

FRIEDEL-CRAFTS REACTIONS - AN OVERVIEW

General thoughts

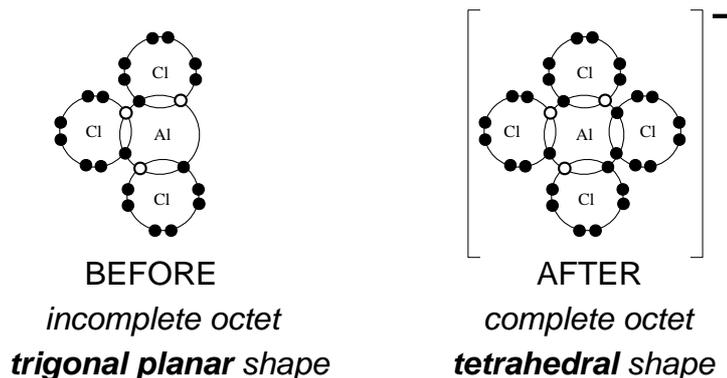
- Friedel-Crafts reactions involve **electrophilic substitution** of aromatic rings
- there are two types - **Alkylation** and **Acylation**
- alkylation involves the substitution of alkyl groups such as CH_3 , C_2H_5 and C_3H_7
- acylation involves the substitution of acyl groups such as $\text{CH}_3\text{C}=\text{O}$
- in both cases a catalyst is needed
- this is because the attacking species isn't a strong enough electrophile
- it hasn't enough positive character to persuade benzene to react
- haloalkanes and acyl chlorides have polar bonds but the C isn't positive enough



- the catalyst makes the attacking species more positive
- **anhydrous** aluminium chloride is the catalyst
- it works because it is a **Lewis acid**
- in AlCl_3 the aluminium is **electron deficient** - it has 6 electrons in its outer shell
- in both cases the reagent has a polar C-Cl bond
- the carbon atom has a $\delta+$ charge but it isn't enough to tempt the benzene
- the aluminium chloride increases the charge so that benzene become interested

Action of AlCl_3

- the aluminium atom is electron deficient with only 6 in its outer shell
- it acts as a Lewis acid as it can accept a lone pair to make up its octet



- it can do this by attracting a chlorine atom away from a C-Cl bond
- the more the Cl is attracted by the AlCl_3 the more polar the C-Cl bond gets
- in the extreme case it pulls the chlorine right off leaving a C^+ behind



- the aromatic ring will now attack and electrophilic substitution takes place

Alkylation substitutes an alkyl (e.g. methyl, ethyl) group

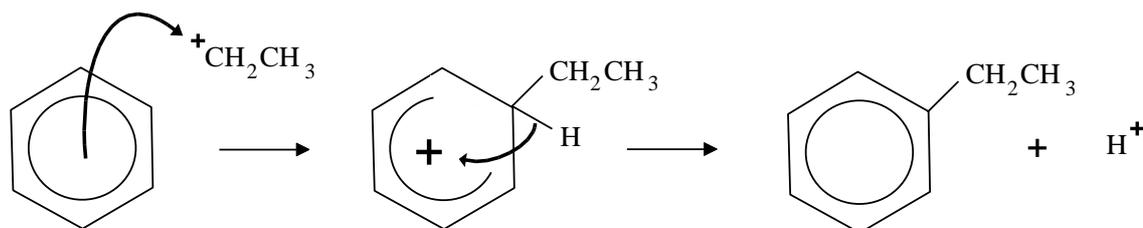
reagents a haloalkane (RX) and anhydrous aluminium chloride $AlCl_3$

conditions room temperature; dry inert solvent (ether)

electrophile a carbocation R^+ (e.g. CH_3^+)



mechanism



Industrial method

The industrial preparation of similar compounds is slightly different. Alkenes are used instead of haloalkanes - see other notes

Acylation substitutes an acyl (e.g. ethanoyl) group

the aluminium chloride catalyst acts in the same as with alkylation

reagents an acyl chloride ($RCOCl$) and anhydrous $AlCl_3$

conditions reflux $50^\circ C$; dry inert solvent (ether)

electrophile $RC^+=O$ (e.g. $CH_3C^+=O$)

product carbonyl compound (aldehyde or ketone)



mechanism

