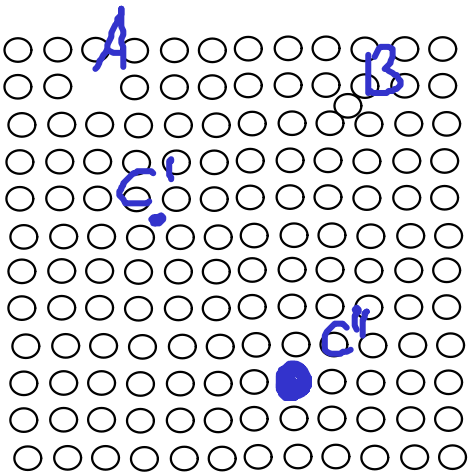
Strukturelle Defekte

0dim Defekte ⟶ Punktdefekte → Leerstellen (vacancies)
→ Zwischengitteratom (interstitial atoms)
→ Fremdatome (impurities)



A Leerstelle
B Zwischengitteratom
C' interstitielle F. A. $r_i > r$
C'' substitielle F. A $r_i < r$

Leerstellen: Schottky-Defekte

z.B. $Na^+ Cl^-$ Paar ○○ (+ −)

Die Zahl von Leerstellen $N_L = const \cdot e^{-\frac{E_L}{k_B T}}$ mit $E_L \sim 1eV$

$const \sim N_0 e^{\frac{S_L}{kT}}$ Entropie S_L $\frac{S_L}{k_B} \sim 0{,}5 - 5$

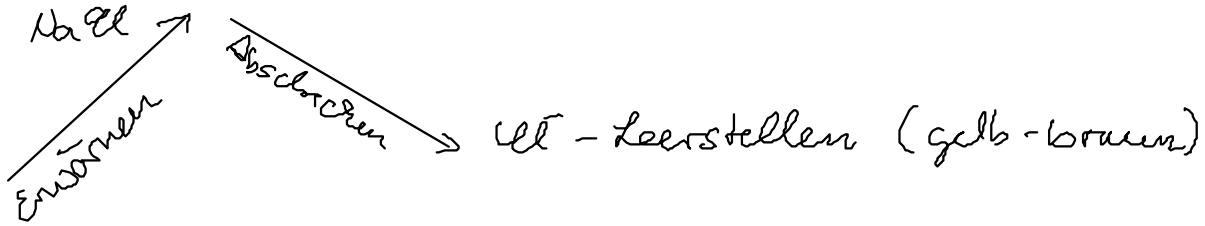
$\left.\frac{N_L}{N}\right|_{1000K} \simeq 10^{-5}$ $\left.\frac{N_L}{N}\right|_{300K} \simeq 10^{-17}$ bei $S_L \sim 1$

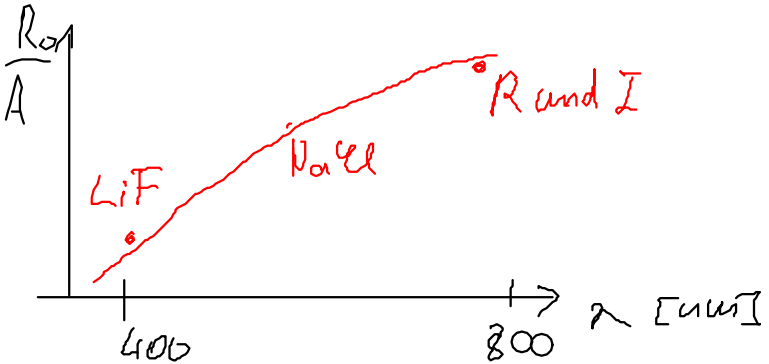
$T \longrightarrow T_C$ (Schmelzpunkt)

$N_L(T) \propto \frac{\Delta V}{V} - 3\frac{\Delta a}{a}$ (Gitterkonstante a und Volumenänderung ΔV messbar)

Farbzentren (F-Zentren)

