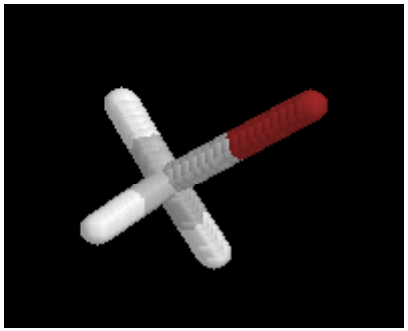
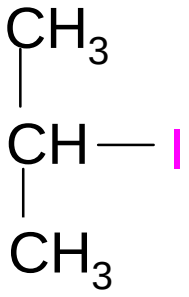
1.4. Halogenalkane, Alkylhalogenide



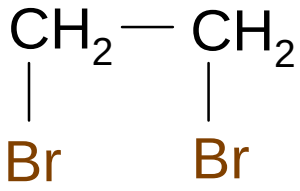
Nomenklatur: R — X X = F, Cl, Br, I

Funktionelle Gruppe

Stammkohlenwasserstoff
Anzahl und Stellung der Halogenatome (Reihung nach Alphabet)



2-Iodpropan



1,2-Dibromethan

Gasförmig: FCKW, CH_3Cl, CH_3Br, C_2H_5Cl (Chlorethan, Ethylchlorid)

Allgemeine Eigenschaften

Unpolar - gute Fettlösemittel
→ Anreicherung in der „Nahrungskette“

Toxisch (Leber, Niere, Zentralnervensystem)

häufig mutagen

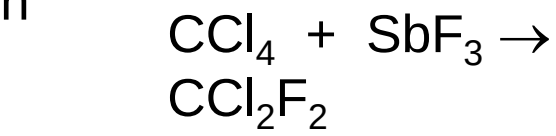
Narkosemittel
z. B. Halothan ($CF_3CHBrCl$)

Schwer abbaubar

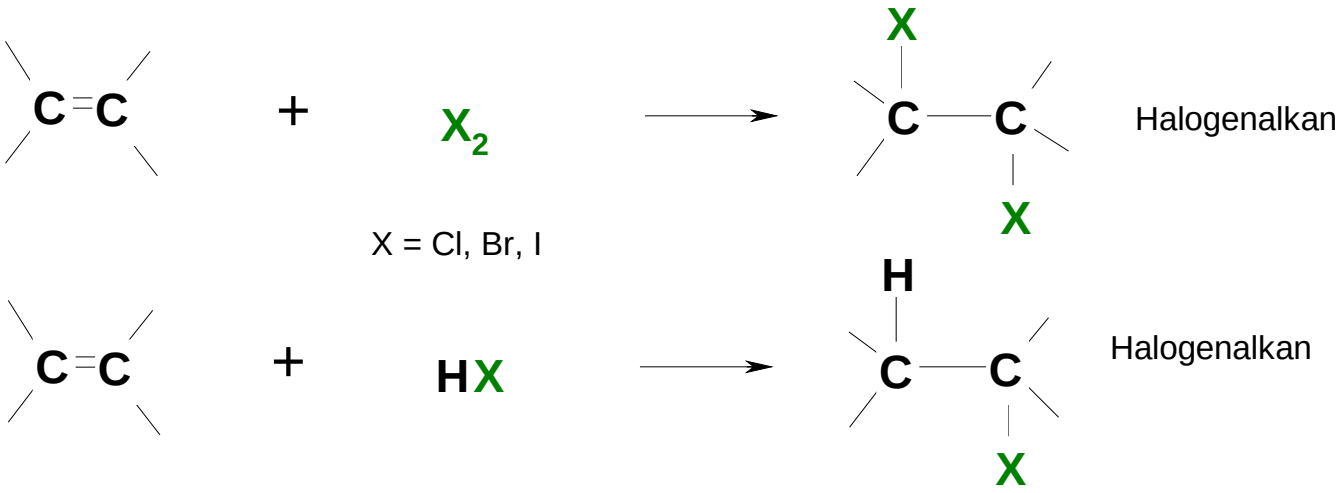
Herstellung von Halogenalkanen

1. Radikalische Halogenierung von Alkanen, siehe Kapitel Alkane

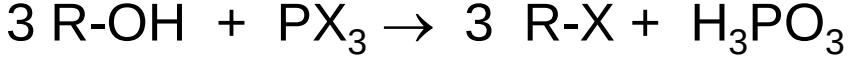
2. Fluorierung direkt nicht möglich
   Indirekt über Metallfluoride



3. Addition von Halogenen oder Halogenwasserstoff an Alkene



4. Aus Alkoholen mit HX, PX_3 oder PX_5

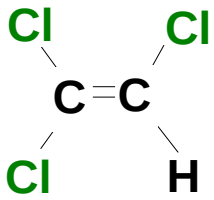


Beispiele

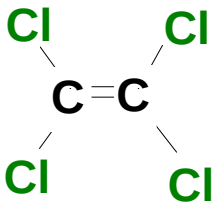
Lösemittel (nicht brennbar, aber toxisch)

CH_3Cl	Chlormethan, von marinen Organismen gebildet
CH_2Cl_2	Dichlormethan, Lösemittel
$CHCl_3$	Trichlormethan, Chloroform, Lösemittel, cancerogen
CCl_4	Tetrachlormethan, Lösemittel, cancerogen

