

Abb. 33: Energieniveaus in einem Band, Bandstruktur und Zustandsdichte (DOS)

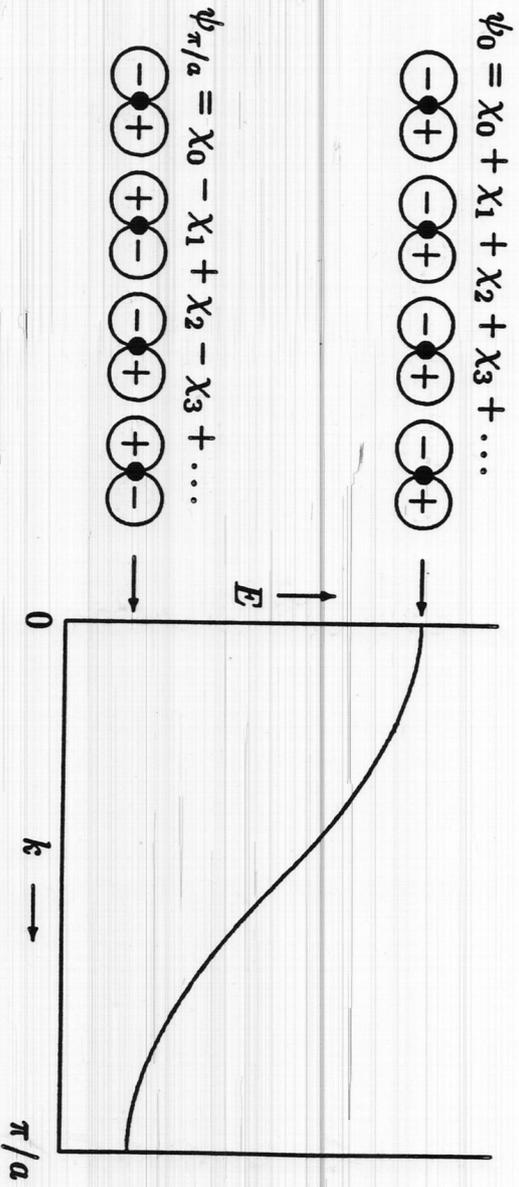


Abb. 34: Bandstruktur für eine Kette von aufeinander ausgerichteten p-Orbitalen

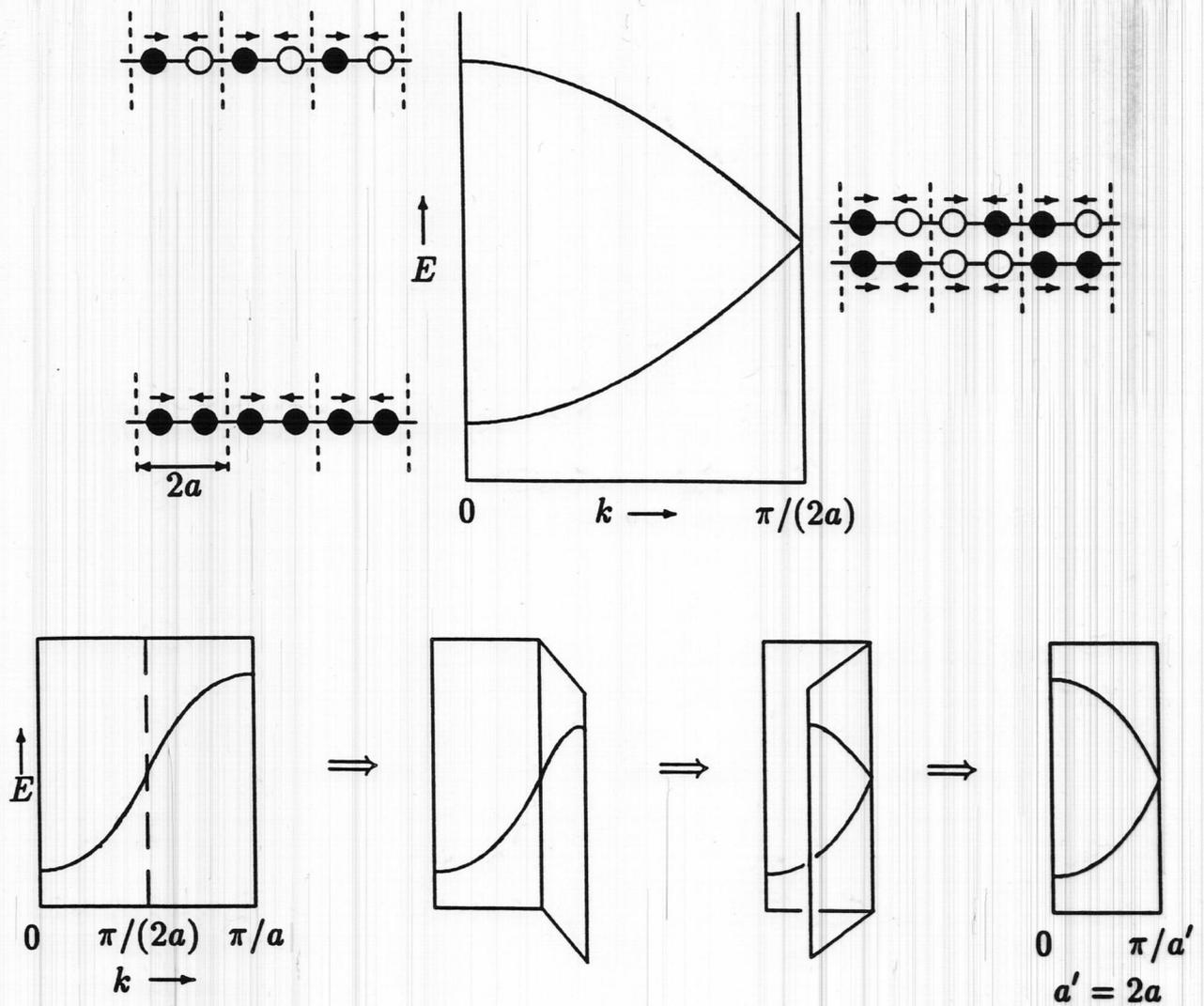


Abb. 35: Oben: Bandstruktur für eine Kette von äquidistanten H-Atomen, entstanden aus H<sub>2</sub>-Molekülen. Unten: Erzeugung des Diagramms durch Falten des Diagramms von Abb. 33

