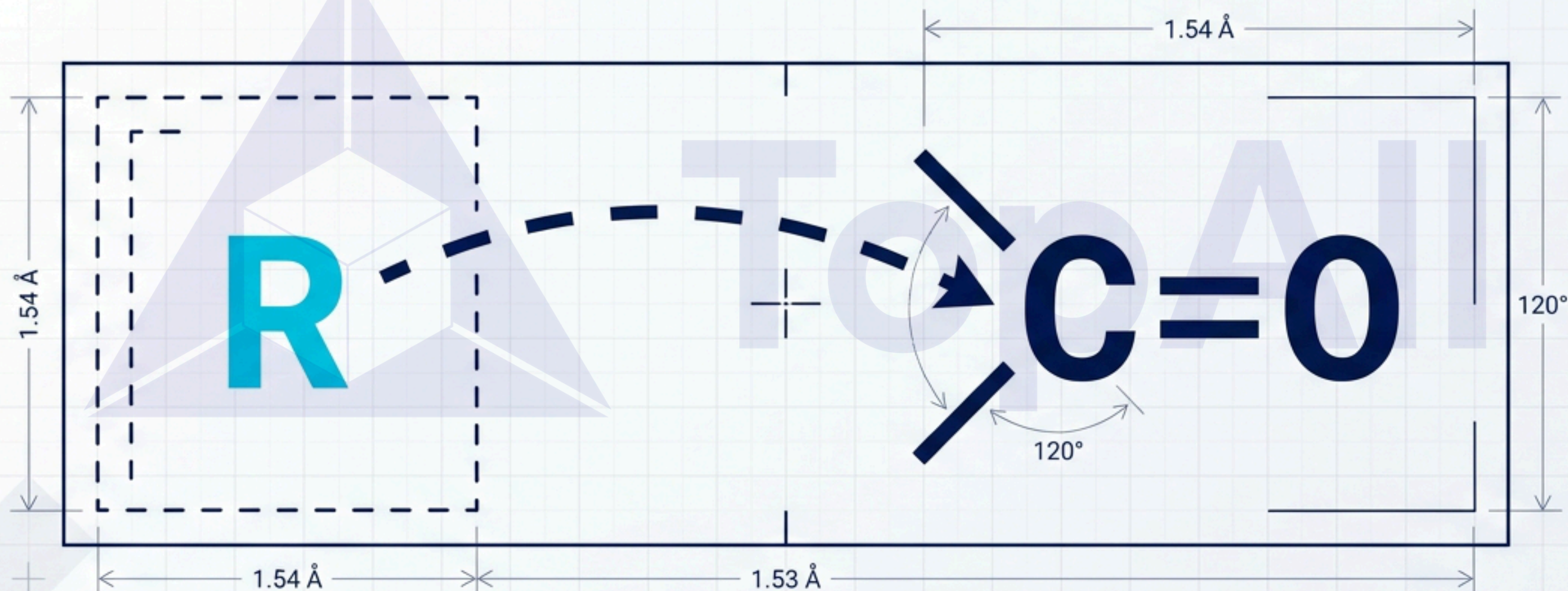


Building Alcohols Carbon by Carbon

The Grignard Synthesis Pathway



WHAT IS A GRIGNARD REAGENT?

Nucleophilic Carbon Source

Acts as a carbanion equivalent; the building block for the new carbon skeleton.



Organometallic Backbone

Highly polarized bond, driving the reactivity of the attached carbon.



