Allmänna relationer för enkomponentsystem

Utgångspunkt: Termodynamiska identiteten

$$dE = TdS - PdV$$

Termodynamiska potentialer

$$\begin{array}{lll} E & E = E(S,V) & dE = TdS - PdV \\ H \equiv E + PV & H = H(S,P) & dH = TdS + VdP \\ F \equiv E - TS & F = F(T,V) & dF = -SdT - PdV \\ G \equiv E - TS + PV & G = G(T,P) & dG = -SdT + VdP \end{array}$$

Allmänna relationer

$$\begin{aligned} dE &= C_v(T,V)\ dT + [T\ (\frac{\partial P}{\partial T})_v - P]\ dV \\ dH &= C_p(T,P)\ dT + [V - T\ (\frac{\partial V}{\partial T})_p]\ dP \\ dS &= \frac{C_v(T,V)}{T}\ dT + (\frac{\partial P}{\partial T})_v\ dV \\ dS &= \frac{C_p(T,P)}{T}\ dT - (\frac{\partial V}{\partial T})_p\ dP \end{aligned}$$

där

$$C_v(T,V) \equiv (\frac{\partial E}{\partial T})_v = T(\frac{\partial S}{\partial T})_v$$

$$C_p(T,P) \equiv (\frac{\partial H}{\partial T})_p = T(\frac{\partial S}{\partial T})_p$$

Vidare

$$\begin{aligned} (\frac{\partial C_v(T,V)}{\partial V})_T &= T\ (\frac{\partial^2 P}{\partial T^2})_v \\ (\frac{\partial C_p(T,P)}{\partial P})_T &= -T\ (\frac{\partial^2 V}{\partial T^2})_p \end{aligned}$$

och

$$C_p - C_v = T\ (\frac{\partial P}{\partial T})_v\ (\frac{\partial V}{\partial T})_p = \frac{TV\beta_p^2}{\kappa_T}$$

där

$$\beta_p(T,P) \equiv \frac{1}{V}(\frac{\partial V}{\partial T})_p$$

$$\kappa_T(T,P) \equiv -\frac{1}{V}(\frac{\partial V}{\partial P})_T$$