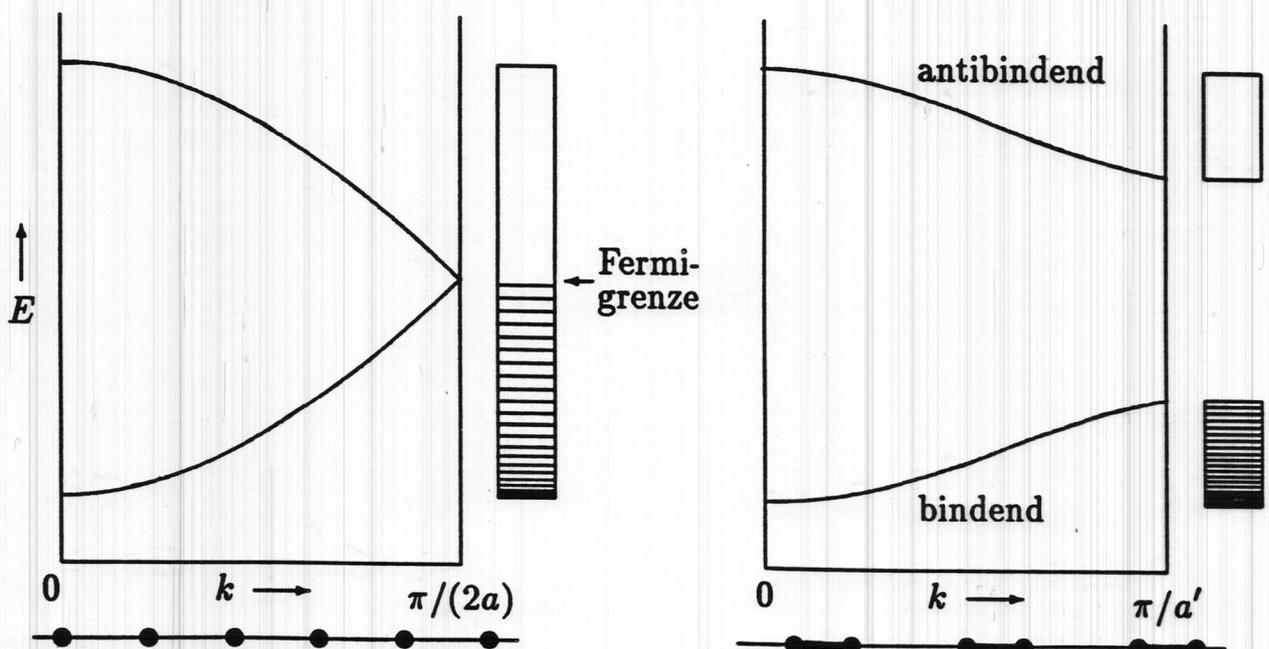
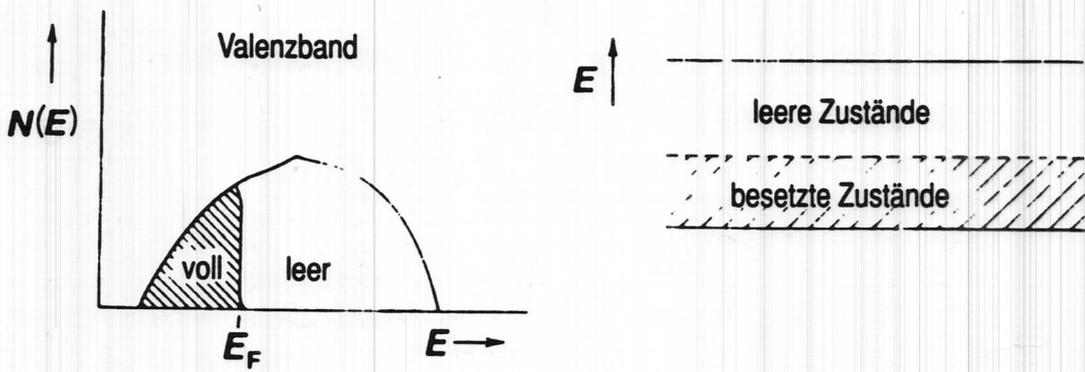
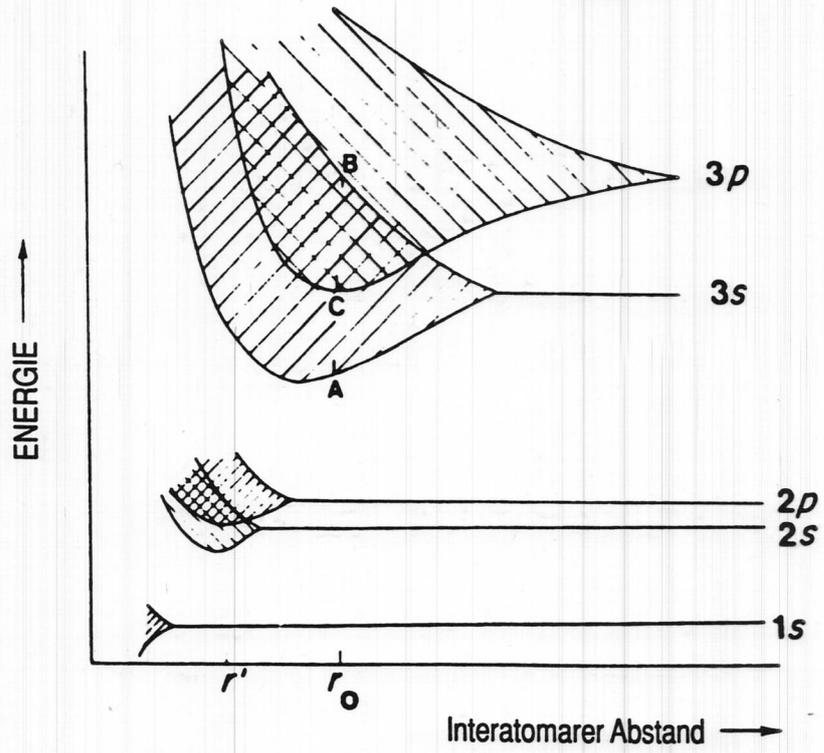
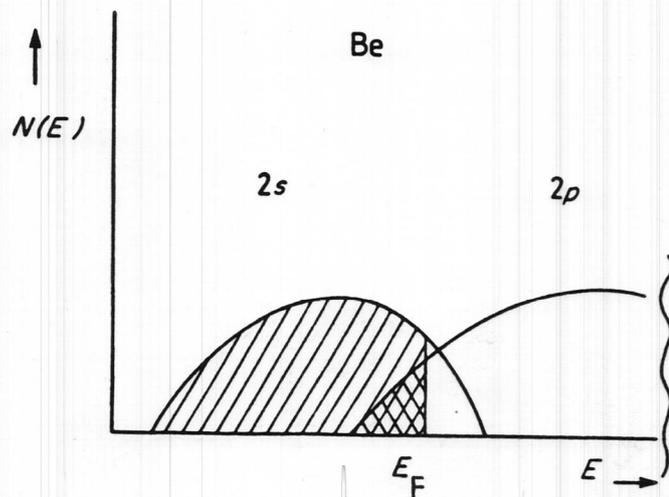


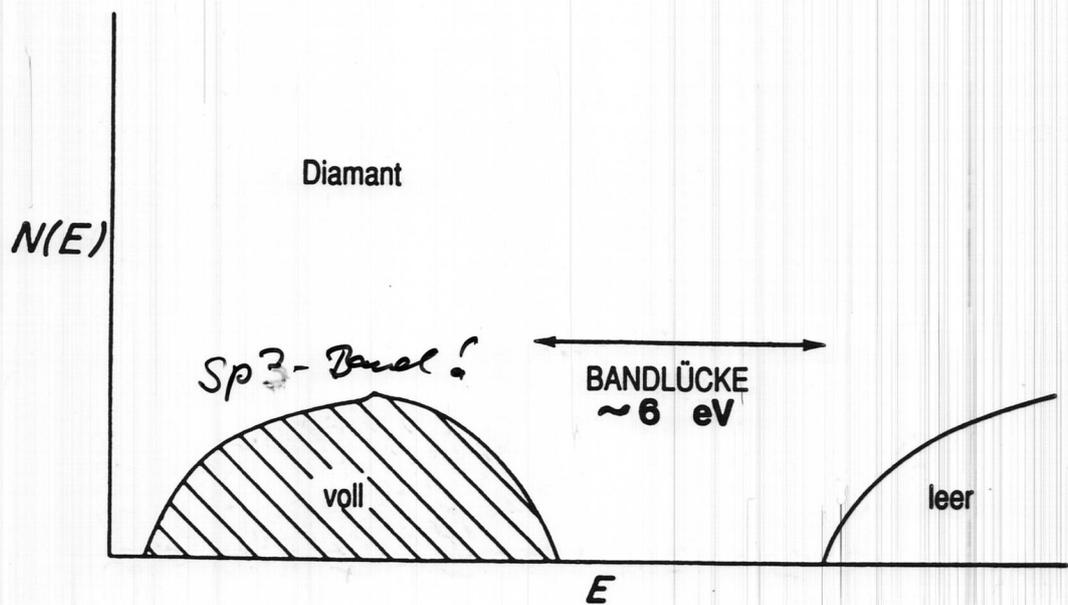
Abb. 36: Bandstruktur für eine Kette aus H-Atomen, links mit äquidistanten Atomen, rechts nach PEIERLS-Verzerrung zu H<sub>2</sub>-Molekülen. Die Striche in den Rechtecken symbolisieren mit Elektronen besetzte Zustände

Bsp. Na



Bandstruktur eines Metalls.





Bandstruktur eines Isolators, Kohlenstoff (Diamant).

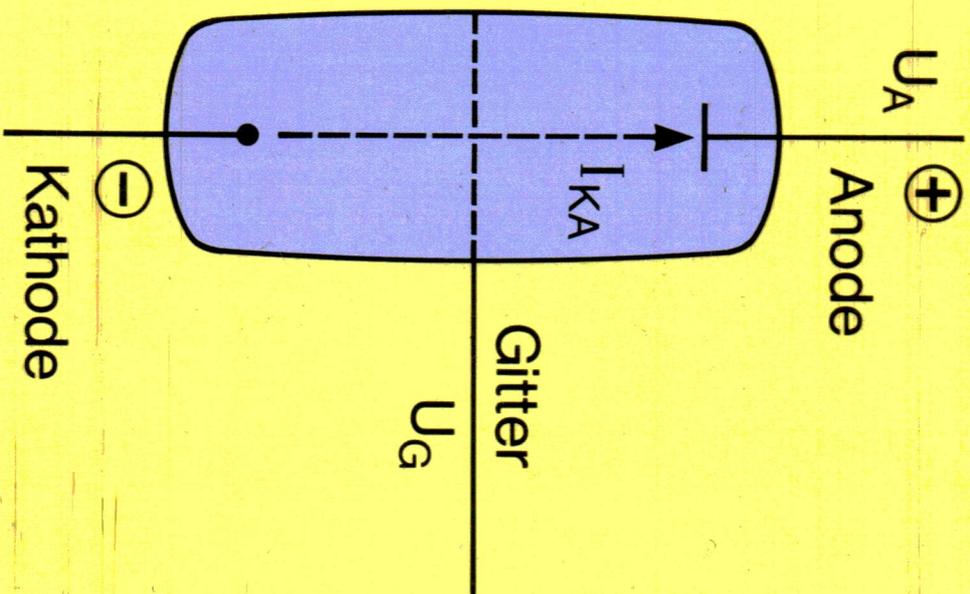
Tab. 2.16. Bandlücken der Elemente der IV Hauptgruppe.

| Element         | Bandlücke (eV) | Art des Materials |
|-----------------|----------------|-------------------|
| Diamant C       | 6.0            | Isolator          |
| Si              | 1.1            | Halbleiter        |
| Ge              | 0.7            | Halbleiter        |
| grau Sn (>13°C) | 0.1            | Halbleiter        |
| weiß Sn (<13°C) | 0              | Metall            |
| Pb              | 0              | Metall            |



