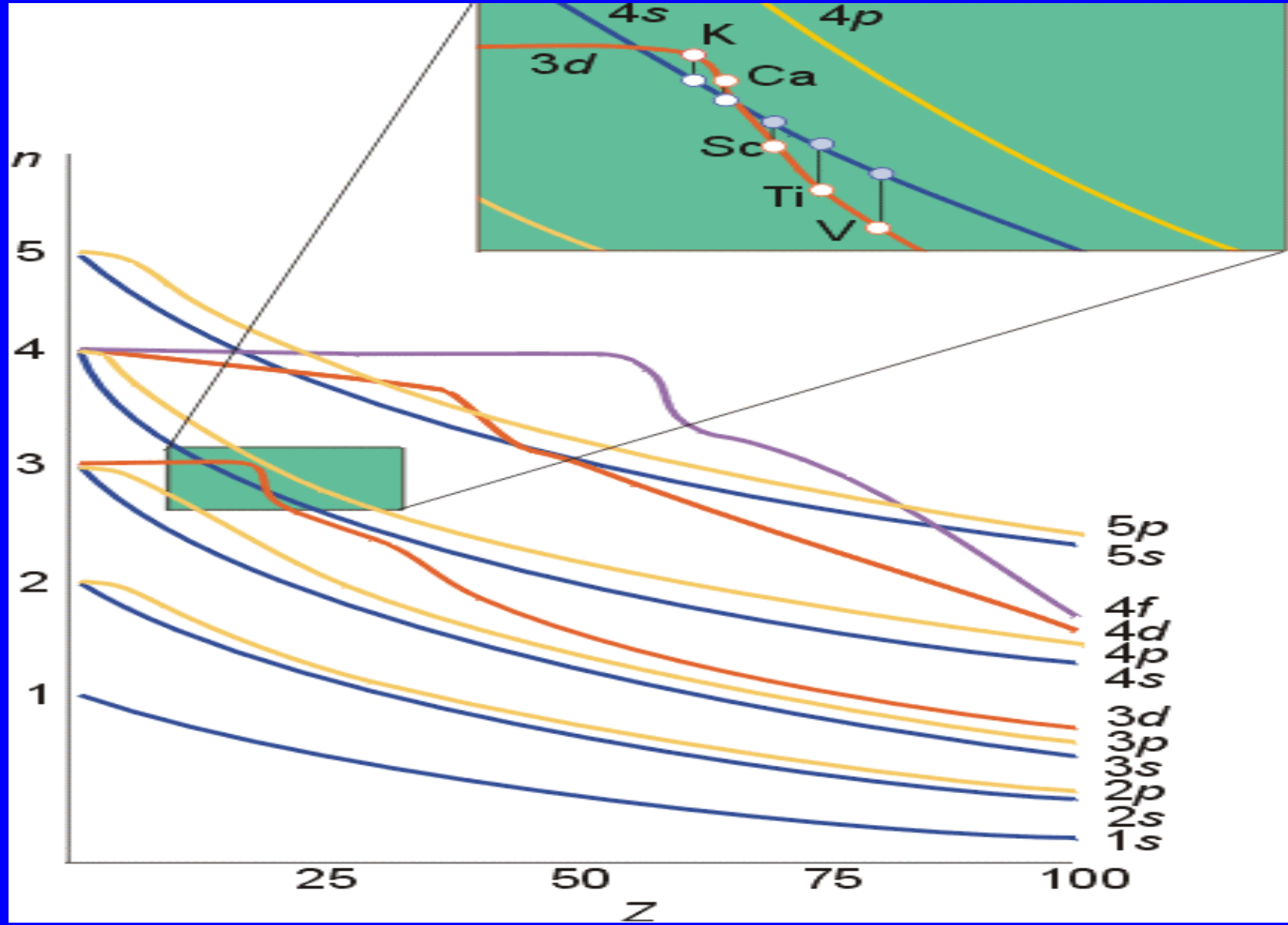
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