

Hesov zakon



Germain Henri Hess

Entalpije neke reakcije r jednaka je zbroju entalpija reakcija na koje reakciju r možemo rastaviti

- Stvaranje

$$\Delta_r H = \sum_i \nu_i \Delta_f H_i$$

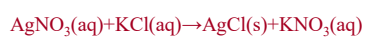
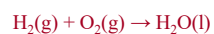
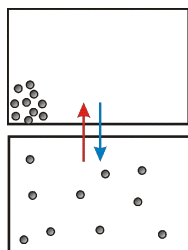
- Sagorijevanje

$$\Delta_r H = -\sum_i \nu_i \Delta_c H_i$$

- Atomizacija

$$\Delta_r H = -\sum_i \nu_i \Delta_{at} H_i$$

Spontani procesi



DRUGI ZAKON TERMODINAMIKE

spontanost neke fizikalne ili kemijske promjene

ENTROPIJA

Entropija svemira raste.

postoji neprekinuta, jednoznačna, jedinstvena ekstenzivna funkcija stanja koja se naziva entropija i to takva da vrijedi:

$$dS = \frac{dq_{rev}}{T}$$

$$dS \geq \frac{dq}{T}$$

Primjeri:

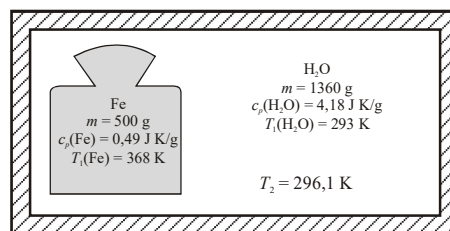
Spontani procesi

$$\Delta S > 0$$

- Promjena entropije s promjenom volumena
- Promjena entropije s promjenom temperature
- Promjena entropije prilikom fazne transformacije



Spontani procesi u izoliranom sustavu popraćeni su povećanjem ukupne entropije.

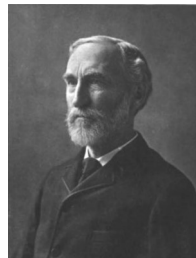


TREĆI ZAKON TERMODINAMIKE

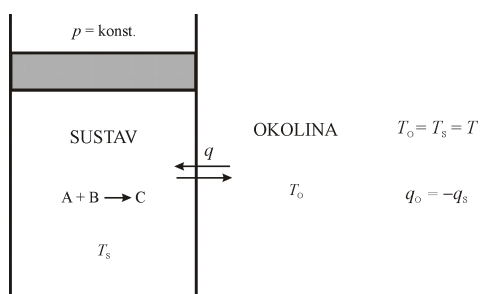
Entropija elemenata i savršenih kristala je nula pri apsolutnoj nuli.

$$S_m(T = 0 \text{ K}) = 0$$

Josiah Willard Gibbs



Gibbsova energija, G



$$G = H - TS$$

Spontani proces: $\Delta S_{uk} > 0 \Rightarrow \Delta G < 0$

$$\Delta_r G = \Delta_r H - T \Delta_r S$$

$\Delta_r G > 0$ Povratna reakcija

$\Delta_r G = 0$ Ravnoteža

$\Delta_r G < 0$ Spontana, napredna reakcija

$$G = H - TS \quad \begin{array}{l} p = \text{konst.} \\ T = \text{konst.} \end{array}$$

$$dG = d(H - TS) = dH - d(TS) = dH - TdS - SdT$$

$$H = U + pV$$

$$dH = dU + d(pV) = dU + pdV + Vdp$$

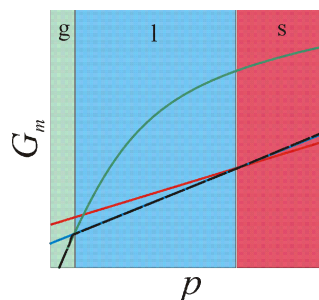
$$dG = dU + pdV + Vdp - TdS - SdT$$

$$dG = dq - pdV + pdV + Vdp - dq - SdT$$

$$dG = Vdp - SdT$$

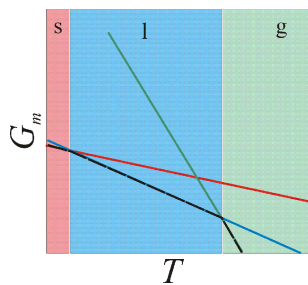
$$dG = Vdp - SdT$$

$$\left(\frac{\partial G}{\partial p} \right)_T = V$$



$$dG = Vdp - SdT$$

$$\left(\frac{\partial G}{\partial T}\right)_p = -S$$



Gibbs-Helmholtzova rovnice

$$\left(\frac{\partial G}{\partial T}\right)_p = -S$$

$$\left(\frac{\partial(G/T)}{\partial T}\right)_p = -\frac{H}{T^2}$$

$$\left(\frac{\partial(G/T)}{\partial(1/T)}\right)_p = H$$