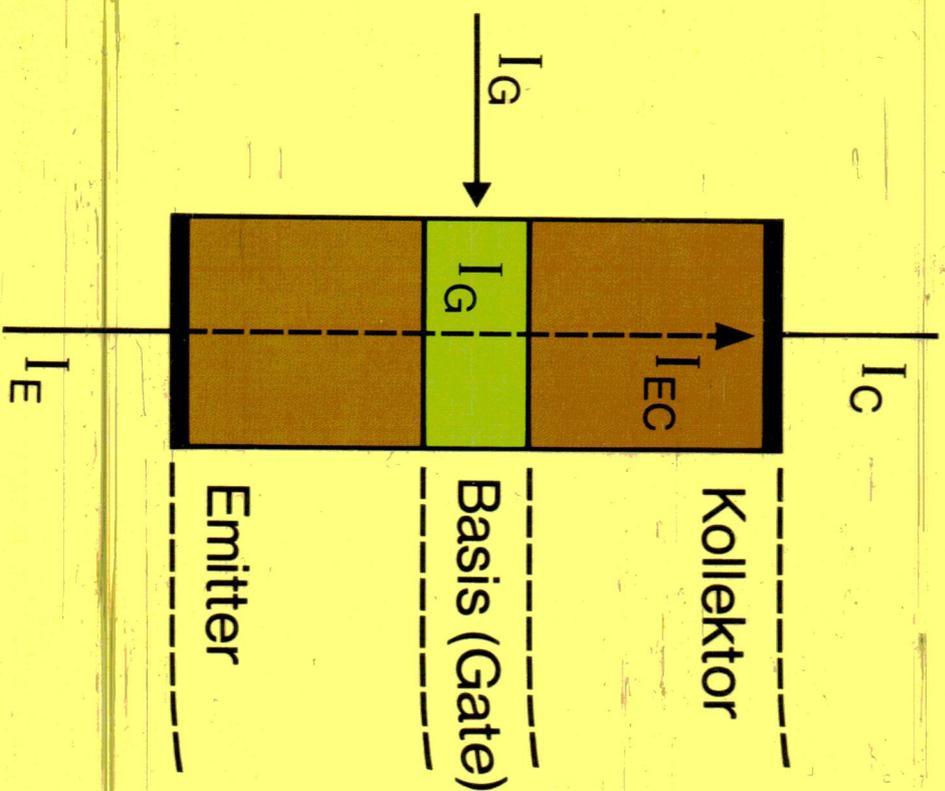
# Symbolischer Vergleich Röhren-/Transistorfunktion

3



$$I_{KA} = f(U_G)$$

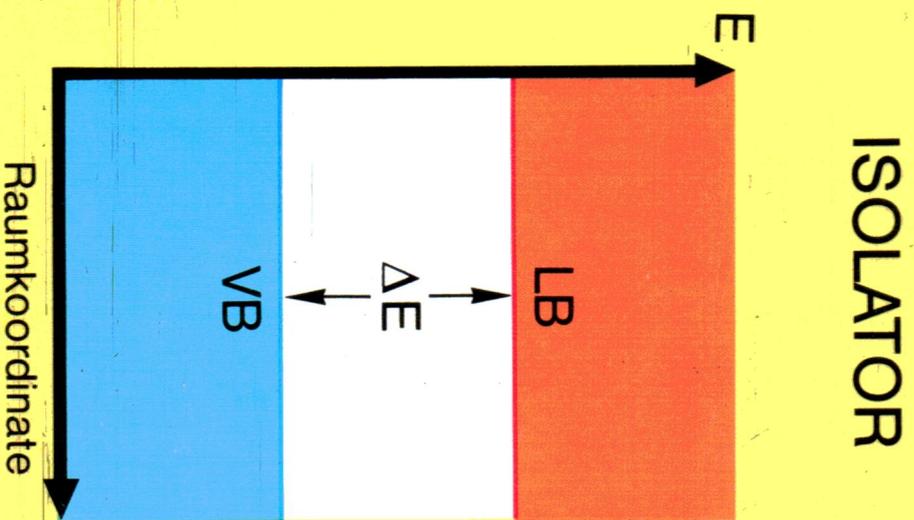
( $U_A = \text{konstant}$ )



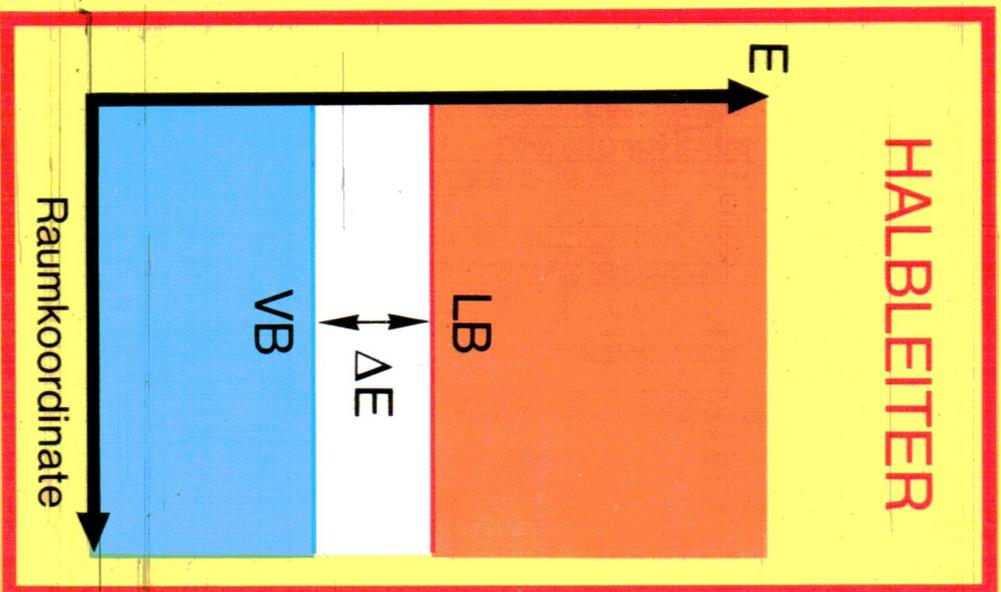
$$I_{EC} = f(I_G)$$



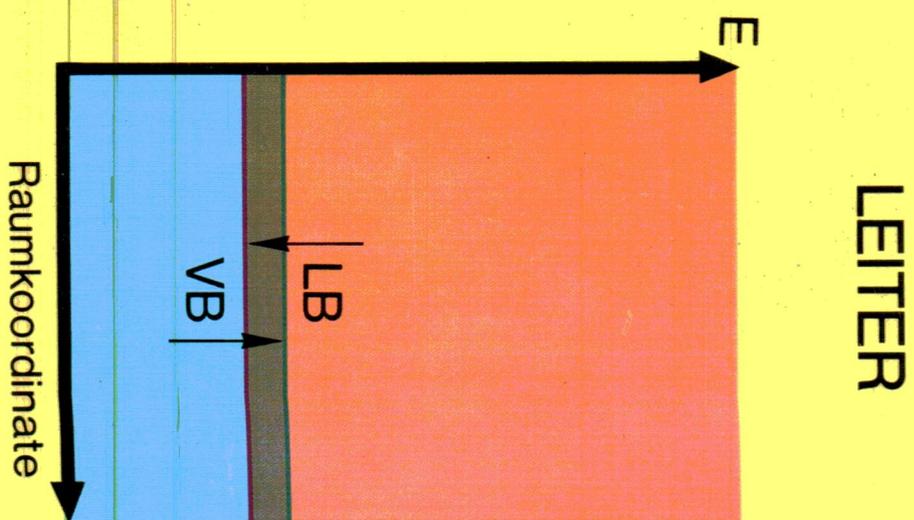
# Energiebänder-Modell



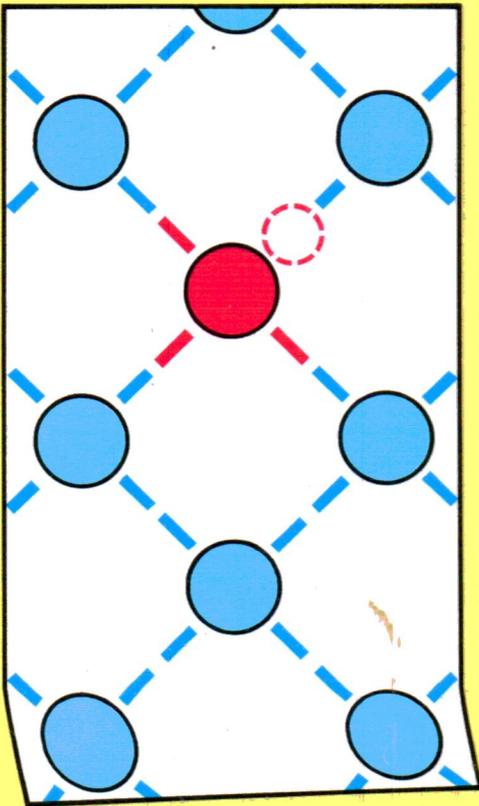
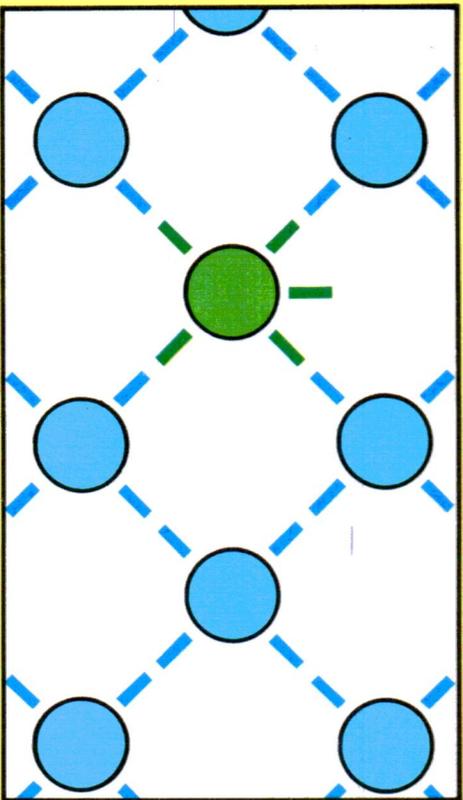
VB = Valenzband  
LB = Leitungsband