Phosgenbildung: $CHCl_3 \xrightarrow{1/2\ O_2} COCl_2 + HCl$



Trichlorethen

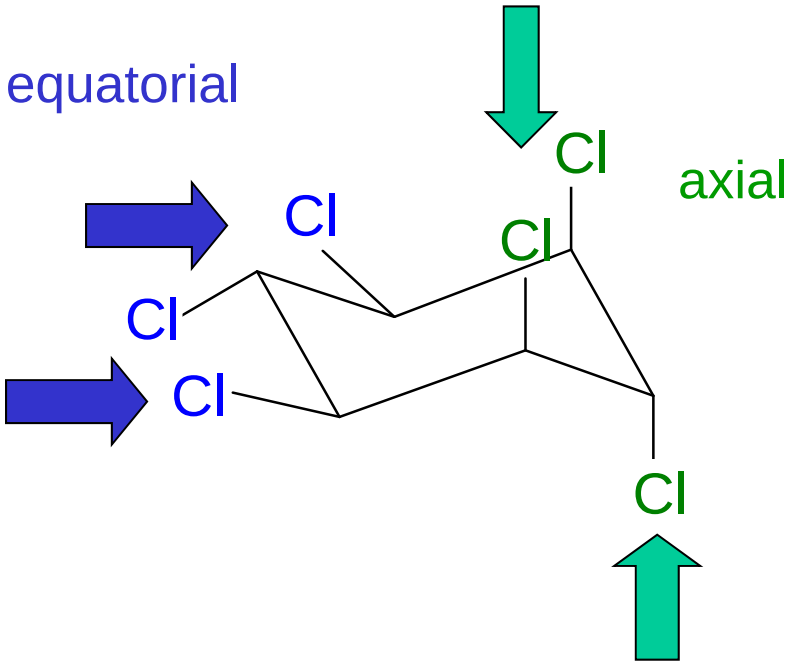


Perchlorethen

Beispiele

Insektizide

Lindan
γ -Hexachlorcyclohexan
HCH



Dieldrin, Aldrin, Heptachlor

Fluorchlorkohlenwasserstoffe, FCKW

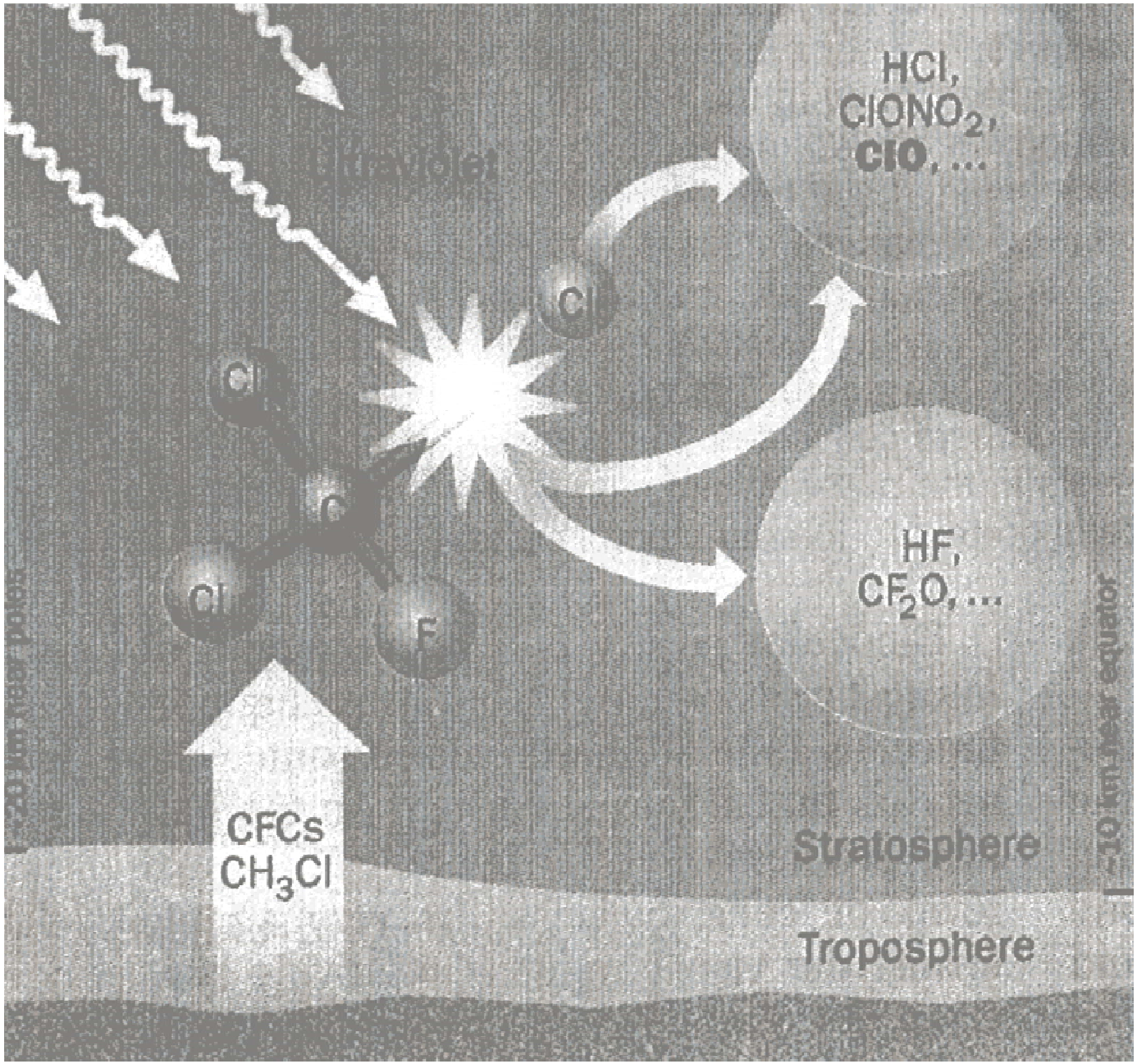
Freone, Frigene,
Kältemittel, Aerosole

$CClF_3$		Freon 13
CCl_2F_2	Kp.: - 30 °	Freon 12
CCl_3F	Kp.: 25 °	Freon 11
$CHClF_2$	Kp.: -40 °	Freon 22

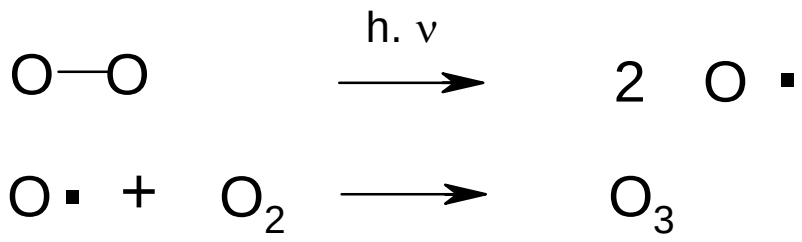
Technische Nomenklatur:
Anzahl C -1
H +1
F

