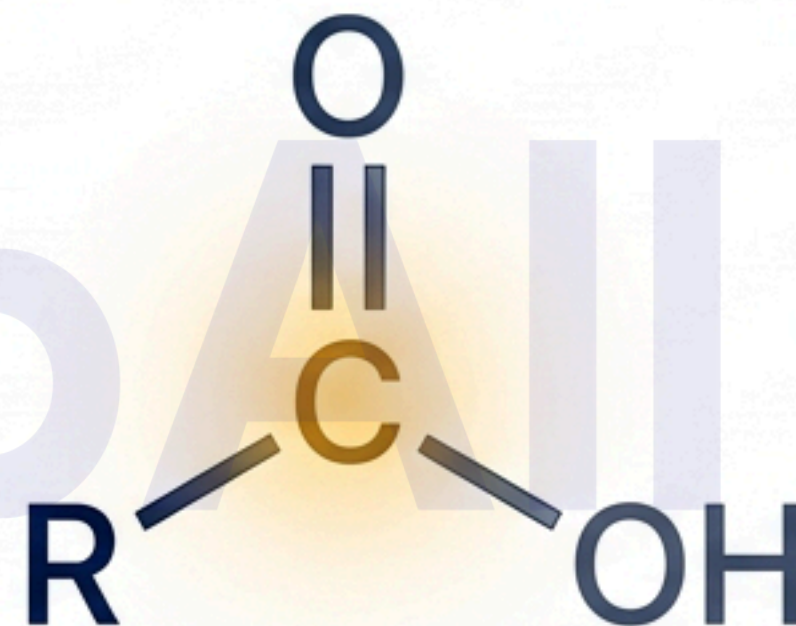


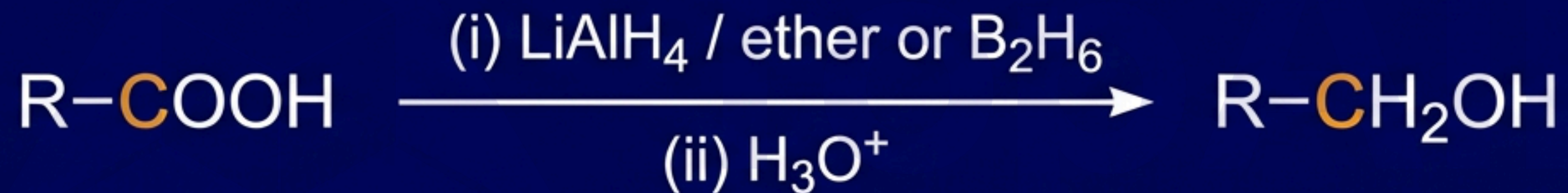
8.9.3 Reactions Involving the -COOH Group

Mastering reduction pathways and carbon-loss transformations (decarboxylation).



Forcing the Reduction: $-\text{COOH}$ to 1° Alcohols

Carboxylic acids are highly oxidized and strongly resistant to reduction. Transforming them requires aggressive reducing environments that strip the oxygen and saturate the carbon with hydrogen.



The Fate of the Carbon: The carbon skeleton remains completely intact. The oxidation state of the carboxyl carbon simply drops to yield a primary alcohol.

Reagent Selectivity: Choosing the Right Tool

NaBH_4 (Sodium Borohydride)

Power: Weak



Fails to reduce the carboxyl group.

LiAlH_4 (Lithium Aluminium Hydride)

Power: Strong & Broad



Reduces $-\text{COOH}$ easily, but lacks selectivity. Will reduce other reducible groups.

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B_2H_6 (Diborane)

Power: The Premium Choice



Excellent reduces $-\text{COOH}$ without affecting easily reducible groups like esters, nitro, or halo groups.