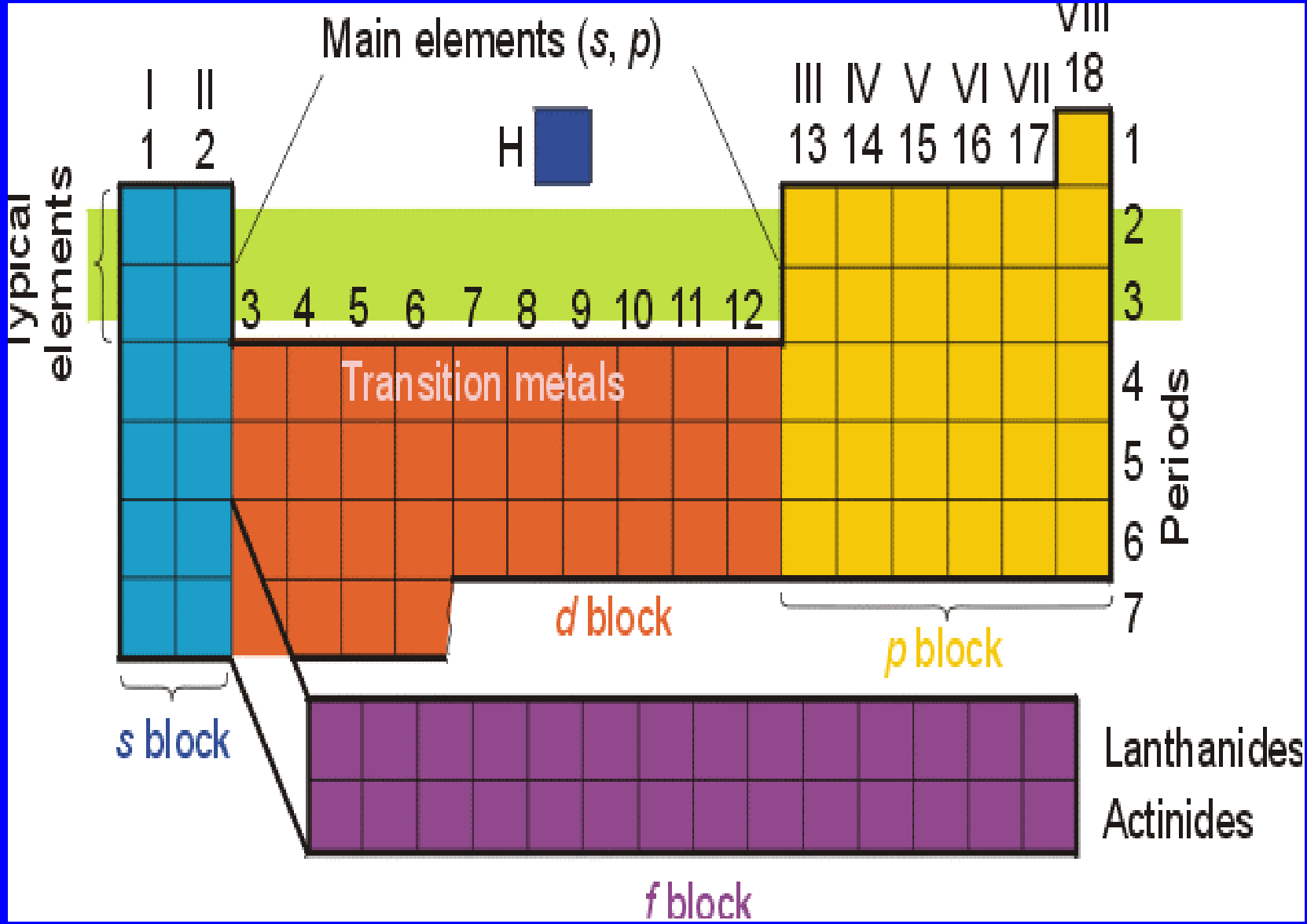
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- **PRAVILO:**