Ozonabbau in der Stratosphäre

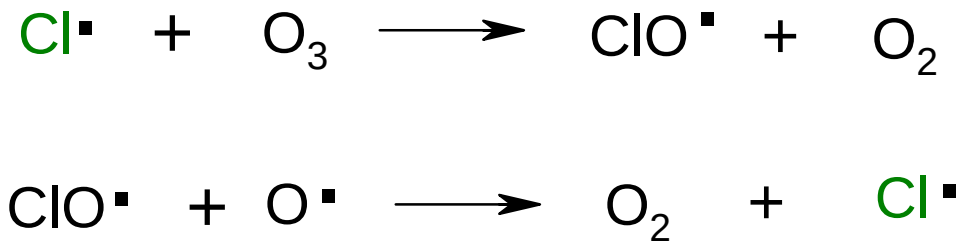
10 ppm O_3



Bildung von Ozon

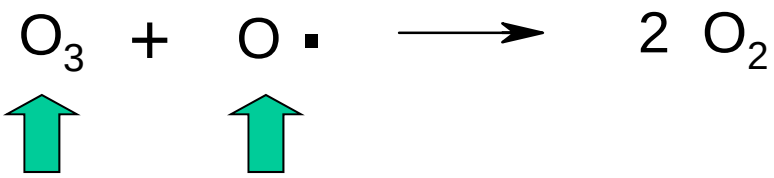


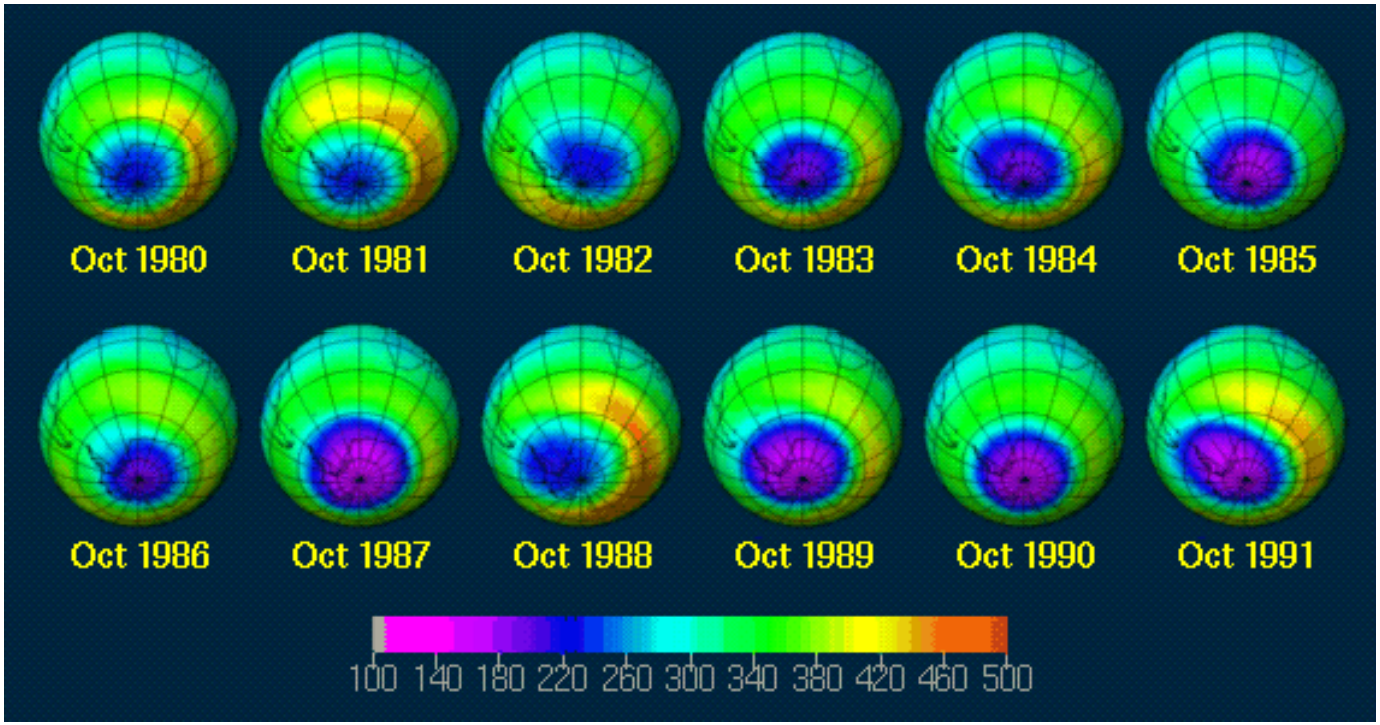
Abbaureaktion



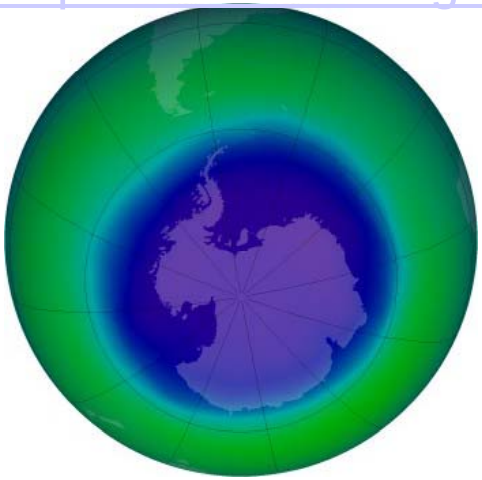
Das Chlorradikal wird fortlaufend regeneriert