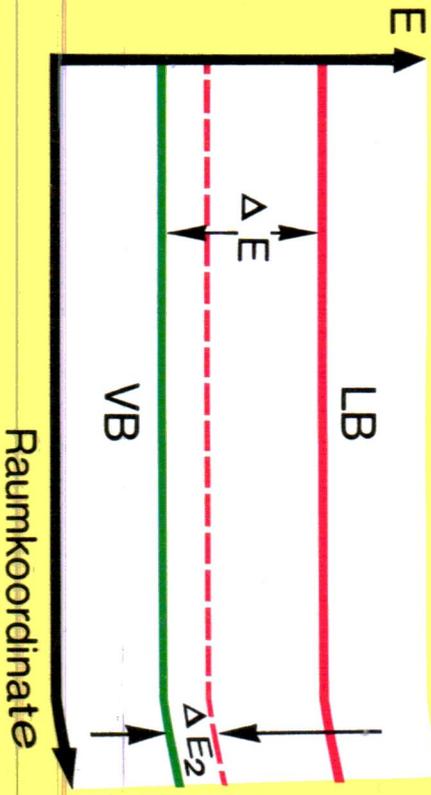
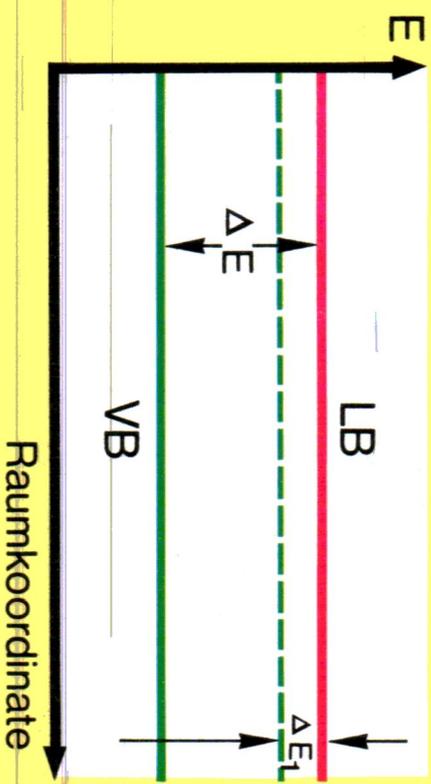
$\Delta E$  = Energiedifferenz (Energielücke)  
entspricht der Breite des  
"verbotenen" Bandes



# Dotierung des Halbleiters



Im Gitter-Modell

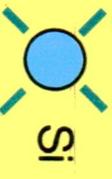


Im Energiebänder-Modell

n-Typ Dotierung  
z.B. Phosphor

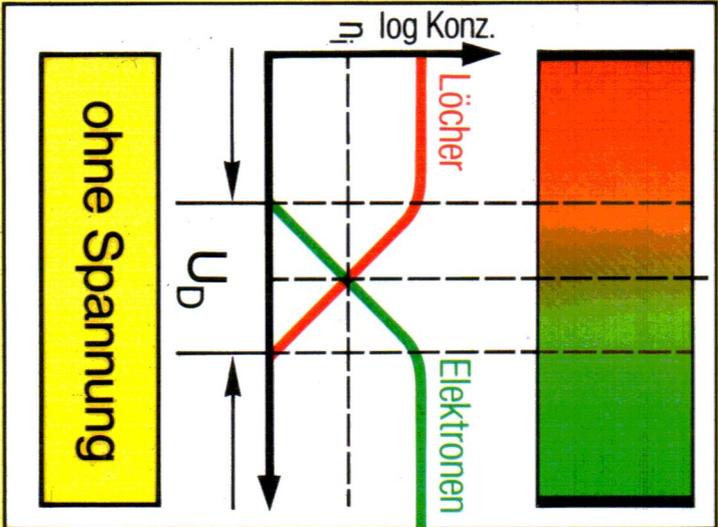
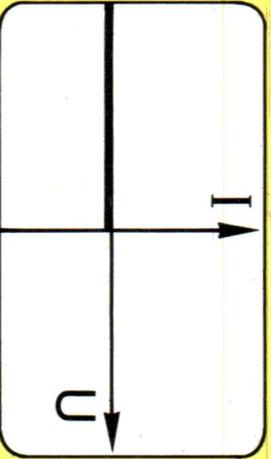
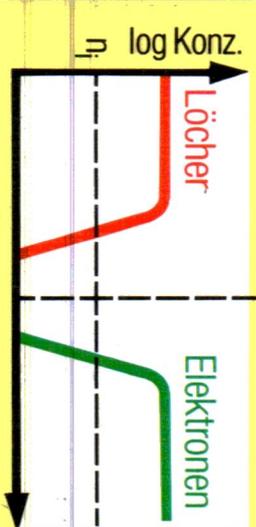
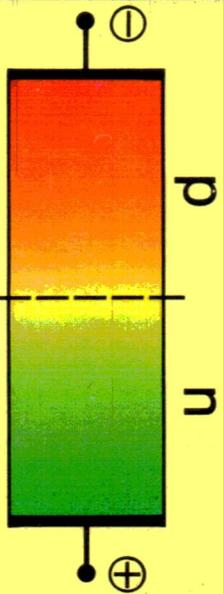
Legende

p-Typ Dotierung  
z.B. Bor

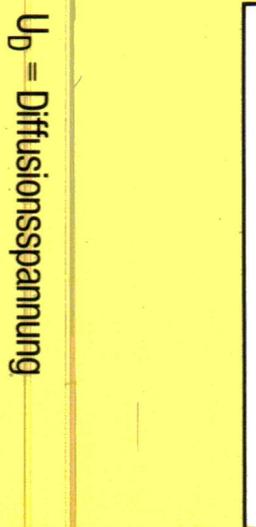


# Der p/n-Übergang

**Sperr-Richtung**



**ohne Spannung**

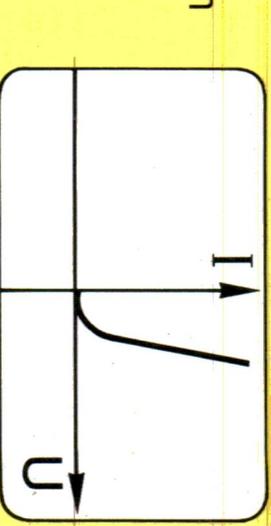
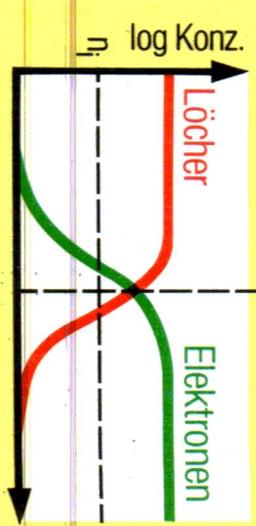
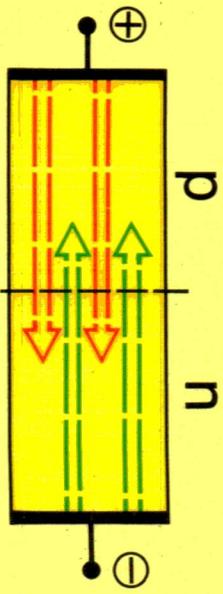


$U_D$  = Diffusionsspannung

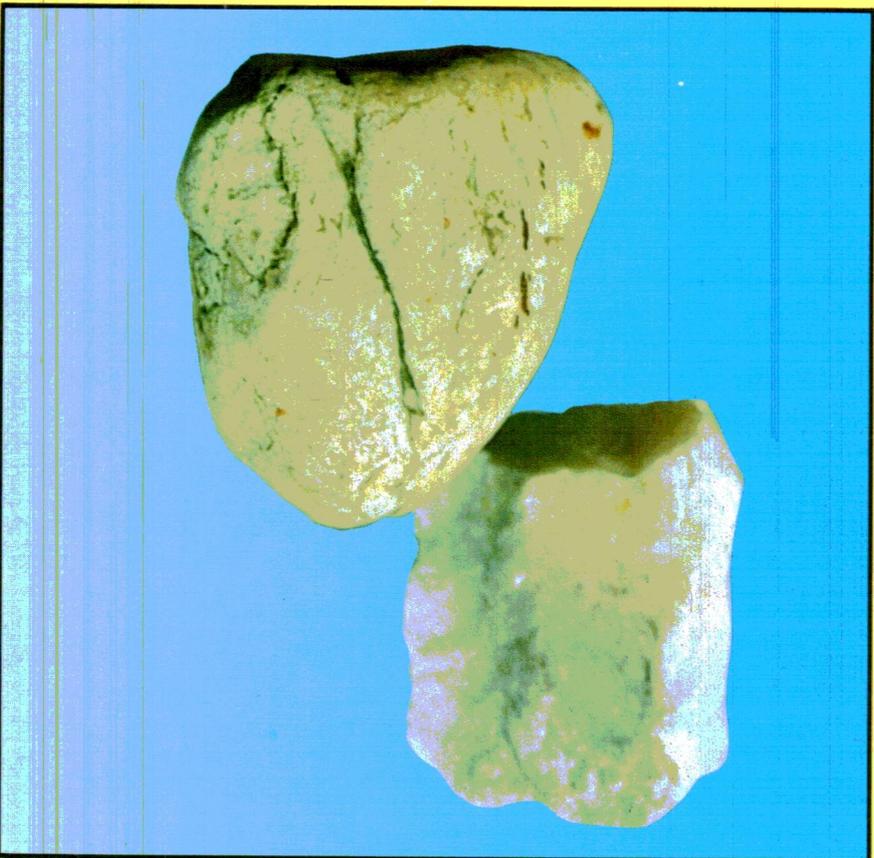
log. Konz. = logarithmische Auf-  
tragung der Konzentration