Solvayev kongres u Briselu 1911g.



VODIK

- $1s^1$ $T_t = 14 \text{ K}$, $T_v = 20 \text{ K}$, $\rho = 0,07 \text{ g/ml}$
- $r_{\text{kov}} = 0,03 \text{ nm}$
- $E_i = 13,6 \text{ eV}$
- $\chi = 2,1$
 - $\text{H}_2 (\text{g}) \rightarrow 2\text{H}$ $\Delta_r H = 436 \text{ KJmol}^{-1}$

- IZOTOPI ${}_1^1\text{H},$ ${}_1^2\text{H},$ ${}_1^3\text{H}$
- H D T
- $t_{0.5} = 12 \text{ god}$

- U VODI 10^{17} 2×10^{13} 1 atoma
- 5000 1
- DOB: D_2O ELEKTROLIZA VODE

- IZ $1\text{m}^3\text{H}_2\text{O} \rightarrow 40 \text{ cm}^3 \text{D}_2\text{O}$

Nesreća cepelina Hindenburga





hinden1.mov



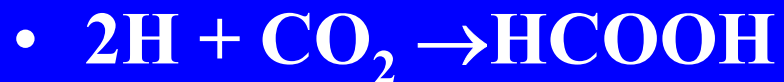
- T 25 K 0,01 0,99
- w 300 K 0,749 0,251
- ∞ 0,75 0,25

- **REAKTIVNOST ATOMNOG VODIKA**



- 9% kod 3000 K $t_{0.5} \sim 0,3 \text{ sec}$

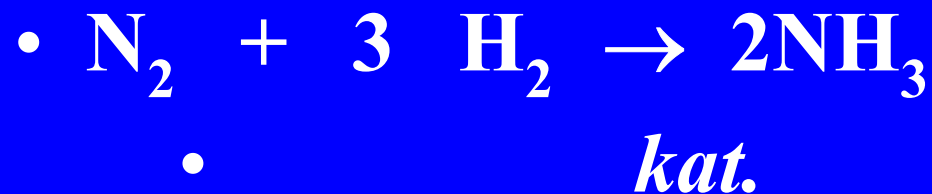
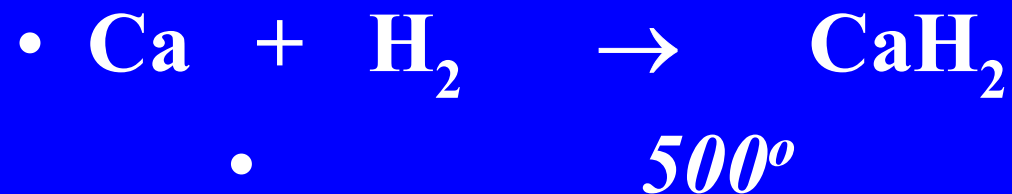
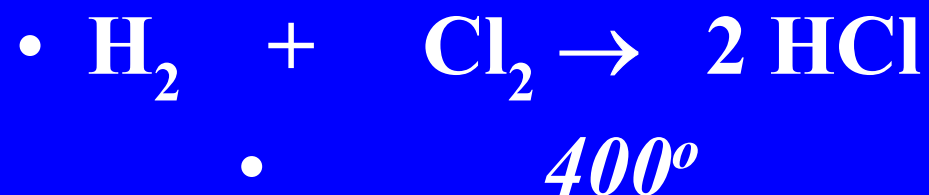
- $2\text{H} \rightarrow \text{H}_2$ *KATALIZIRA* Pt, Pd, W, Fe, Cr, Ag i dr.



DOB. U LABORATORIJU



REAKTIVNOST VODIKA



DOBIVANJE VODIKA

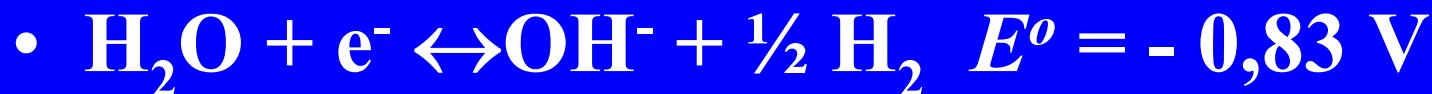
- REDUKCIJA SPOJEVA

I



- $E = E^0 + 0,059 \text{ V} \log (\text{H}^+/\text{mol dm}^{-3})$

- $E = - 0,059 \text{ V} \cdot \text{pH}$



- $\text{Na}^+ + \text{e}^- \leftrightarrow \text{Na} \quad E^0 = - 2,7 \text{ V}$
- $\frac{1}{2} \text{Zn}^{2+} + \text{e}^- \leftrightarrow \frac{1}{2} \text{Zn} \quad E^0 = - 0,76 \text{ V}$
- $\frac{1}{2} \text{Zn} (\text{OH})_4^{2-} + \text{e}^- \leftrightarrow \frac{1}{2} \text{Zn} + 2 \text{OH} \quad E^0 = - 1,2 \text{ V}$