Nettoreaktion

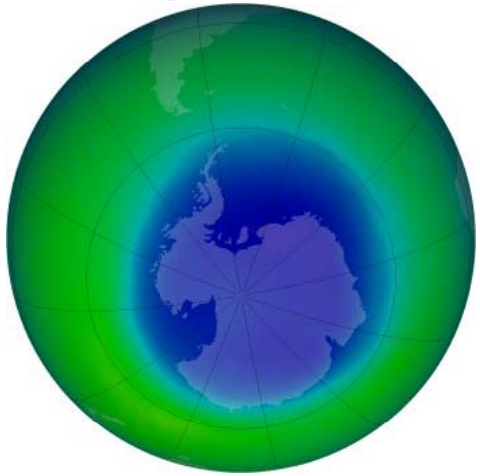




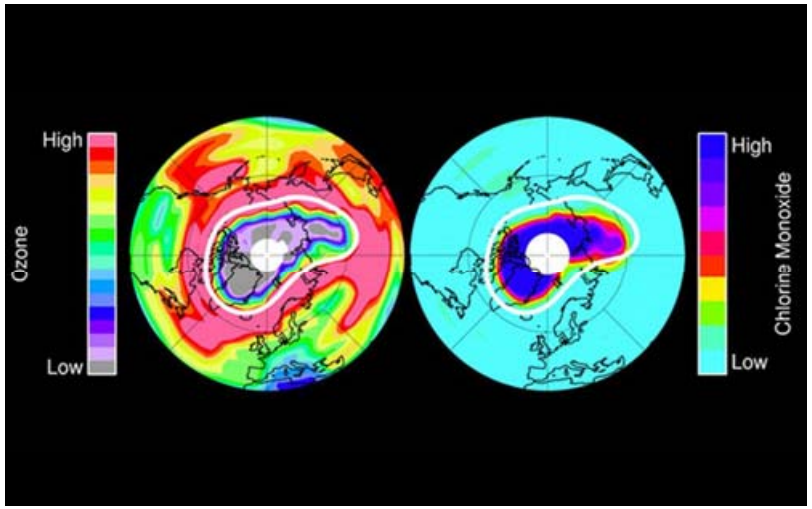
http://ozonewatch.gsfc.nasa.gov/ Antarktis



