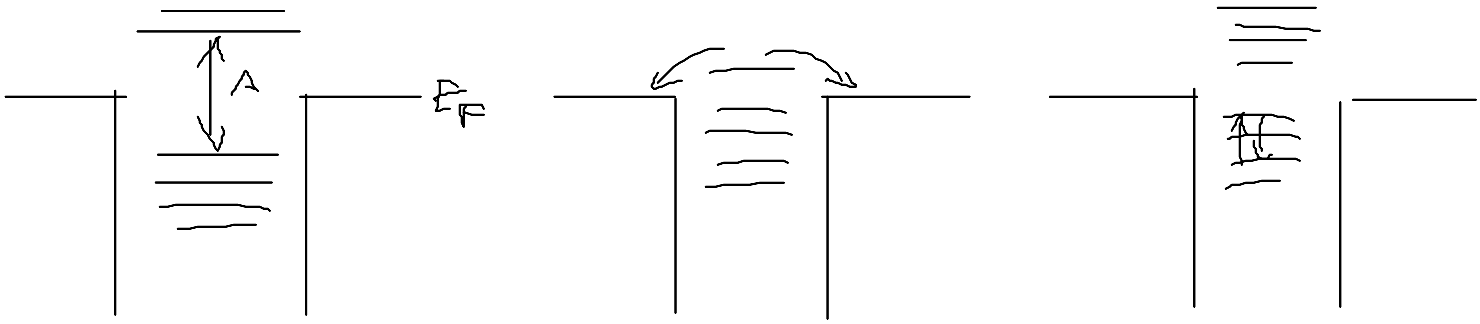
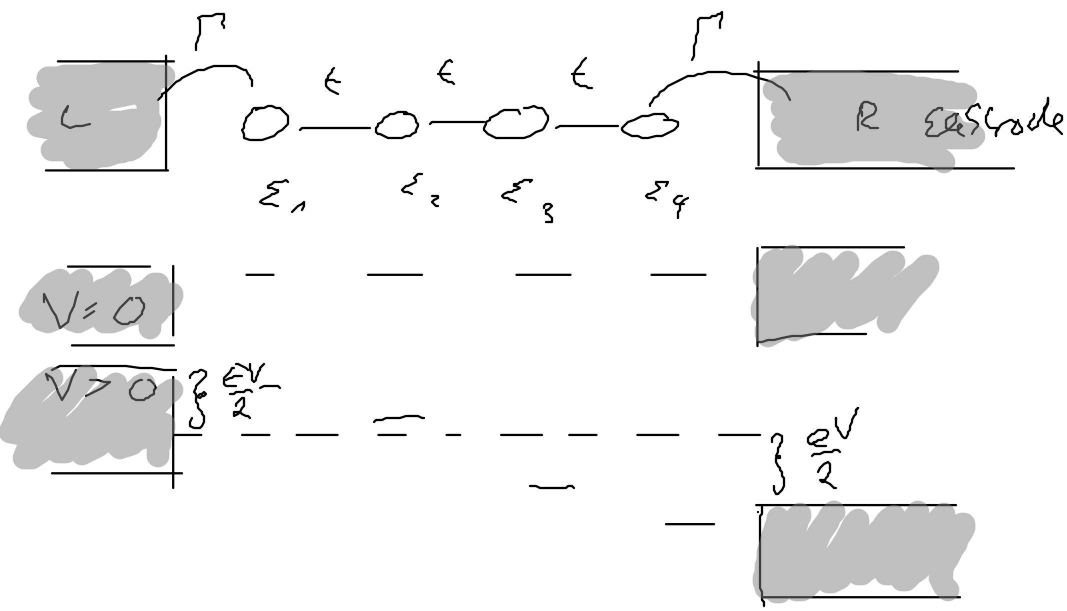
Problematik bei den hergestellten Leitern



Strom Spannungscharakteristik



$V \neq 0$: Verschiebung des elektrochemischen Potentials in der L und R Elektrode. Modifikation der Potentiale im Draht

$$I(V) = \int_0^\infty dE\, T(E,V)\,\left(f(E-\mu_L) - f(E-\mu_R)\right) = \int_{-\frac{eV}{2}}^{\frac{eV}{2}} dE\, T(E,V)$$

↑ T klein

$$T(E,V) = Tr(\Gamma_L\, G^r_{cc}\, \Gamma_R\, G^a_{cc})$$

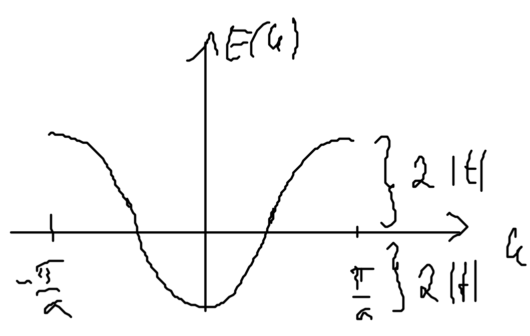
$$\Gamma_L(E) = \Gamma\left(E - \frac{eV}{2}\right)$$