H₂O:



• **H⁺:**



• **OH⁻:**

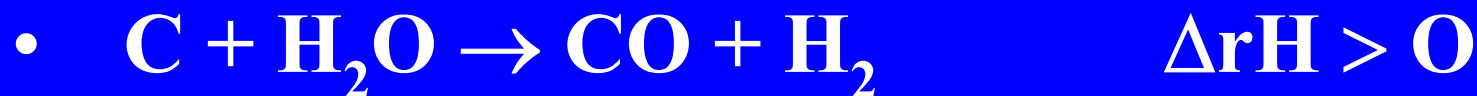
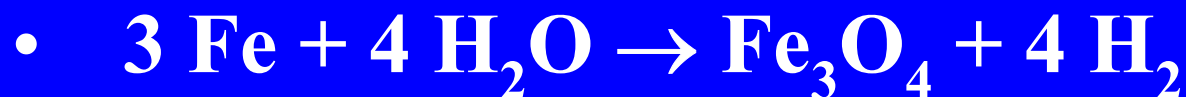


ELEKTROLIZA

- *REDUKCIJA NA KATODI*



- DRUGI REDUCENSI



OSTALI POSTUPCI



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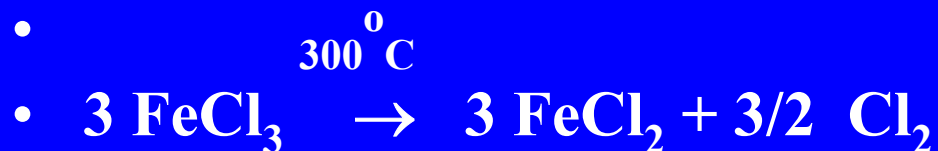
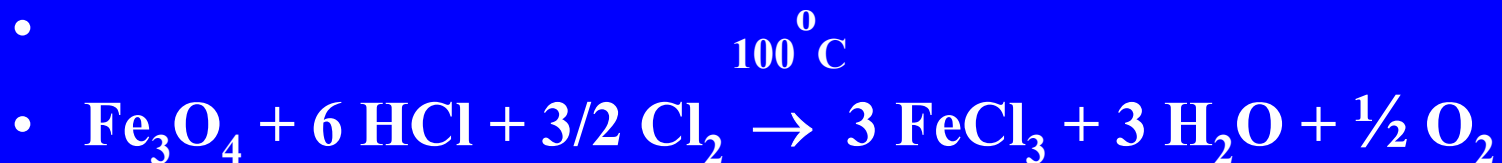
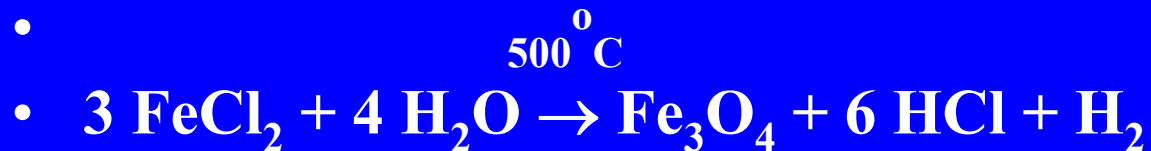
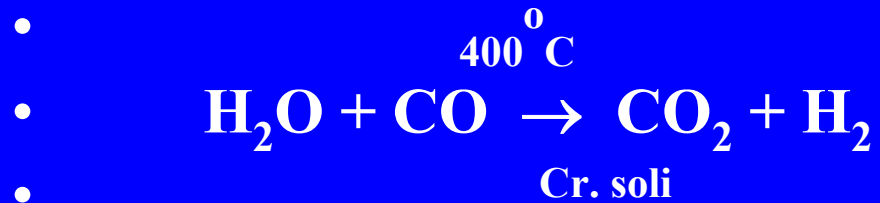
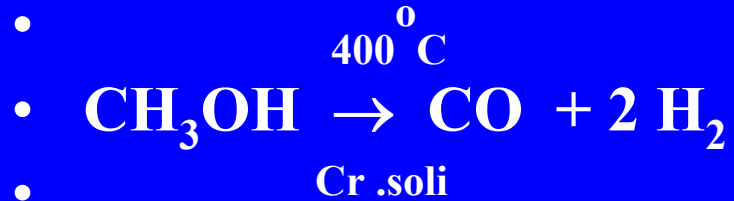
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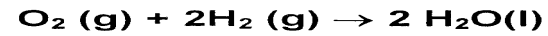