2006



Okt.2011

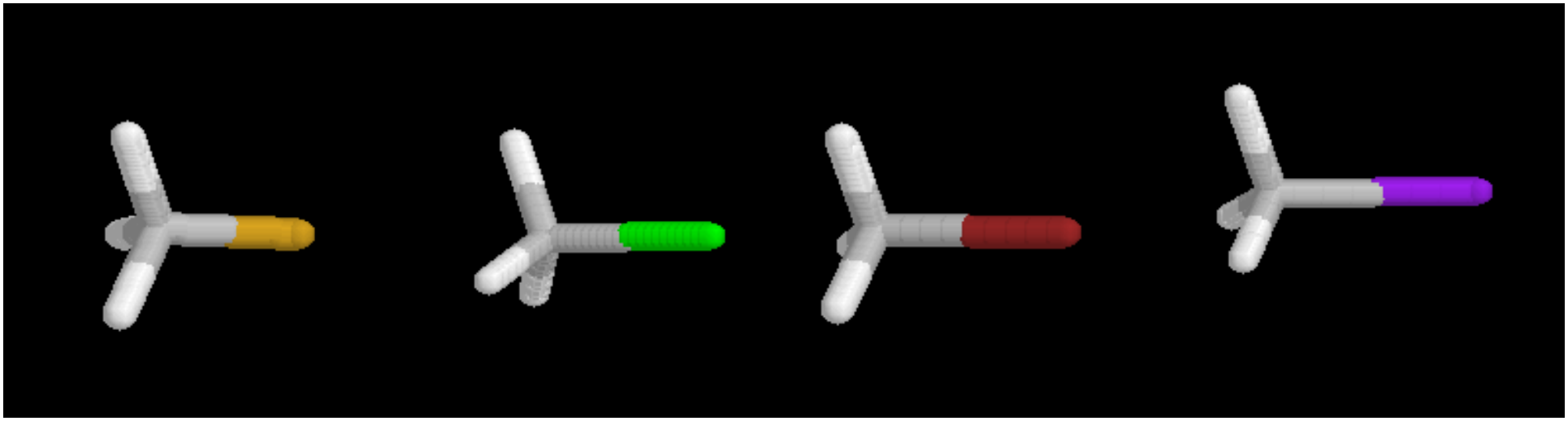


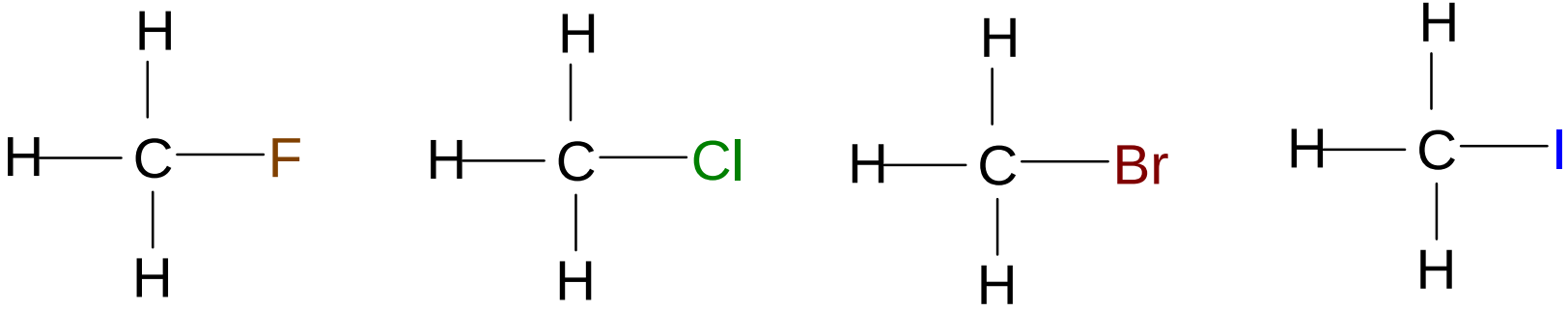
Ozonloch Arktis

Reaktivität

Reaktionen der Halogenalkane

F << Cl < Br < I

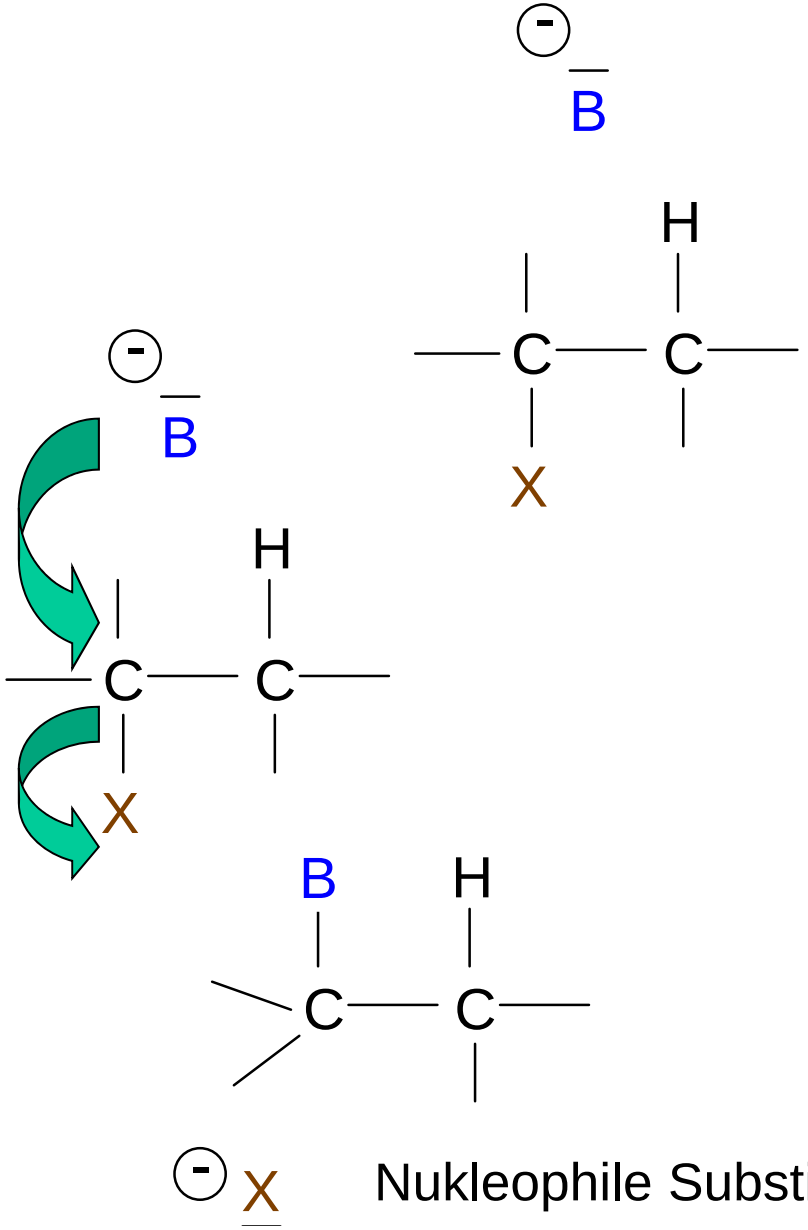




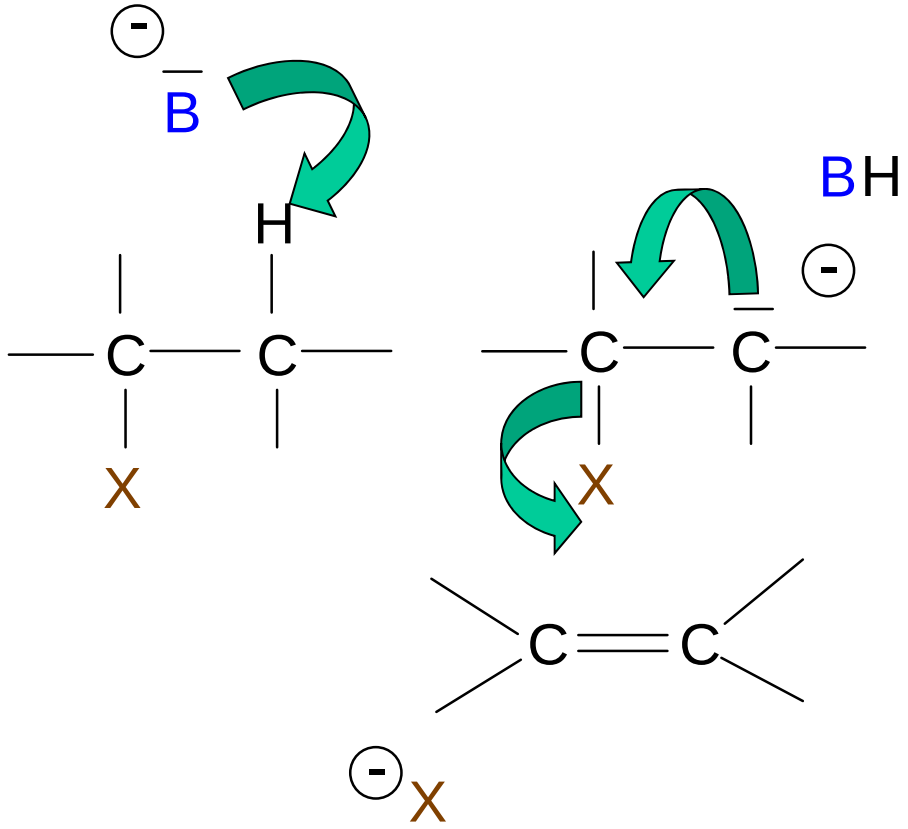
Bindungslänge
Polarisierbarkeit

Reaktionen der Halogenalkane

Allgemein:
Eliminierung bzw. Substitution



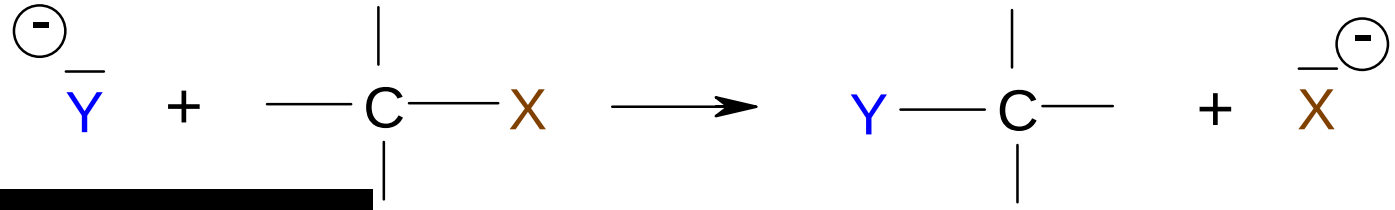
Nukleophile Substitution



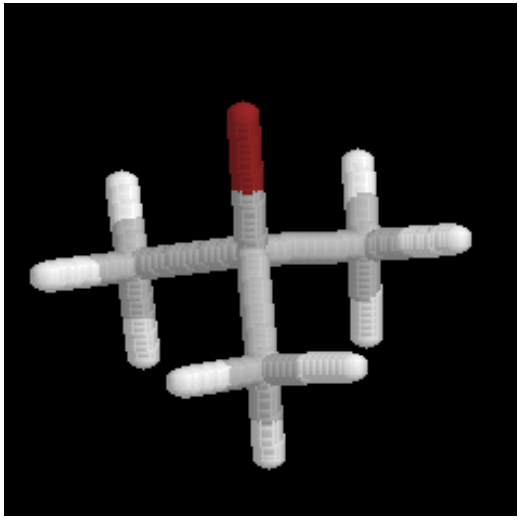
Eliminierung: durch starke Basen
und Temperaturerhöhung ↑

Nukleophile Substitution

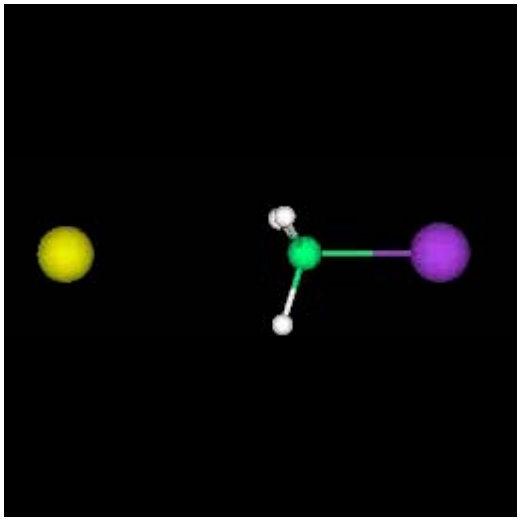