$n_i$  = Eigenleitungsträgerdichte

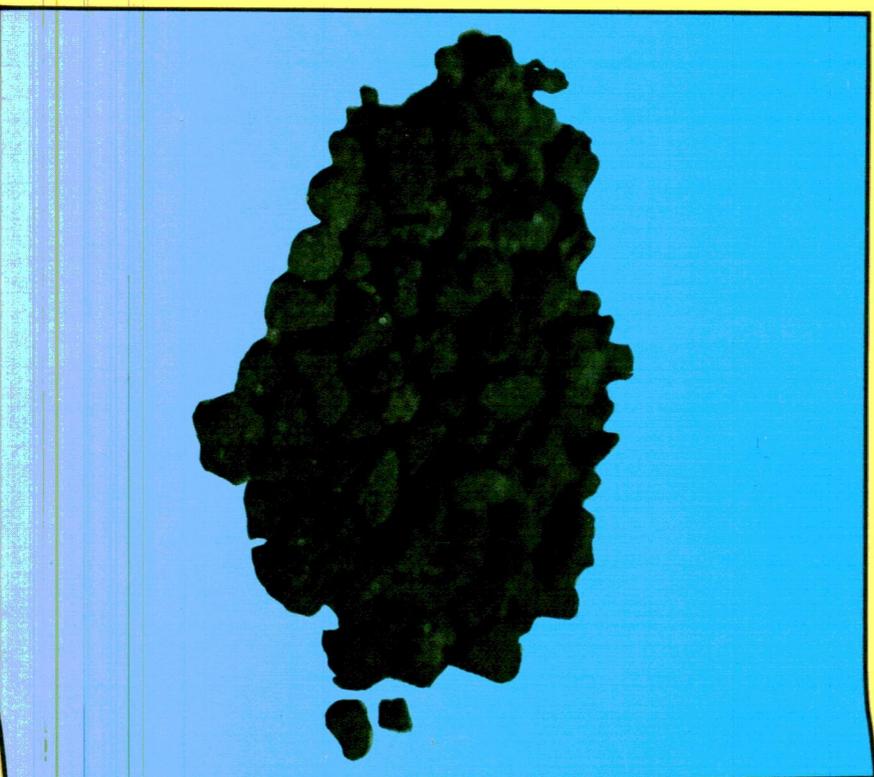
**Durchlaß-Richtung**



# Ausgangsstoffe der Siliciumchemie



Quarz

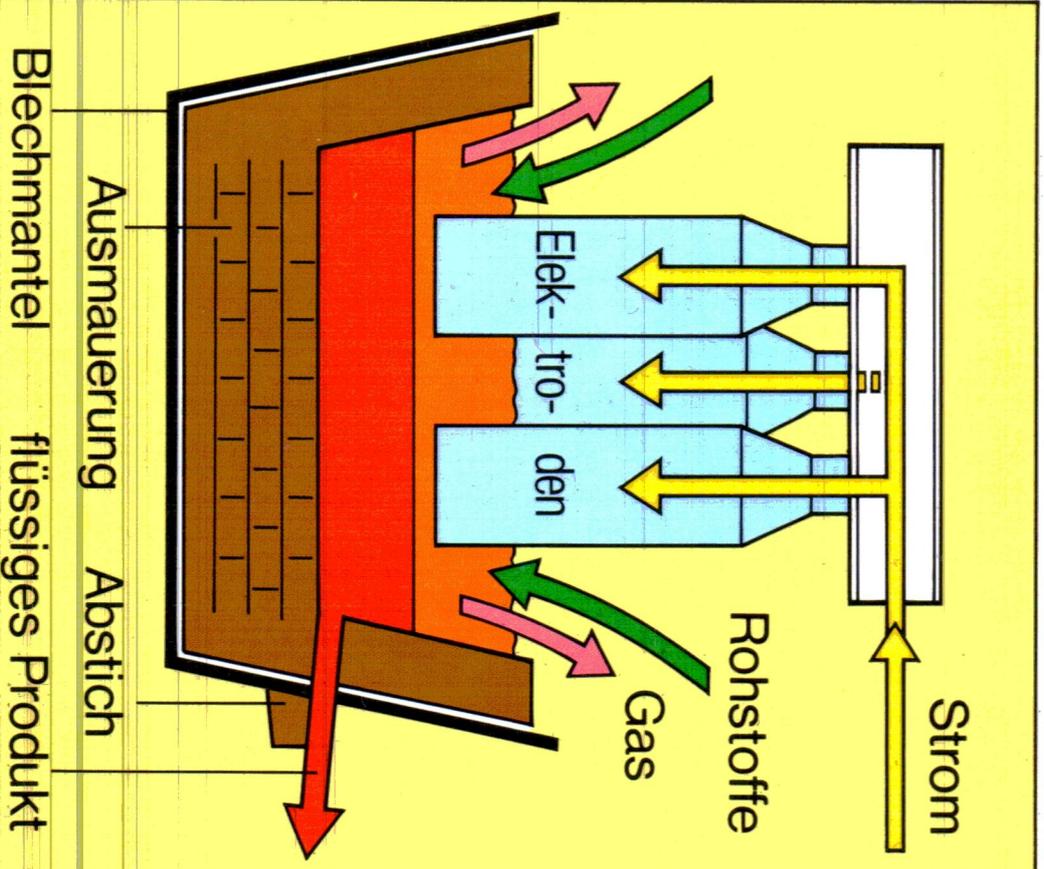


Kohle, Koks



# Reduktion des Siliciums

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## Reaktionsgleichung



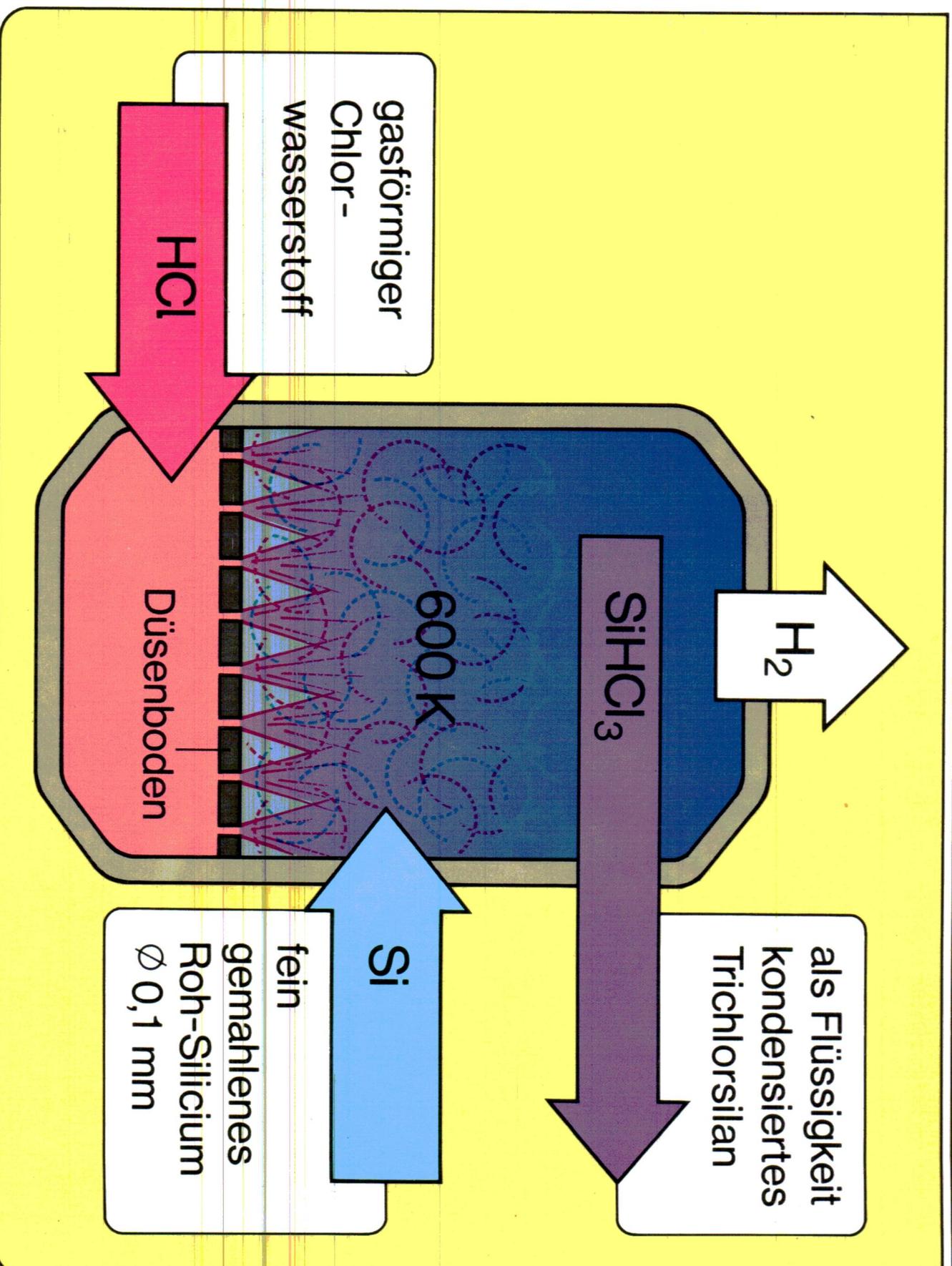
Blechmantel      Ausmauerung      flüssiges Produkt

