

Synthesis of Primary, Secondary and Tertiary Alcohols using Grignard Reagents

Grignard Reagent: RMgX (R = alkyl/aryl group, X = Cl , Br , I). These are strong nucleophiles and react with carbonyl compounds followed by acidic hydrolysis to form alcohols.

1. Primary Alcohols

Formed by reaction of Grignard reagent with formaldehyde (HCHO).

General Reaction: $\text{RMgX} + \text{HCHO} \rightarrow \text{RCH}_2\text{OMgX} \rightarrow (\text{H}_3\text{O}^+) \rightarrow \text{RCH}_2\text{OH}$

Example: $\text{CH}_3\text{MgBr} + \text{HCHO} \rightarrow \text{CH}_3\text{CH}_2\text{OH}$ (Ethanol)

2. Secondary Alcohols

Formed by reaction with aldehydes other than formaldehyde.

General Reaction: $\text{RMgX} + \text{R}'\text{CHO} \rightarrow \text{R}'\text{CH}(\text{OMgX})\text{R} \rightarrow (\text{H}_3\text{O}^+) \rightarrow \text{R}'\text{CH}(\text{OH})\text{R}$

Example: $\text{CH}_3\text{MgBr} + \text{CH}_3\text{CHO} \rightarrow \text{CH}_3\text{CH}(\text{OH})\text{CH}_3$ (Isopropyl alcohol)

3. Tertiary Alcohols

Formed by reaction with ketones.

General Reaction: $\text{RMgX} + \text{R}'\text{COR}'' \rightarrow \text{R}'\text{C}(\text{OMgX})(\text{R})(\text{R}'') \rightarrow (\text{H}_3\text{O}^+) \rightarrow \text{R}'\text{C}(\text{OH})(\text{R})(\text{R}'')$

Example: $\text{CH}_3\text{MgBr} + (\text{CH}_3)_2\text{CO} \rightarrow (\text{CH}_3)_3\text{COH}$ (tert-Butyl alcohol)