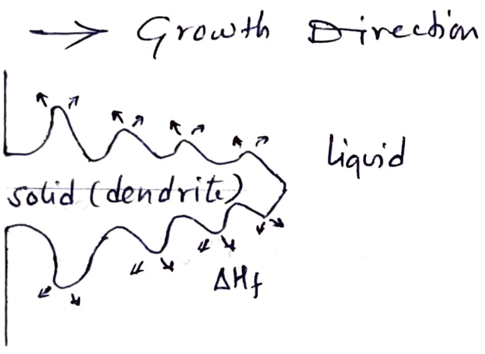
primary stalks to speed the evolution of the latent heat.

Dendritic growth continues until the undercooled liquid warms to the freezing temperature.

Any remaining liquid then solidifies by planar growth.

The difference between planar and dendritic growth arises because of the different sinks for the Latent heat.

The container or mold must absorb the heat in planar growth, but the undercooled liquid absorbs the heat in dendritic growth.



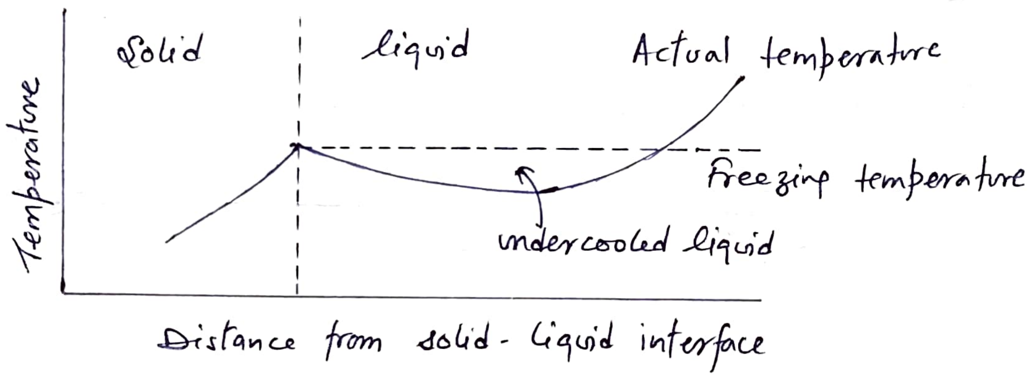


Fig 6: If the liquid is undercooled, a protuberance on the solid-liquid interface can rapidly grow as a dendrite. The Latent heat of fusion is removed by raising the temperature of the liquid back to the freezing temperature.

In pure metals, dendritic growth normally represents only a small fraction of the total growth.

$$\text{Dendritic Growth} = f = \frac{c\,\Delta T}{\Delta H_f}$$

where c is the specific heat of the liquid.

The numerator represents the heat that the undercooled liquid can absorb, and the latent heat in the denominator represents the total heat that must be given up during solidification.

As the undercooling ΔT increases, more dendritic growth occurs.

EX :-

Calculate the fraction of growth that occurs dendritically in copper which (a) nucleates homogeneously and (b) nucleates heterogeneously with 10°C undercooling.

Ans :

The latent heat of fusion for copper is $1628 \times 10^6 \ J\,m^{-3}$, the specific heat is $4.4 \times 10^6 \ J\,(m^3 K)^{-1}$, and, from ex-1, the undercooling for homogeneous nucleation is 272°C.

(a) For homogeneous nucleation

$$f = \frac{c\,\Delta T}{\Delta H_f} = \frac{(4.4 \times 10^6)\,(272)}{1628 \times 10^6} = 0.735$$

(b) For 10°C undercooling

$$f = \frac{(4.4 \times 10^6)\,(10)}{1628 \times 10^6} = 0.027$$