Ausmahlung      Abstich

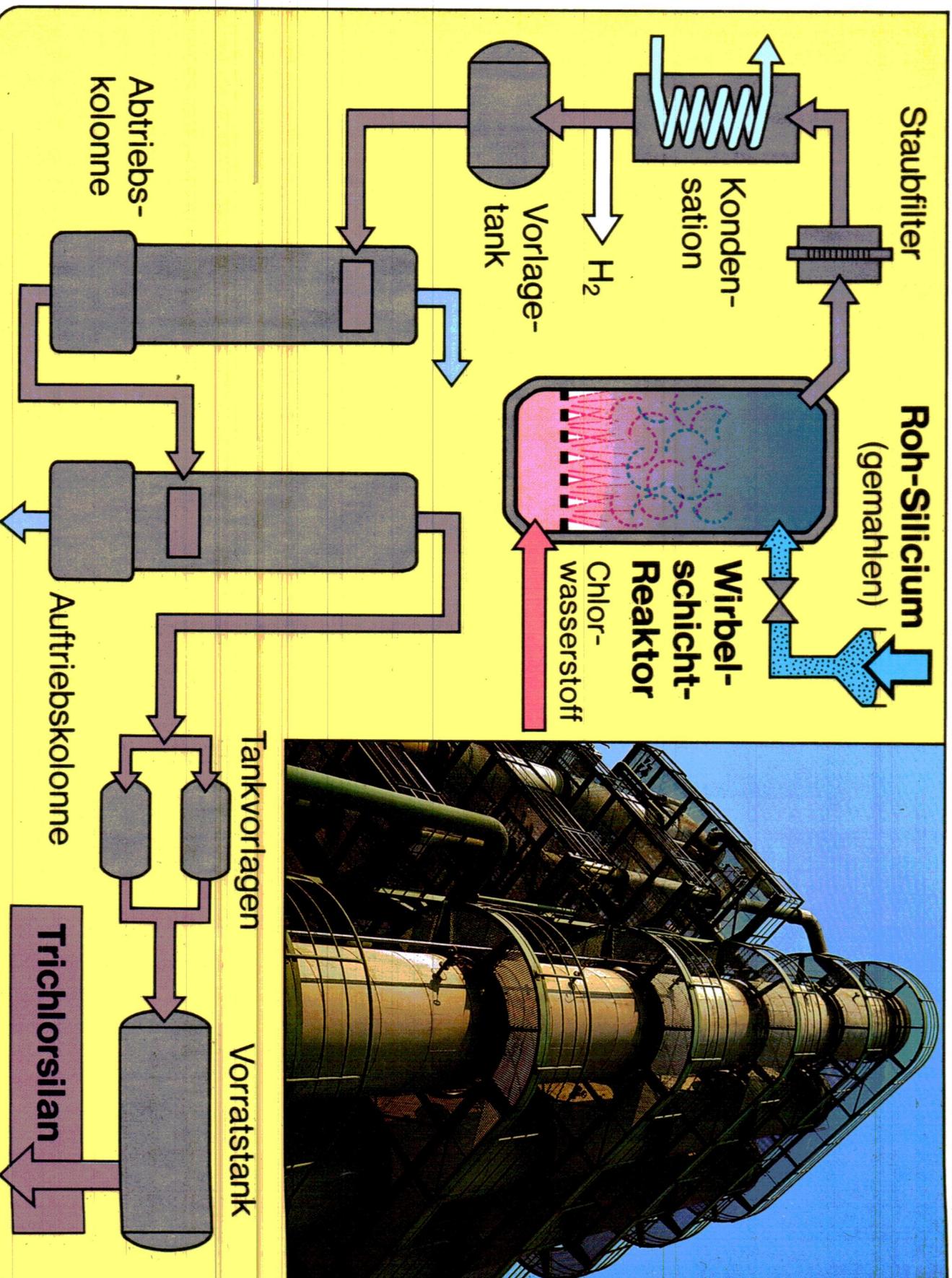


# Wirbelschicht-Reaktor

12



# Trichlorsilan-Destillation

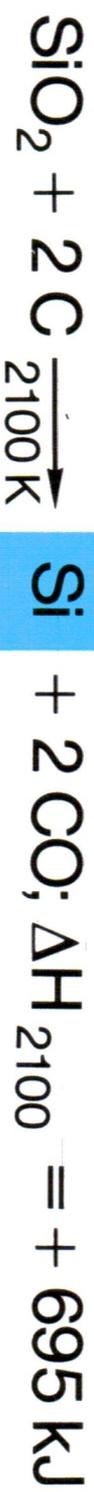


# Reaktionsgleichungen der Siliciumchemie

14

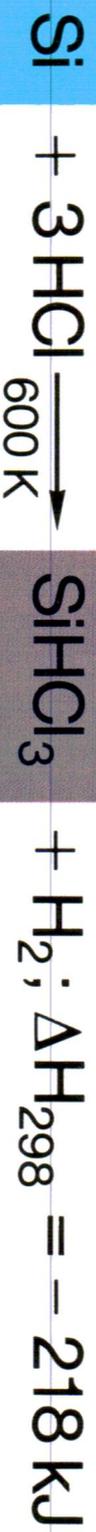
Silicium

1. Stufe



Trichlorsilan

2. Stufe

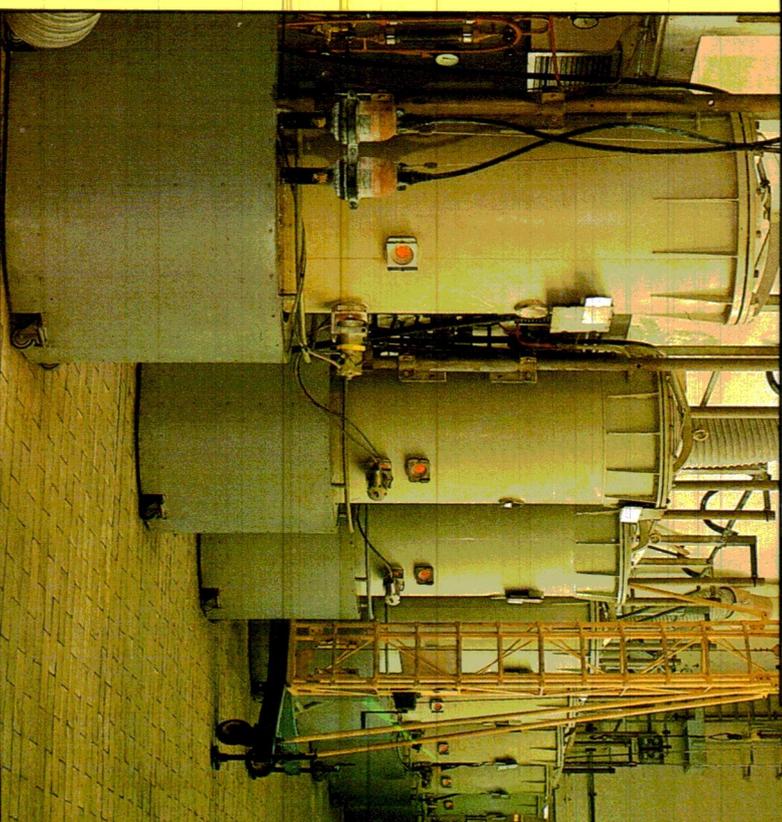
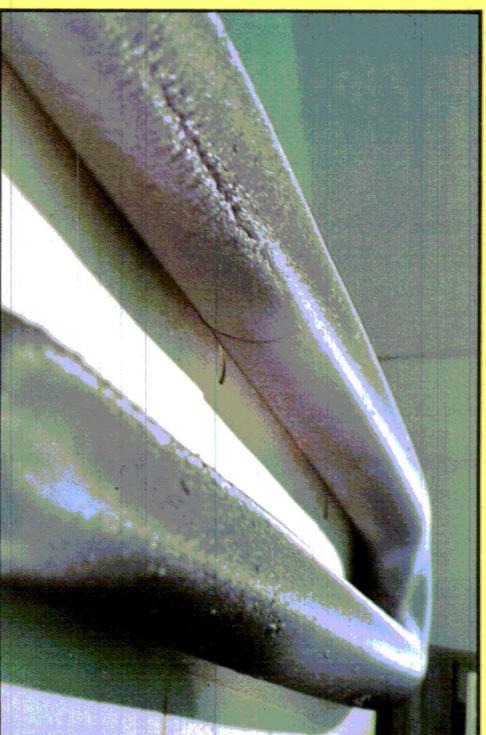
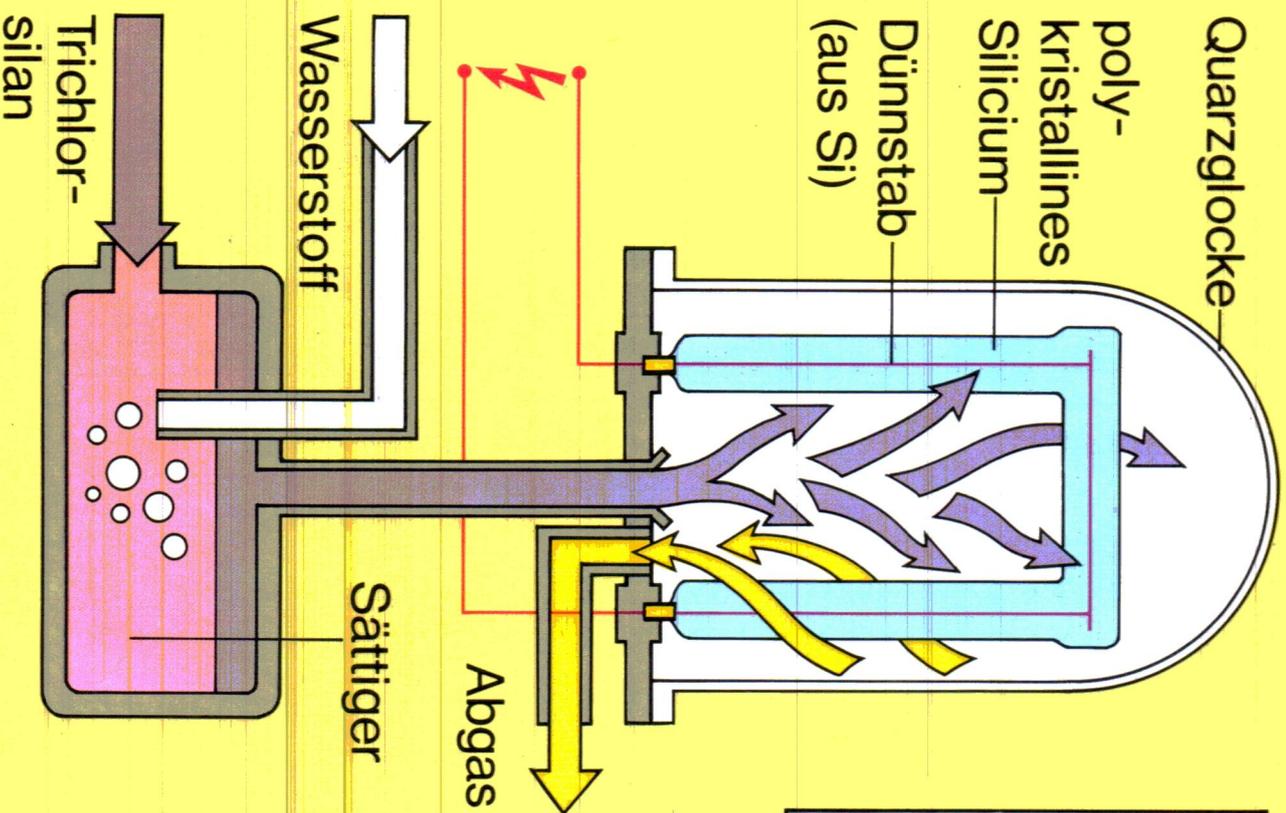