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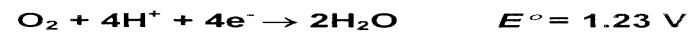
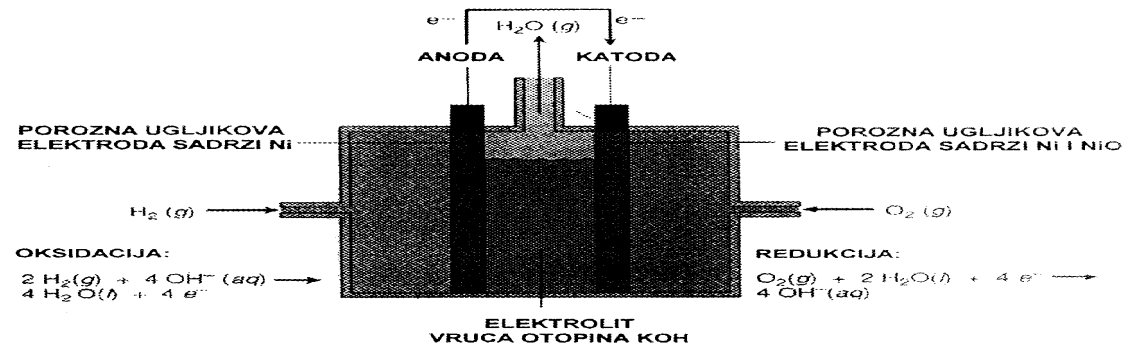




GORIVE ČELIJE (ČLANCI)



$$\Delta_f H^\circ = -286 \text{ kJ / mol}$$



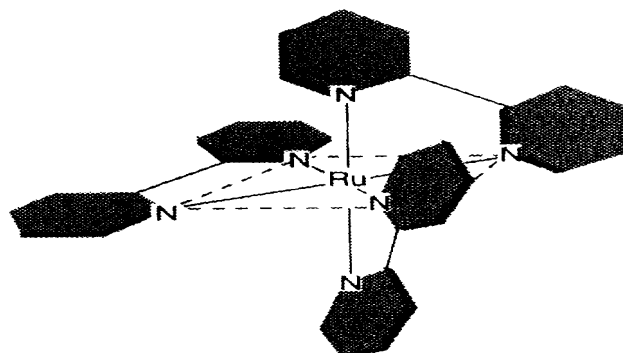
ISKORISTIVOST REAKCIJA U GORIVIM ČLANCIMA

REAKCIJA	<i>t</i> / °C	<i>η</i> / %
H ₂ + 1/2 O ₂ → H ₂ O	25	0.83
	150	0.91
CH ₄ + 2O ₂ → CO ₂ + 2H ₂ O	25	0.91
	150	0.99
NH ₃ + 3/4 O ₂ → 1/2 N ₂ + 3/2 H ₂ O	25	0.93
	150	0.61
N ₂ H ₄ + O ₂ → N ₂ + 2H ₂ O	25	0.967

Fuel Cell ALT-TAB

ENERGIJA VEZE O-H U VODI = 459 kJ/mol
 $\lambda(\text{ZRAČENJA}) = 261 \text{ nm}$

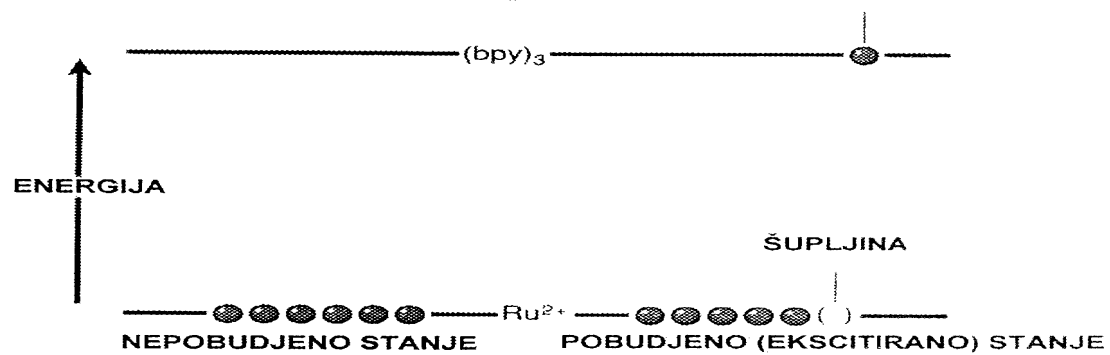
KATALIZATOR: $\text{Ru}(\text{bpy})_3\text{Cl}_2$



