TD10 : Transitions de phase

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TD10: accorciare nucleazione, aggiungere TD Alice su trans phase

1 Melting and latent heat

1.1

Consider a block of ice and an iron cylinder standing over it, with a circular section of $S = 1$ cm^2. At $T = -2$°C and ambient pressure, for what minimal mass M and height H the cylinder passes through the block of ice by locally melting it? We know that at $T = 0$°C the latent heat is $l = 6.05$ kJ/mol, the molar volumes are $v_{\text{liq}} = 18$ cm^3/mol, $v_{\text{ice}} = 22.5$ cm^3/mol, and the density of iron is 7.8 g/cm^3. Make a sketch of the problem on the phase diagram.

2 Crystal nucleation

2.1

Starting from the expression from classical nucleation theory

$$\Delta G(r) = 4\pi r^2 \gamma - \frac{4\pi}{3} r^3 \Delta\mu$$

find the size r^* of the critical nucleus, the corresponding critical number of atoms (or molecules) n^*, and the height of the barrier.

2.2

Consider the behavior of ΔG^*: assuming γ to be constant, what happens when we approach the coexistence conditions? Why? What happens when we get farther away? Why?

2.3

For which value of ΔG^* we can say that the barrier is negligible, and therefore that the nucleation proceeds unhampered by a barrier?

2.4

An experiment shows that, at a given p, the nucleation barrier ΔG^* becomes negligible at $T = 200$ K, while the melting point at the same p is $T_M = 250$ K. What can we deduce about the mathematical form of the chemical potentials as a function of T? (We assume γ to be constant.)