polykristallines Reinst-Silicium

3. Stufe



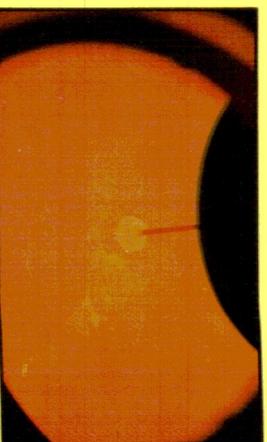
# Silicium-Abscheidungsreaktor



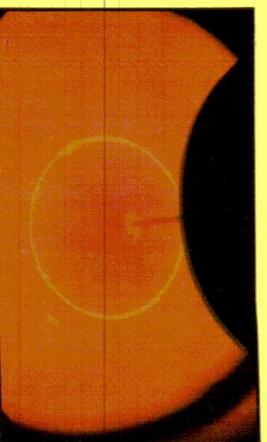
# Einkristall-Herstellung / Tiegelziehen



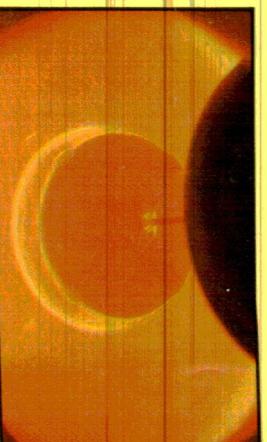
1



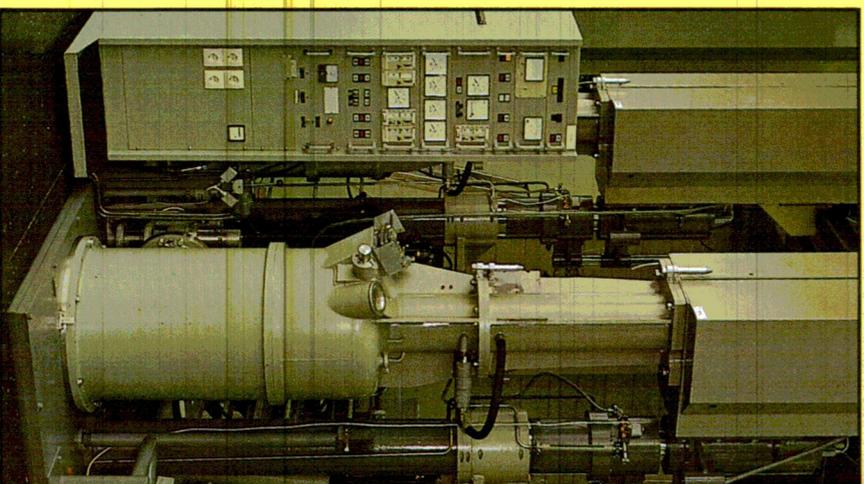
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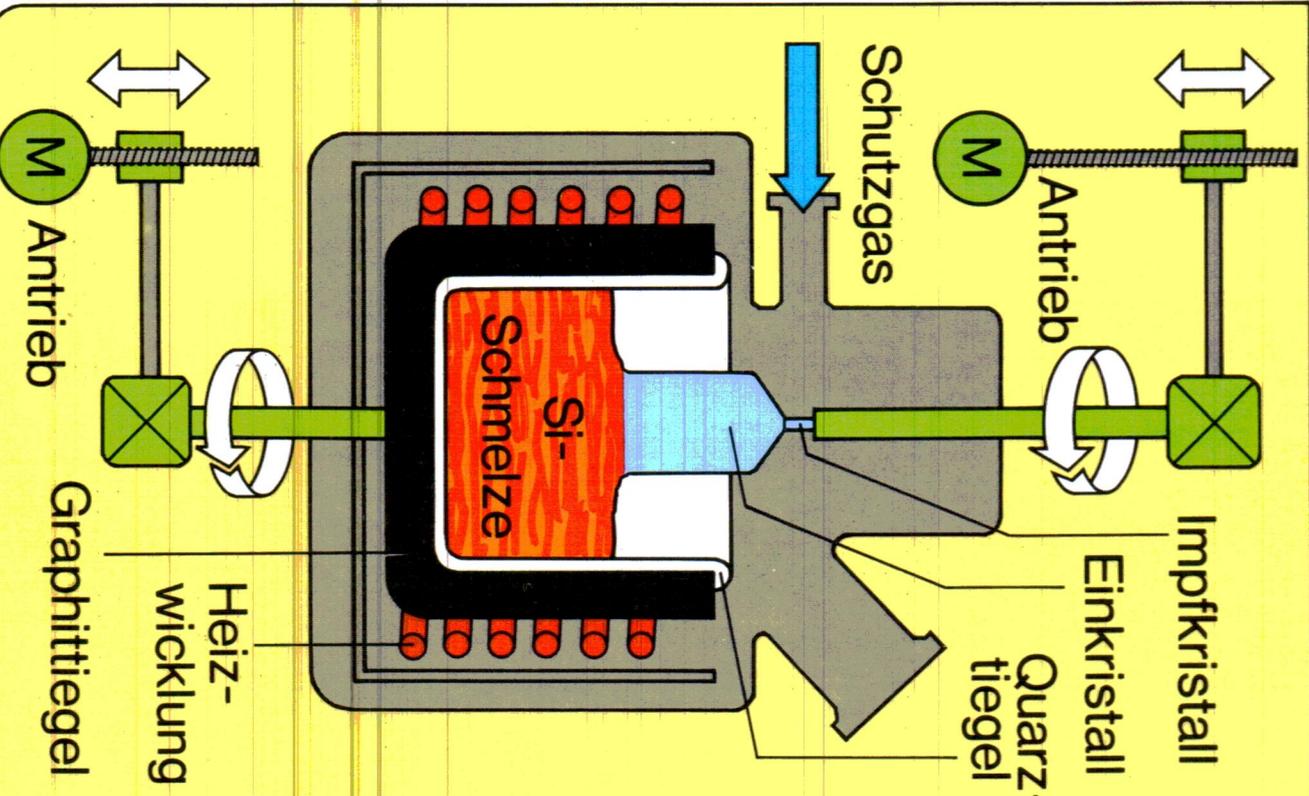
3