$\lambda(\text{ZRAČENJA}) = 450 \text{ nm}$



POBUDJENI ELEKTRON



SPOJEVI VODIKA

- *HIDRIDNI*
- **SOLNOG KARAKTERA**
- 1. MH
- 2. MH₂ Ca, Sr, Ba
- DOKAZ H⁻: ELEKTROLIZA
- TALINE (LiH)
- A: $2\text{H}^- \rightarrow \text{H}_2 + 2\text{e}^-$
- $E^\circ \frac{1}{2} \text{H}_2/\text{H}^- = -2,23 \text{ V}$
- *REDUKTIVNA SREDSTVA*

- **Li[AlH₄], Na[BH₄]**
- *(1947)*
-
- **Na + Al + 2H₂ → Na[AlH₄]**
 eter
 p.t.
- **-METALNOG KARAKTERA**
- **ELEMENTI d i f BLOKA**
- **PdH_{0,8}**
- **-KOVALENTNOG KARAKTERA**
- **(AlH₃)_n, (BH₃)_n**

SPOJEVI S VODIKOM

LiH	BeH₂	B₂H₆	CH₄	NH₃	H₂O	HF
NaH	MgH₂	AlH₃	SiH₄	PH₃	H₂S	HCl
KH	CaH₂	GaH₃	GeH₄	AsH₃	H₂Se	HBr
RbH	SrH₂		SnH₄	SbH₃	H₂Te	HI
CsH	BaH₂		PbH₄	BiH₃		HAt

<u>Hidrid</u>	<u>w(H₂)/%</u>	<u>γ(H₂)/gml⁻¹</u>	<u>E/kJg⁻¹</u>
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- MgH₂ 7 0,101 9,9
- TiH₂ 4 0,15 5,7
- FeTiH_{1,95} 0,08 4,5
- LaNi₅H_{5,9} 1,37 0,09 1,95

H₂ pod tlakom

spremnik s hidridom

-
- **volumen spremnika** **10 L** **1,7 L**
- **masa** **18 kg** **7,5 kg FeT**
- **3,5 kg boca**
- **tlak** **200 bar** **5 -30 bar**
- **(25°C)**
- **100 bar**
- **(75°C)**
- **masa vodika** **0,178 kg** **0,14 kg**
- **čistoća vodika** **99,9 %** **99,9999 %**

- $\Delta \chi = \chi (\text{aniona}) - \chi (\text{kationa})$
- $\Delta \chi$ - RAZLIKA
ELEKTRONEGATIVNOSTI
- $> 1,8$ uglavnom ionski
- $0,4 - 1,8$ polarni kovalentni
- $< 0,4$ uglavnom kovalentni
- 0 nepolarni kovalentni

