5.6 Diffusion

For non degenerated semiconductors we can take the relation

$$n_e = n_i \exp\left(-\frac{E_i - \mu^*}{kT}\right) \qquad , \tag{5.39}$$

or after transformation

$$\mu^* = E_i + kT \ln\left(\frac{n_e}{n_i}\right) \qquad . \tag{5.40}$$

E_i is the energy in the middle of the band.
So we find

$$\vec{\nabla}\mu^* = kT\frac{\vec{\nabla}n_e}{n_e} \qquad . \tag{5.41}$$

Neglecting electrical fields the second term in Eq. (5.34) is written as

$$\vec{j}_{diff} = -kT\mu_e\vec{\nabla}n_e = -qD\vec{\nabla}n_e \qquad . \tag{5.42}$$

Comparing the left and the right hand side of Eq. (5.42) we get the Einstein relation

$$D = \frac{kT}{q}\mu_e \qquad . \tag{5.43}$$

- Local gradients in the quasi Fermi potential cause the diffusion transport
- Local gradients are induced by external perturbations
- Diffusion is the response to this perturbations