Alkalihalogenidkristalle: NaCl, KF, CsI

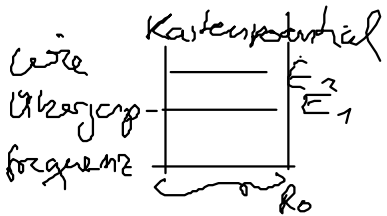




$\lambda \propto A R_0^2$

A Abstand zw. Atomen

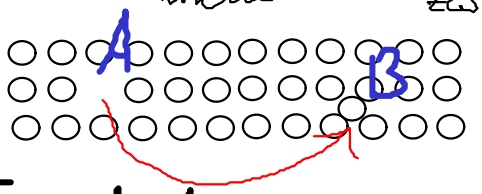
$\Delta E \propto \frac{1}{R_0^2}$



wie Übergangsfrequenz

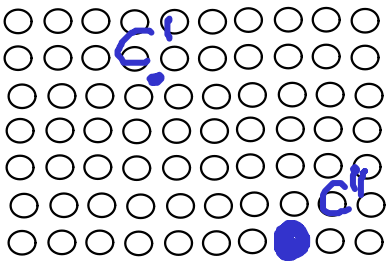
Zwischengitteratome

Ionenkristalle $E_{Zw} \sim E_L$



Leerstelle und Zw.-Atom
⇒ Frenkel-Defekte

Fremdatome



C' Stahl Fe + C (2%)
$r = 1{,}24$ Å $r = 0{,}71$ Å

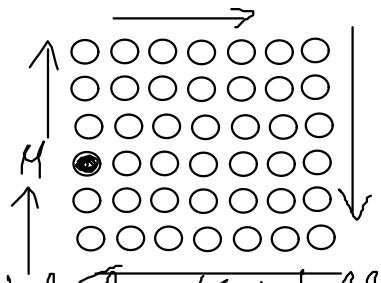
C'' Messing Cu Zn → bis zu 35%
$r = 1{,}28$ Å $r = 1{,}33$ Å

- Judicium ant Zinonid In Sb
- Si Dotierung $Si^{+} \rightarrow Ga^{3+}$
  $Si^{4+} \rightarrow P^{5+}$

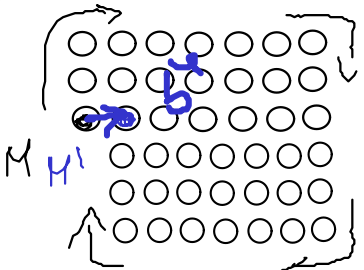
Experimentelle Methoden

- ESR Elektronenspinresonanz (electron spin resonance)
- NMR Kernspinresonanz (nuclear magnet resonance)
- optische Eigenschaften

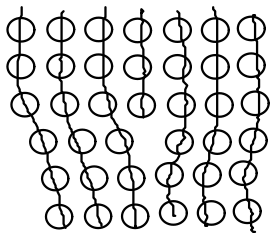
1 dim ⟶ Versetzungen (dislocations)



idealer Kristall $M = M'$

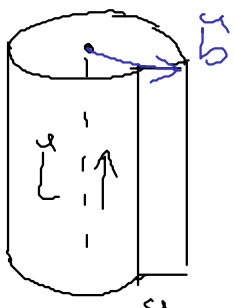


Versetzung Burgersvektor $\vec{b}$

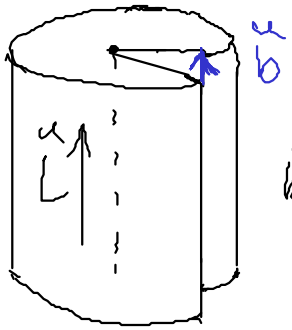


Stufenversetzung
edge dislocation

≙



$\vec{L} \perp \vec{b}$

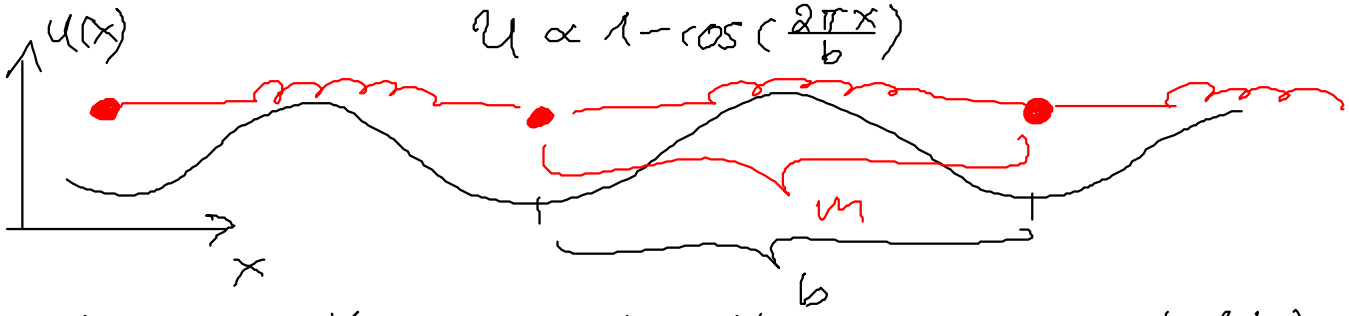


Schraubenversetzung

screw dislocation

Einkristalle: $10^2 - 10^5 \frac{\text{Versetzungen}}{cm^2}$

Frenkel-Kontorowa-Modell



$u \propto 1 - \cos\left(\frac{2\pi x}{b}\right)$

$\langle a \rangle = b$ Kommensurabilität (commensurability)

$\langle a \rangle \neq b$

$\frac{|\langle a \rangle - b|}{b}$

$\varphi_n = x_n - nb$

$n \sin\varphi_n = \alpha(\varphi_n - \varphi_{n-1}) - \alpha(\varphi_{n+1} - \varphi_n)$

$\underbrace{\varphi_{n+1} - 2\varphi_n + \varphi_{n-1}}_{\sim \varphi''} \sim \sin\varphi_n$

sin-Gordon-Gleichung

$\varphi'' - \ddot{\varphi} = \sin\varphi$