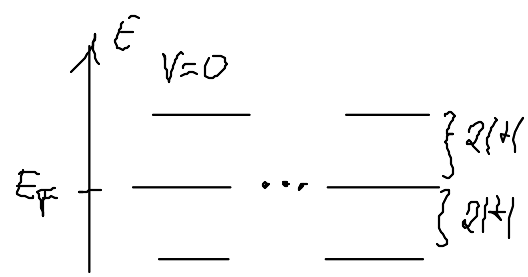
$$\Gamma_R(E) = \Gamma\left(E + \frac{eV}{2}\right)$$

$$G^r_{cc} = (E - H_{cc}(V) - \Sigma_L\left(E - \frac{eV}{2}\right) - \Sigma_R\left(E + \frac{eV}{2}\right)$$

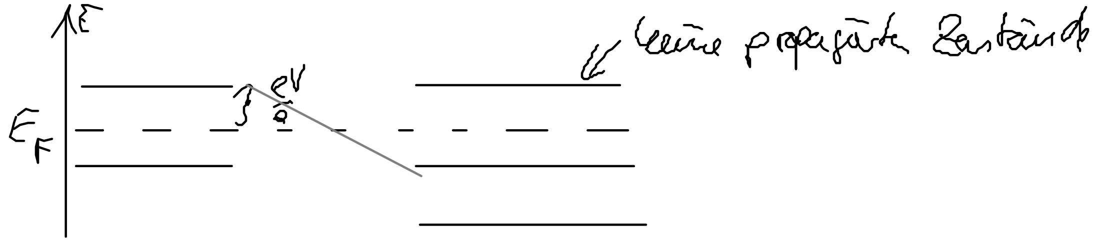
1D-Draht

Dispersionsrelation

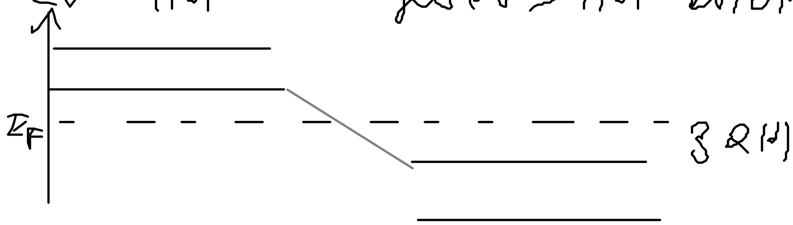




- $eV = 2|t|$



- $eV = 4|t|$ für $eV > 4|t|$ bricht der Strom zusammen

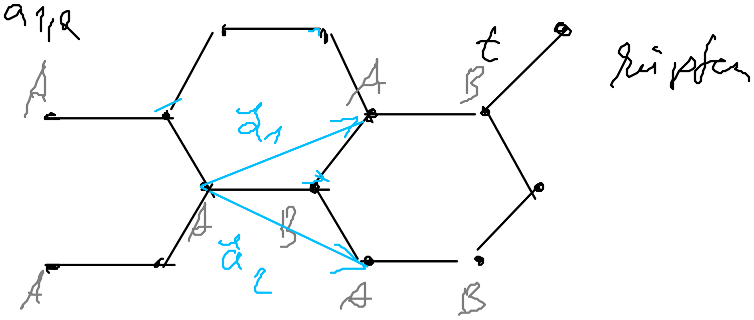


$\frac{dI}{dV} < 0$ für $eV \geq 2|t|$

Bandstruktur von Graphen

- Ansatz Wellenfkt $\psi_k(\vec{r}) = \sum_{l \text{ alle Zellen}} e^{i\vec{k}\vec{R}_l}\left(b_1 \phi_A(\vec{r}-\vec{R}_l) + b_2 \phi_B(\vec{r}-\vec{R}_l)\right)$
- p-z Orbitale $\phi_{A,B} = p_z(\vec{r} - \vec{r}_{A,B})$
- Gitterplätze $\vec{r}_{A,B}$, Gittervektoren $\vec{a}_{1,2}$

$$\begin{pmatrix} E(\vec{k}) & -t\,\alpha(\vec{k}) \\ -t\,\alpha(\vec{k}) & E(\vec{k}) \end{pmatrix} \begin{pmatrix} b_1 \\ b_2 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$$



$\alpha(\vec{k}) = 1 + e^{-i\vec{k}\vec{a}_1} + e^{-i\vec{k}\vec{a}_2}$

$\alpha(\vec{k}) = 0$ liefert $\vec{k}$ und $\vec{k}'$, $\delta\vec{k} = \vec{k} - \vec{k}'$

$E(\vec{k}) = \pm \hbar v_F |\delta\vec{k}|$

- Es gibt Zustände $|s = \pm 1\rangle = \frac{1}{\sqrt{2}} \begin{pmatrix} s\, e^{-i\frac{\theta_k}{2}} \\ e^{i\frac{\theta_k}{2}} \end{pmatrix}$

$H = \hbar v_F |\delta\vec{k}| \sigma_z$ mit $\theta_k = \arctan\left(\frac{\delta k_x}{\delta k_y}\right)$

- Spinstruktur durch Gitterplätze (pseudo Spin)