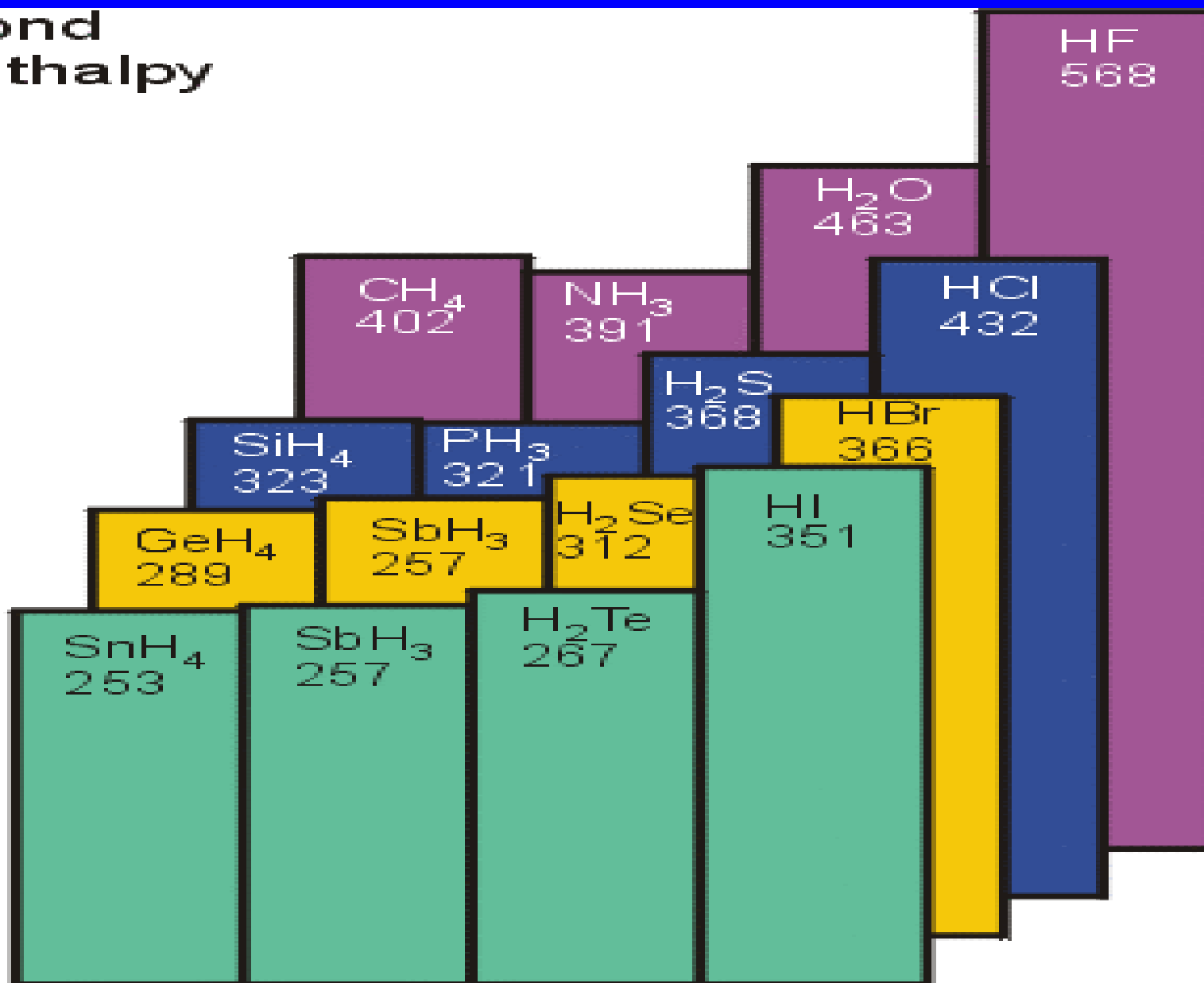
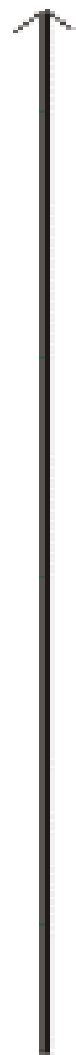
kovalentni molekularni hidridi

14.	15.	16.	17.
C_nH_m	NH_3, N_2H_4, HN_3	H_2O, H_2O_2	HF
Si_nH_{2n+2} $n = 1..8$	PH_3, P_2H_4	H_2S_n $n = 1-8$	HCl
Ge_nH_{2n+2} $n = 1..5$	AsH_3, As_2H_4	H_2Se	HBr
SnH_4, Sn_2H_6	SbH_3, Sb_2H_4	H_2Te	HI
PbH_4	BiH_3	($PoH_2 ?$)	AtH

SPOJEVI ELEMENATA *p*-BLOKA S VODIKOM

XVII	HF	HCl	HBr	HI
XVI	H ₂ O	H ₂ S	H ₂ Se	H ₂ Te
XV	NH ₃ 107°	PH ₃ 94°	AsH ₃ 92°	SbH ₃ 91°
XIV	CH ₄ 109°	SiH ₄	GeH ₄	SnH ₄

Bond enthalpy



THE END