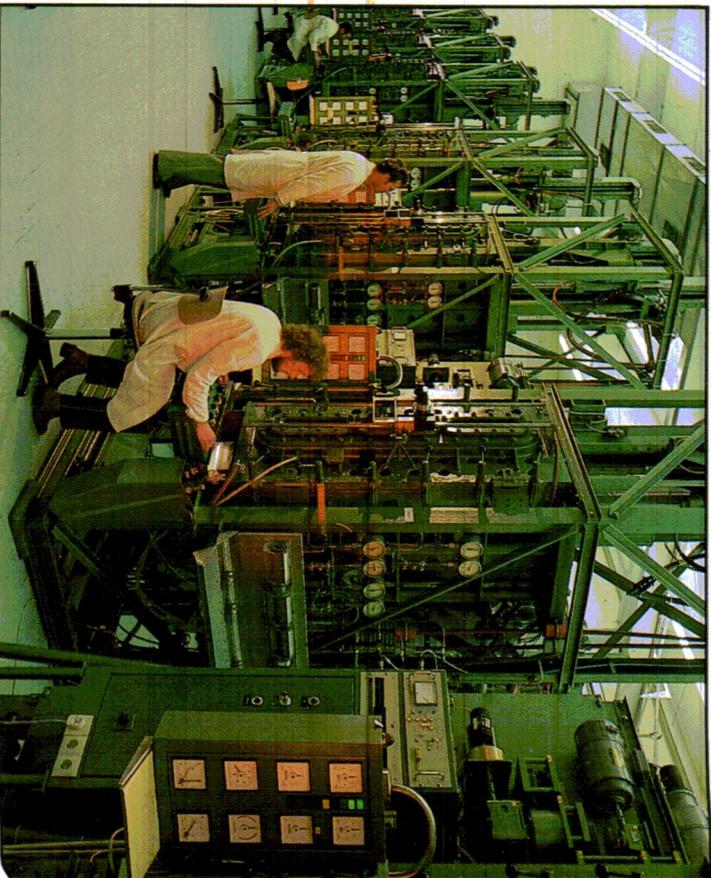
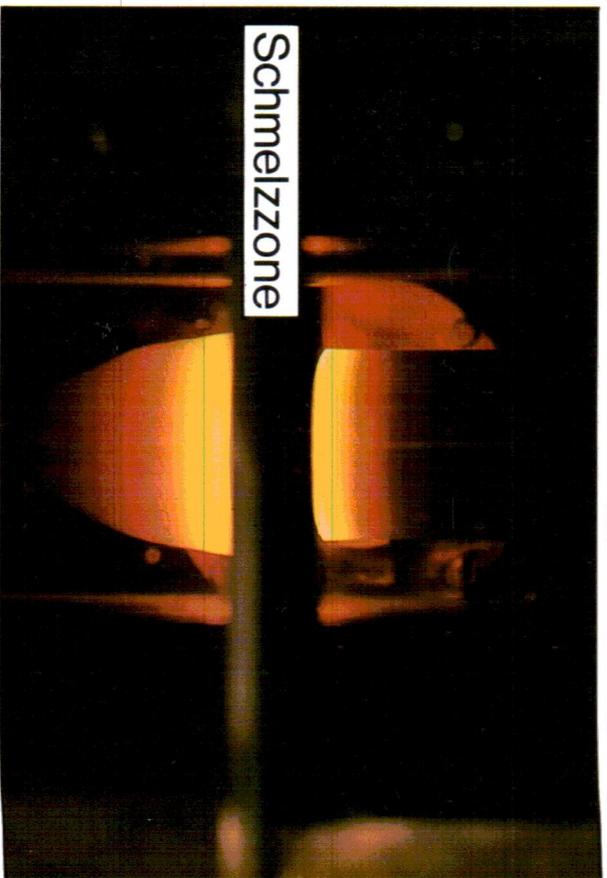
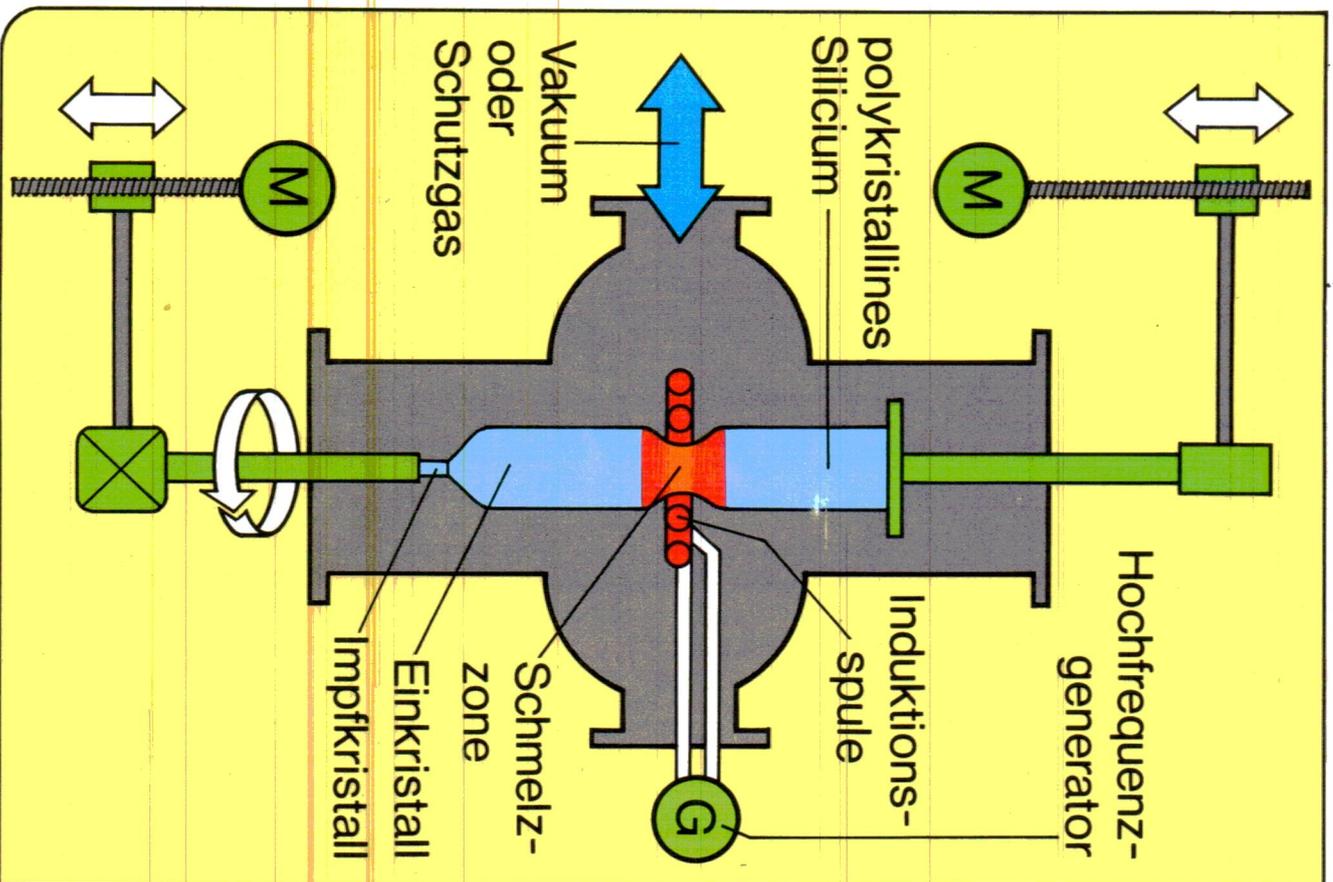
4

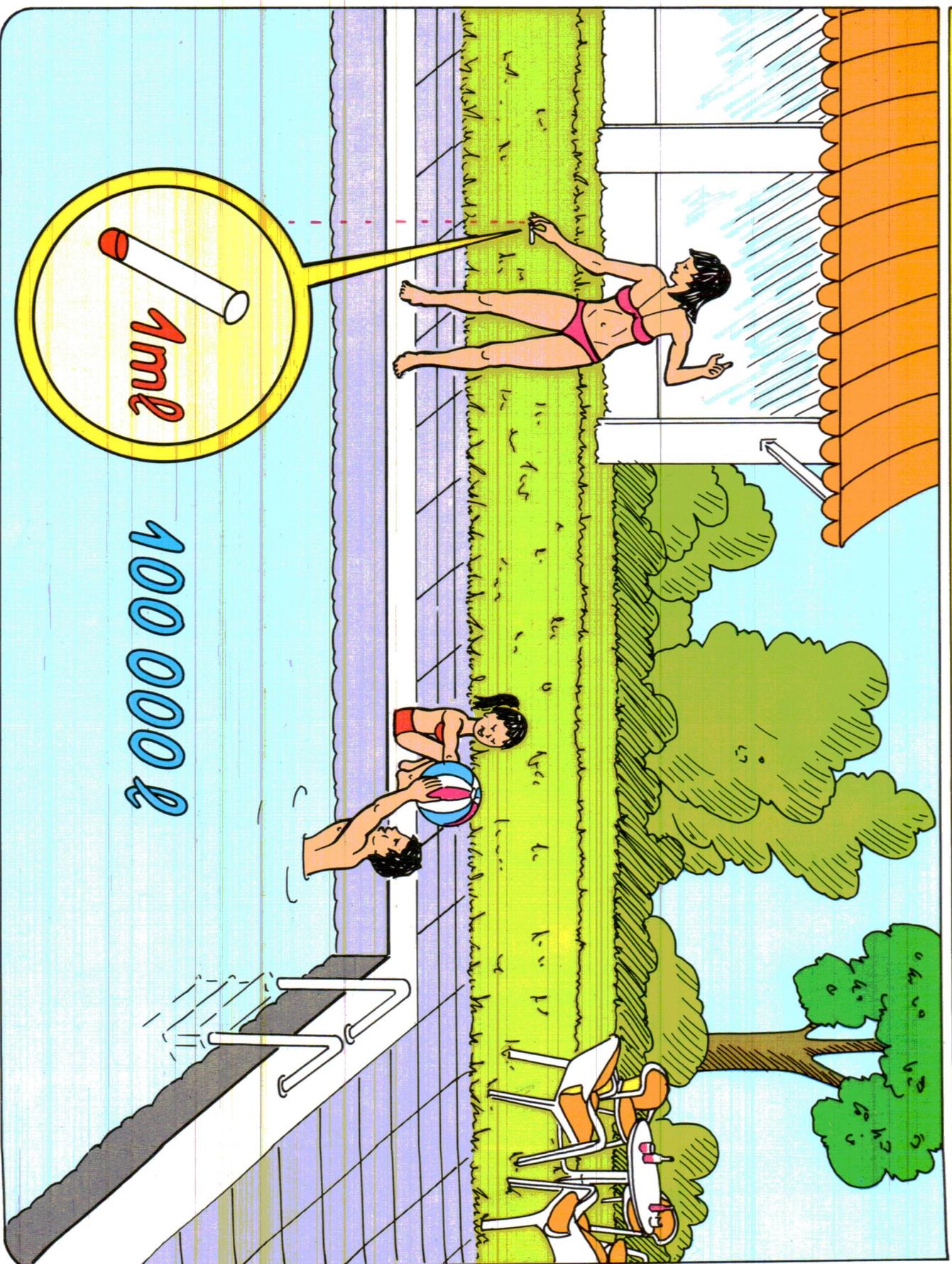


5



# Einkristall-Herstellung / Zonenziehen





100 000 2

