Promjena entropije u procesima

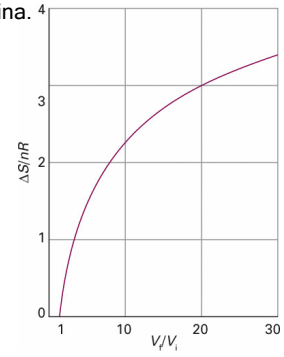
Izotermna ekspanzija idealnog plina.

Reverzibilna:

$$\Delta S_{tot} = 0$$

Ireverzibilna:

$$\Delta S_{tot} = nR \ln \frac{V_f}{V_i}$$



Promjena entropije kod faznog prijelaza

Entropija sustava kod faznog prijelaza: $\Delta S_{trs} = \frac{\Delta_{trs} H}{T_{trs}}$

Ukupna entropija: $\Delta S_{tot} = 0$

	Fusion (at T_f)	Vaporization (at T_b)
Argon, Ar	14.17 (at 83.8 K)	74.53 (at 87.3 K)
Benzene, C_6H_6	38.00 (at 279 K)	87.19 (at 353 K)
Water, H_2O	22.00 (at 273.15 K)	109.0 (at 373.15 K)
Helium, He	4.8 (at 1.8 K and 30 bar)	19.9 (at 4.22 K)

* More values are given in the *Data section*.

Troutonovo pravilo

Eksperimentalne standardne entropije isparavanja velikog broja različitih tekućina iznose oko 85 $\mathrm{J\ K\ mol^{-1}}$.

	$\Delta_{vap}H^{\circ}/(\mathrm{kJ\ mol^{-1}})$	$\theta_b/^{\circ}\mathrm{C}$	$\Delta_{vap}S^{\circ}/(\mathrm{J\ K^{-1}\ mol^{-1}})$
Benzene	30.8	80.1	87.2
Carbon tetrachloride	30	76.7	85.8
Cyclohexane	30.1	80.7	85.1
Hydrogen sulfide	18.7	−60.4	87.9
Methane	8.18	−161.5	73.2
Water	40.7	100.0	109.1

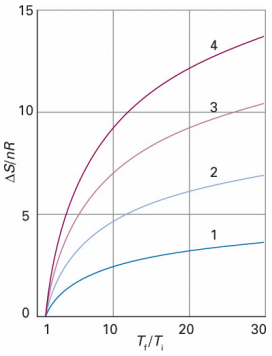
* More values are given in the *Data section*.

Promjena entropije kod zagrijavanja

$$S(T_f) = S(T_i) + \int_{T_i}^{T_f} \frac{dq_{rev}}{T}$$

$$S(T_f) = S(T_i) + \int_{T_i}^{T_f} \frac{C_p dT}{T}$$

$$S(T_f) = S(T_i) + C_p \ln \frac{T_f}{T_i}$$



Nernstov teorem

Promjena entropije svakog kemijskog ili fizičkog procesa ide prema 0 kako se temperatura približava 0.

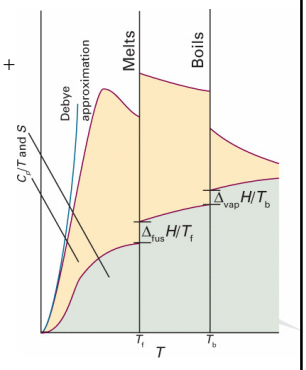
$$\Delta S \to 0 \text{ kako } T \to 0$$

III zakon termodinamike:

Entropija svih tvari (u obliku čistog idealnog kristala) na $T = 0$ iznosi 0.

Mjerenje entropije

$$S_m(T) = S_m(0) + \int_0^{T_f} \frac{C_{p,m}(s,T)}{T} dT + \frac{\Delta_{fus} H}{T_f} +$$
$$+ \int_{T_f}^{T_b} \frac{C_{p,m}(l,T)}{T} dT + \frac{\Delta_{vap} H}{T_b} +$$
$$+ \int_{T_b}^{T} \frac{C_{p,m}(g,T)}{T} dT$$



Standardna entropija

Standardna entropija tvari na temperaturi T: $S^{\ominus}(T)$

Standardna reakcijska entropija na temperaturi T: $\Delta_r S^{\ominus}(T)$

$$\Delta_r S^{\ominus} = \sum_{\text{Produkti}} \nu S_m^{\ominus} - \sum_{\text{Reaktanti}} \nu S_m^{\ominus}$$

$$\Delta_r S^{\ominus} = \sum_{\text{J}} \nu_J S_J^{\ominus} \ (J)$$

Helmholtzova i Gibbsova energija

Helmholtzova energija: $A = U - TS$ (T i V = konst.)

Gibbsova energija: $G = H - TS$ (T i p = konst.)

$$dA = dU - TdS$$

$$dG = dH - TdS$$

Proces unutar sustava se odvija spontano ako je:

$$dA_{T,V} \leq 0$$

$$dG_{T,p} \leq 0$$