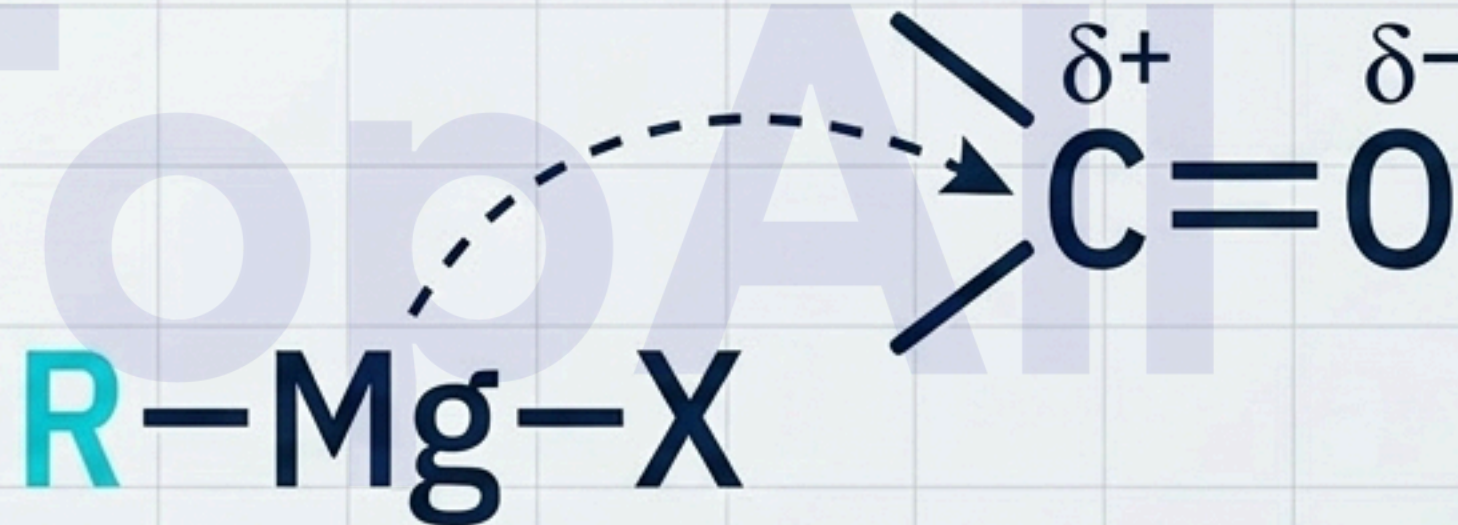
Important Note: Highly reactive species. Requires strictly anhydrous (water-free) conditions during preparation.

Step 1: The Attack

Nucleophilic addition to carbonyl

The carbon-oxygen double bond is highly polar.

The nucleophilic alkyl group of the Grignard reagent targets the electron-deficient carbonyl carbon.





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$$E=mc^2$$



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The Intermediate State

Adduct formation



New Carbon-Carbon
Bond Formed

Double bond breaks;
oxygen coordinates with
the MgX complex.

Step 2: Acid/Water Workup

Hydrolysis

Addition of water breaks
the unstable O-Mg bond.



Proton (H^+) replaces
MgX to yield the final
hydroxyl group.

The Product Rule

Synthesizing Primary, Secondary, and Tertiary Alcohols

Starting Carbonyl	+ Grignard	Resulting Alcohol Class
Methanal (HCHO)	+ RMgX	Primary (1°) Alcohol: $\text{R}-\text{CH}_2-\text{OH}$
Other Aldehydes ($\text{R}'\text{CHO}$)	+ RMgX	Secondary (2°) Alcohol: $\text{R}'-\text{CH}(\text{R})-\text{OH}$
Ketones ($\text{R}'\text{COR}''$)	+ RMgX	Tertiary (3°) Alcohol: $\text{R}'\text{R}''\text{C}(\text{R})-\text{OH}$

The Dual Transformation

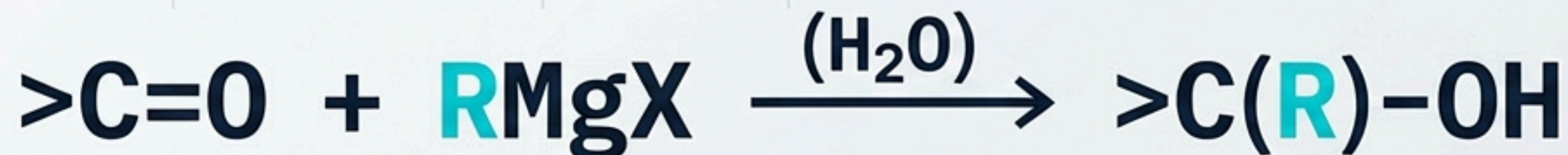
Grignard reactions are powerful because they accomplish two crucial synthetic steps simultaneously.



Converts Carbonyl to Alcohol



Extends the Carbon Chain





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