Assignment - Q1

Kittel 5.4 (Heat capacity of layer lattice):

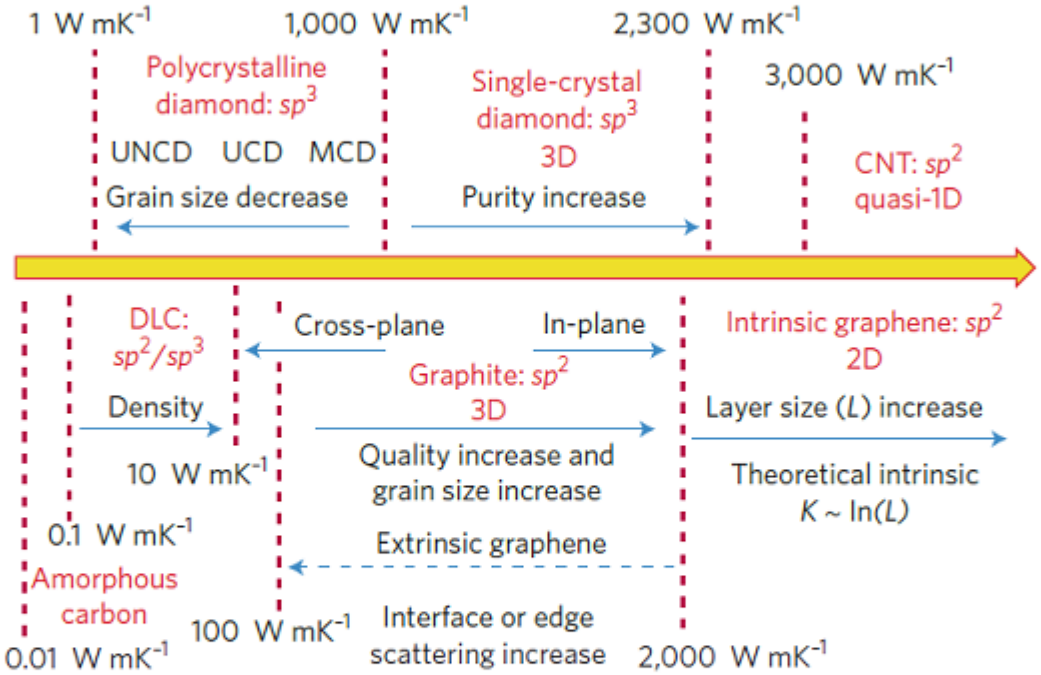
- Consider a dielectric crystal made up of layers of atoms, with rigid coupling between layers, so that the motion of the atoms is restricted to the plane of the layer. Show that the phonon heat capacity in the Debye approximation in the low temperature limit is proportional to T^2.
- Suppose instead, as in many layer structures, that adjacent layers are now weakly bound, what form would the phonon heat capacity approach at extremely low temperatures.

Assignment - Q2

Kittel 5.2 (rms thermal dilation of crystal cell):

- Estimate for 300 K the RMS thermal dilation $\Delta V/V$ for a primitive cell of sodium. Take the bulk modulus as $7x10^{1}0\mathrm{erg\ cm}^{-}3$. Note that the Debye temperature 158 K is less than 300 K, so that the thermal energy is of the order k_BT.
- Use this result to estimate the RMS thermal fluctuation $\Delta a/a$ of the lattice parameter.

Assignment - Q3



This diagram is taken from a review article on thermal conductivities of carbon based materials. An interesting phenomenon is that graphite's thermal conductivity along the c-axis (cross-plane) is about 200 times less than the thermal conductivity in-plane. Explain the difference between the cross-plane and the in-plane thermal conductivities.