Reaktionen der Halogenalkane



Abgangsgruppe X:
Anionen starker Säuren



Nukleophile Substitution 1. Ordnung
SN1 Reaktion



Nukleophile Substitution 2. Ordnung
SN2 Reaktion

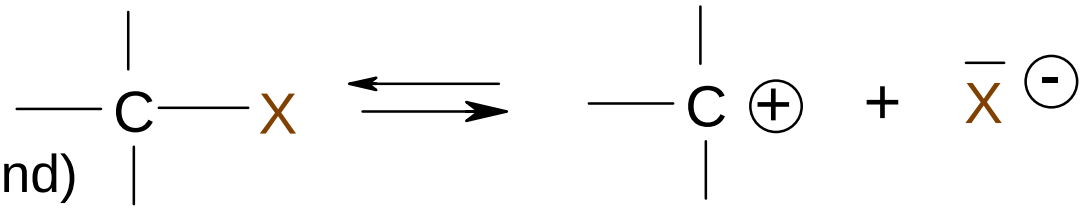
Nukleophile Substitution 1. Ordnung (SN1 Reaktion)

Reaktionsgeschwindigkeit abhängig von der Konzentration **eines** Reaktanden (monomolekular)

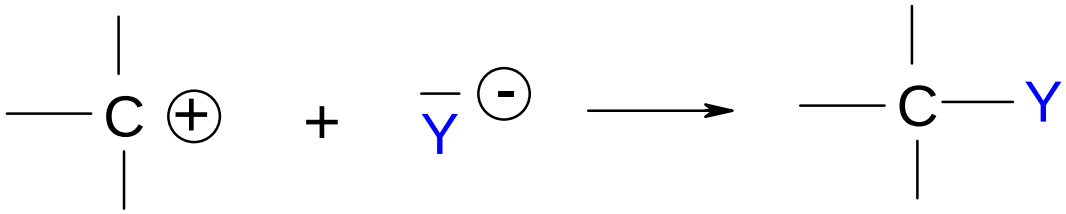
$$v = k \cdot [RX]$$

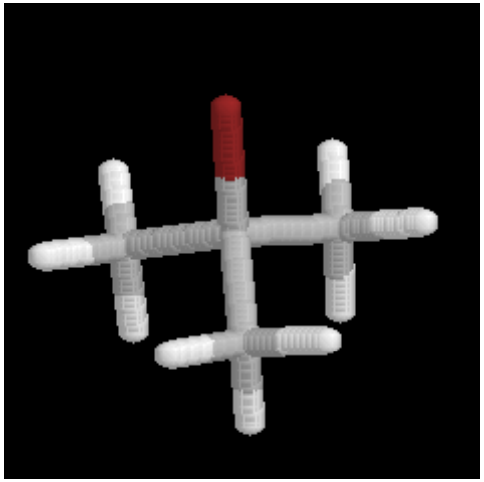
Carbeniumion

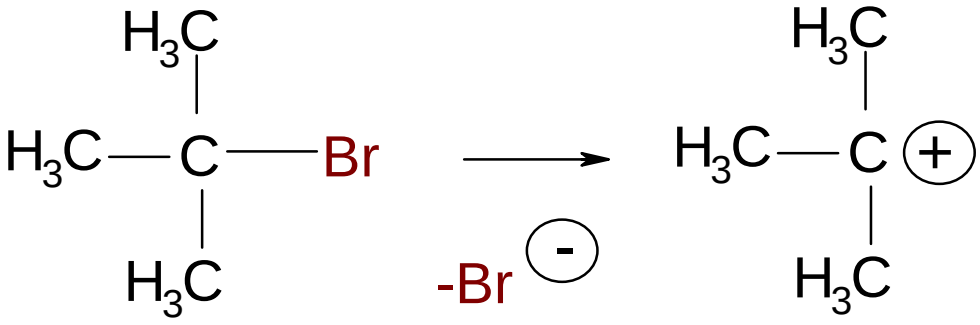
Langsame Reaktion
(geschwindigkeitsbestimmend)



