The number of microstates is:

$$\Omega = \frac{N_L!}{N_V!(N_L - N_V)!}$$

where N_V is the number of defects, and N_L is the number of atoms.

Entropy is:

$$S = k_B \ln \Omega$$

Using the approximation $\ln x! \approx x \ln x$, this gives:

$$\Delta S_m = k_B \left[N_L \ln N_L - N_V \ln N_V - (N_L - N_V) \ln(N_L - N_V) \right]$$

The change in free energy is:

$$\Delta F = N_V \Delta h_V + T \Delta S$$

where Δh_V is the energy cost of creating one vacancy.

So

$$\Delta h_V + k_B T \ln \left(\frac{N_V}{N_L - N_V} \right) = 0,$$

or, since $N_V \ll N_L$,

$$\Delta h_V + k_B T \ln \frac{N_V}{N_L} = 0,$$

$$\Rightarrow \frac{N_V}{N_L} \approx \exp\left(-\frac{\Delta h_V}{k_B T} \right).$$