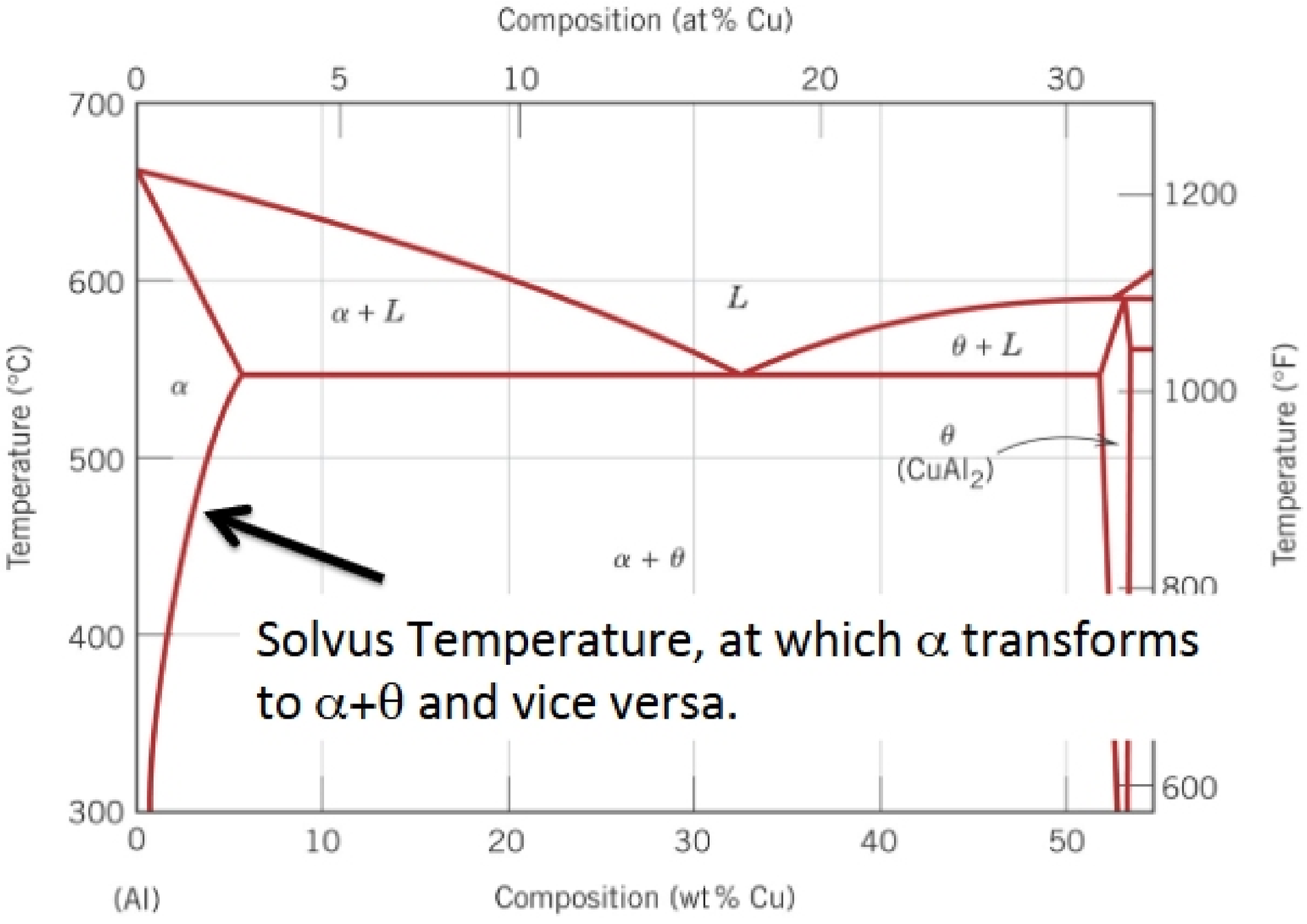
Two things to explain:

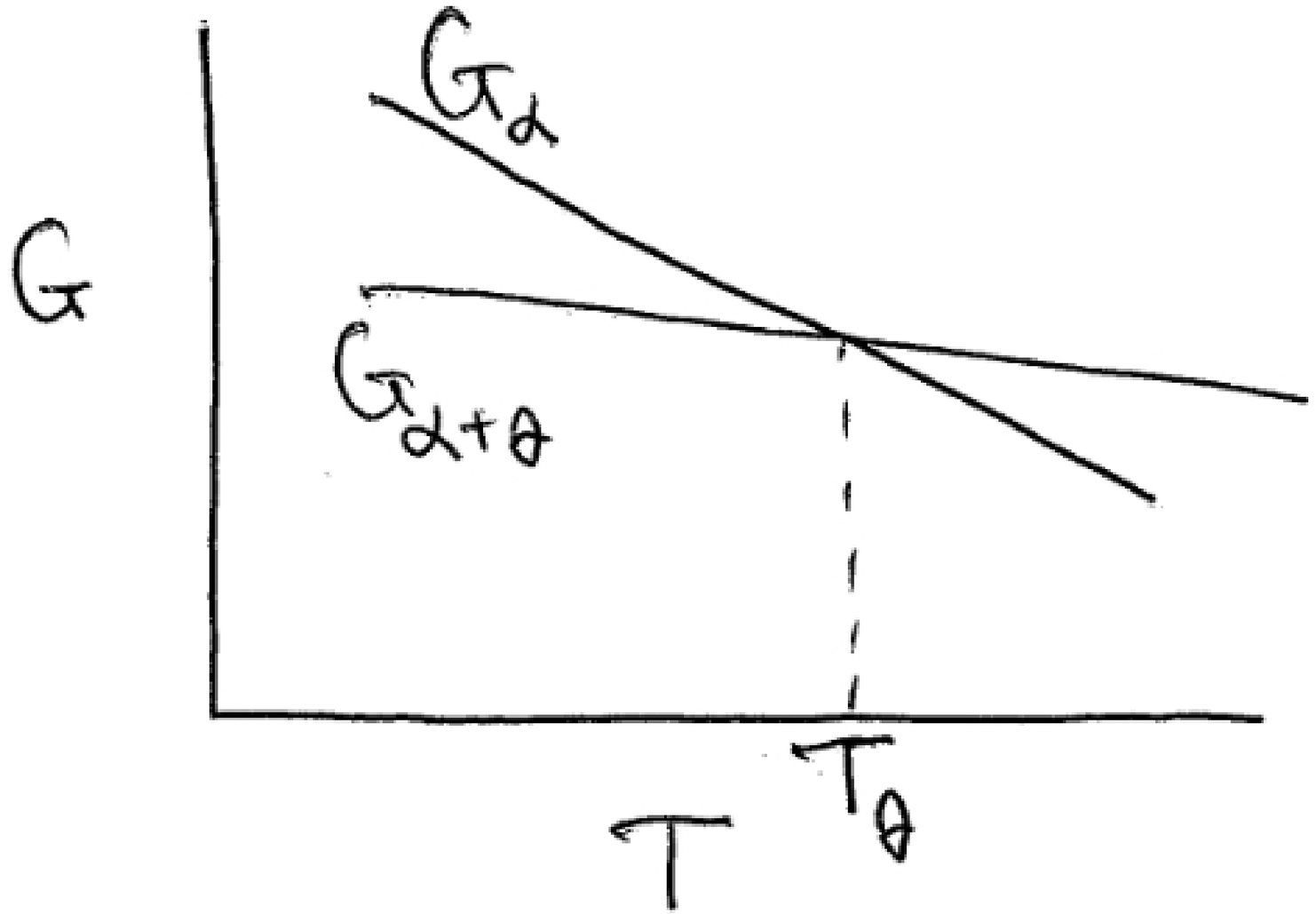
- Why does the transformation rate depend on temperature? Further, why isn't the trend monotonic?

- Why does the microstructure depend on the temperature at which the transformation occurs?

To answer these questions we need to consider the thermodynamics (driving force) for the transformation and the ability of the material to respond to the driving force via diffusion.


Composition (at % Cu)
0
5
10
20
30
700
600
500
400
300
1200
1000
800
600
α
$\alpha + L$
L
$\theta + L$
θ
($CuAl_2$)
$\alpha + \theta$
Solvus Temperature, at which α transforms to α+θ and vice versa.
0
10
20
30
40
50
(Al)
Composition (wt % Cu)
Temperature (°C)
Temperature (°F)

The driving force for the precipitation of θ particles is the free energy difference between the single phase a region and the two phase α+θ region. The free energy difference depends on temperature.



T_θ is the solvus temperature and depends on alloy composition.