Schnelle Reaktion





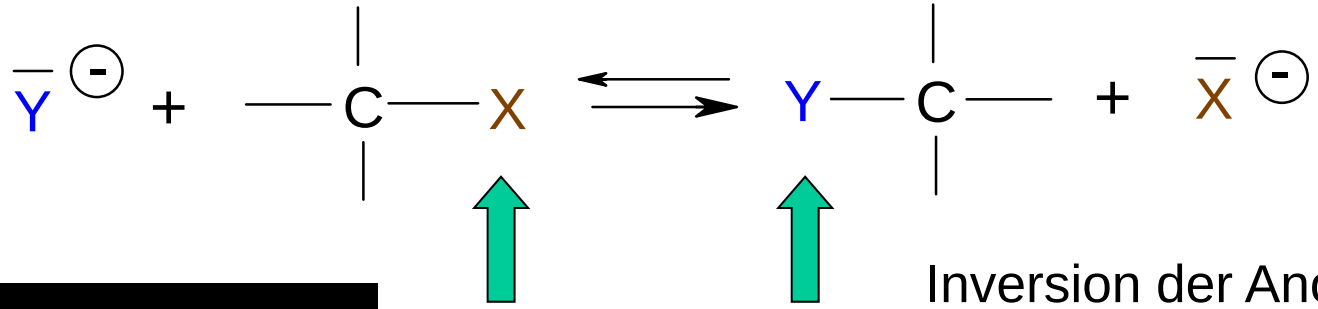


Nukleophile Substitution 2. Ordnung (SN2 Reaktion)

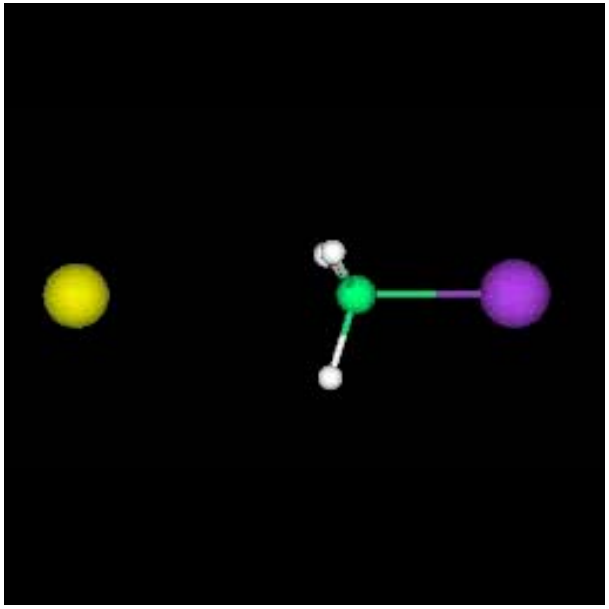
Reaktionsgeschwindigkeit abhängig von der Konzentration **zweier** Reaktanden (bimolekular)

$$v = k \cdot [RX] \cdot [Y]$$

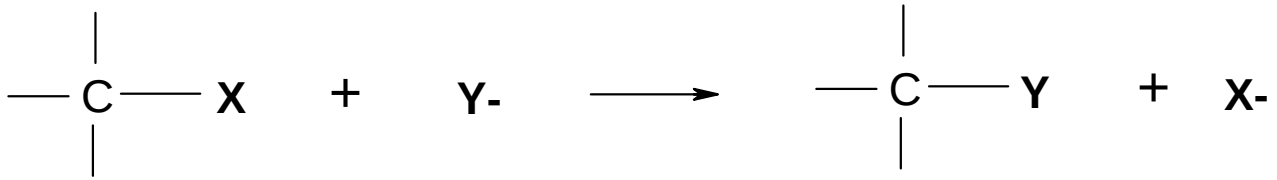
Langsame Reaktion
(geschwindigkeitsbestimmend)



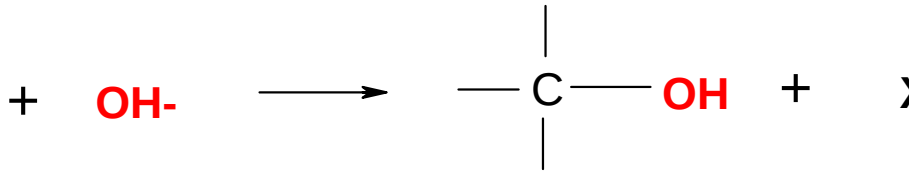
Inversion der Anordnung
am C-Atom



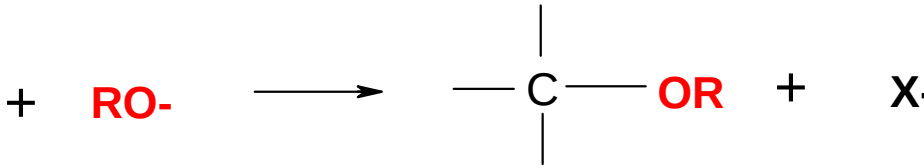
Beispiele für nukleophile Substitutionsreaktionen



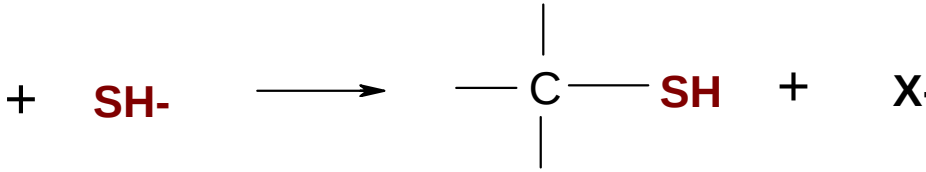
X = Cl, Br, I



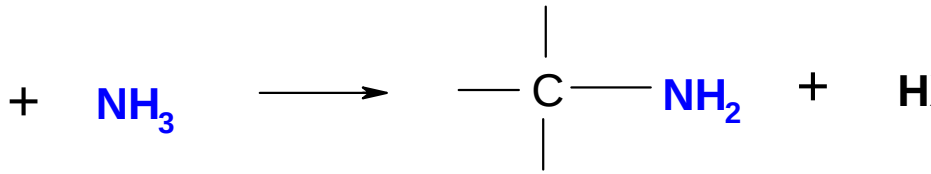
Alkohol



Ether

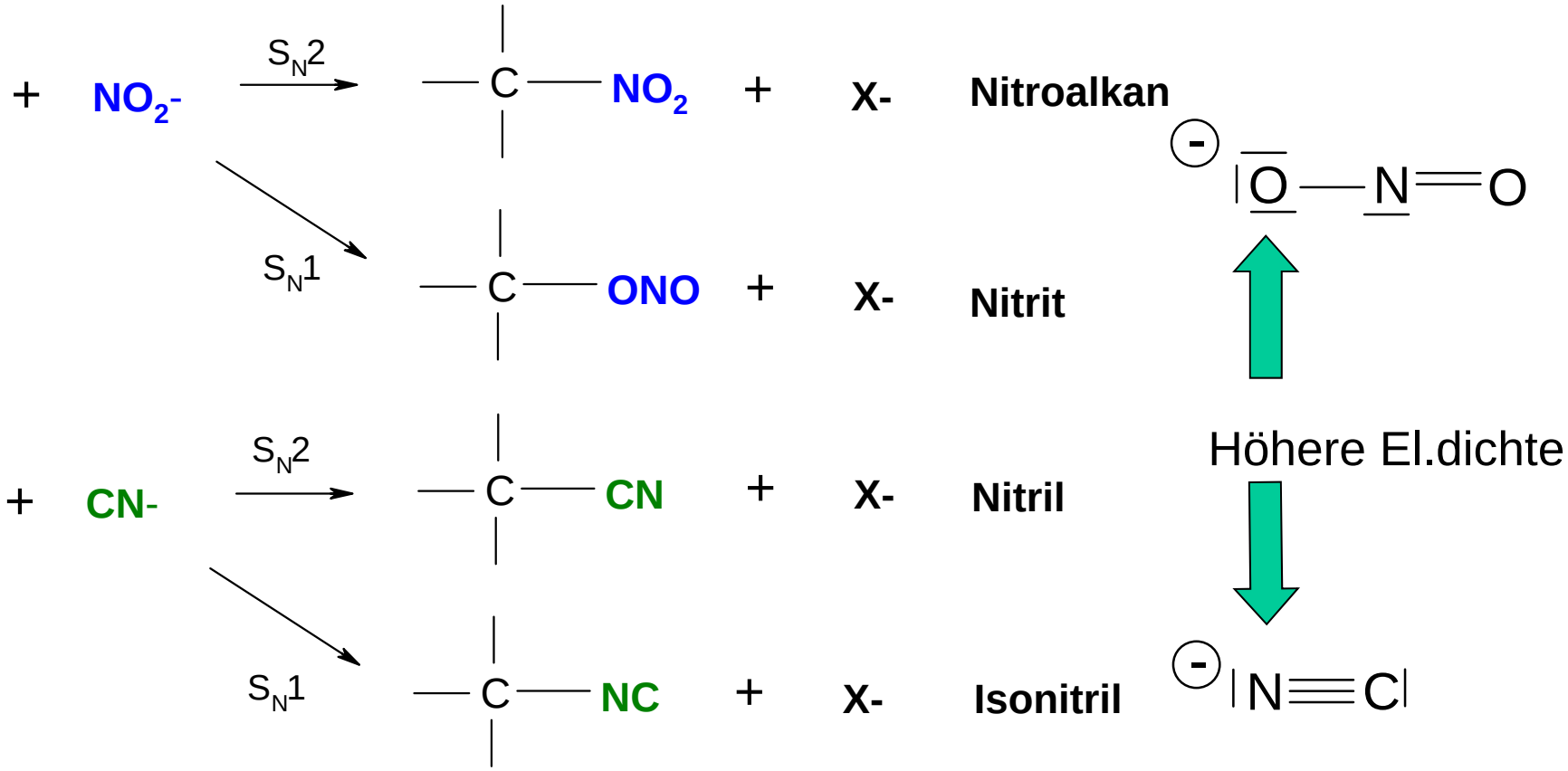


Thiol



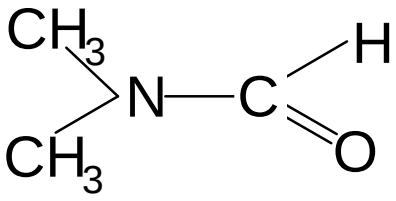
Amin

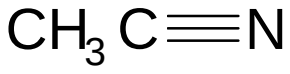
Abhängigkeit der Produktbildung vom Mechanismus (SN1 bzw. SN2)
Reaktionen mit Nitrit- bzw. Cyanidionen

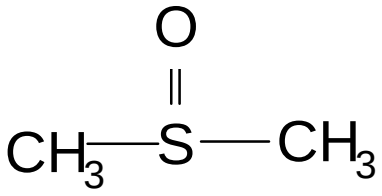


Einfluss des Lösemittels

Polare Lösemittel wirken beschleunigend auf SN-Reaktionen







DMF
N,N-Dimethylformamid

Acetonitril

DMSO
Dimethylsulfoxid