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$$E=mc^2$$



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Key Highlights

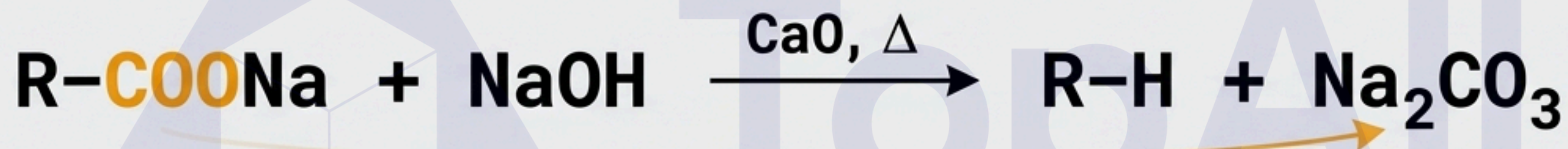
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Soda Lime Decarboxylation: Stepping Down the Chain

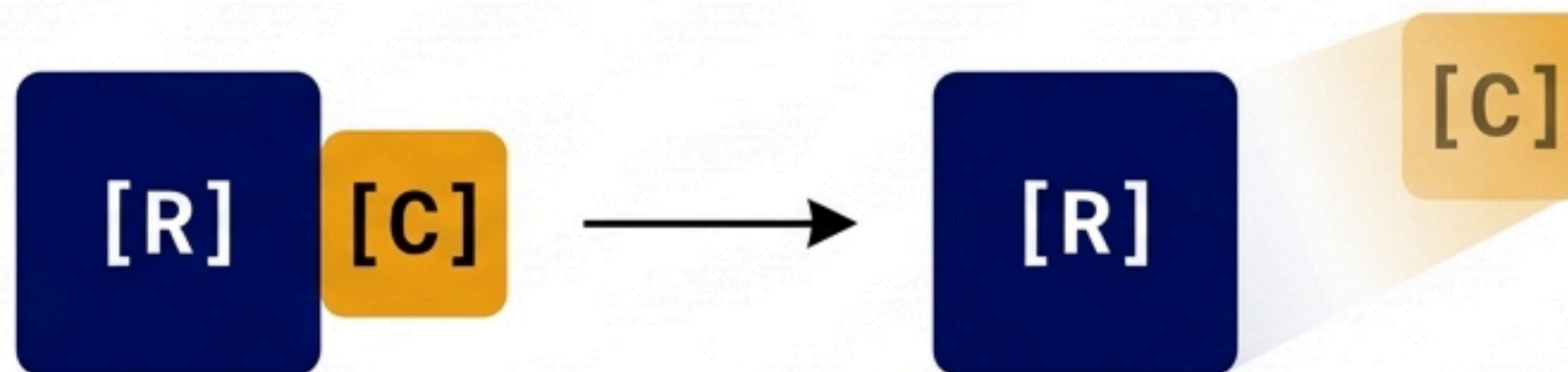


Heating the sodium salt of a carboxylic acid with soda lime completely removes the carboxyl carbon as carbon dioxide (captured as a carbonate salt).



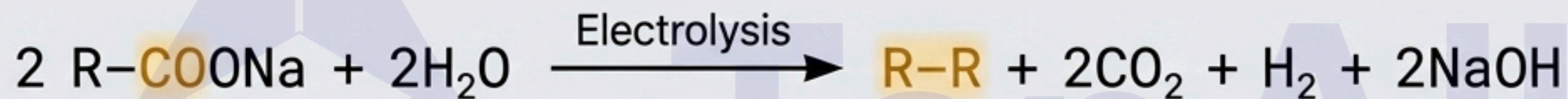
Catalyst: Soda Lime
(3:1 ratio of NaOH:CaO)

Carbon Count: Step-Down
(n-1 carbons)



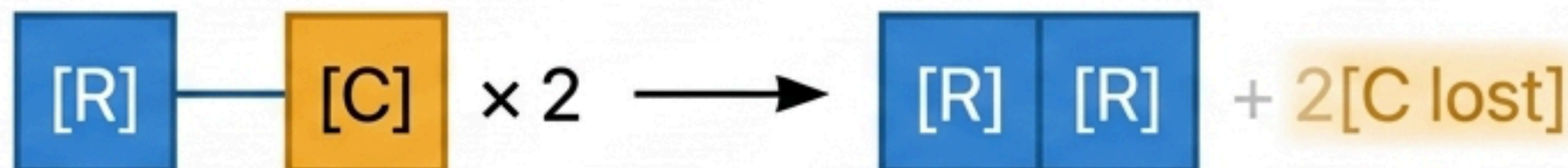
Kolbe Electrolysis: Radical Dimerization

Electrolysis of aqueous alkali metal salts of carboxylic acids strips the CO_2 and creates **alkyl radicals** that fuse together at the anode.



The Math of Kolbe

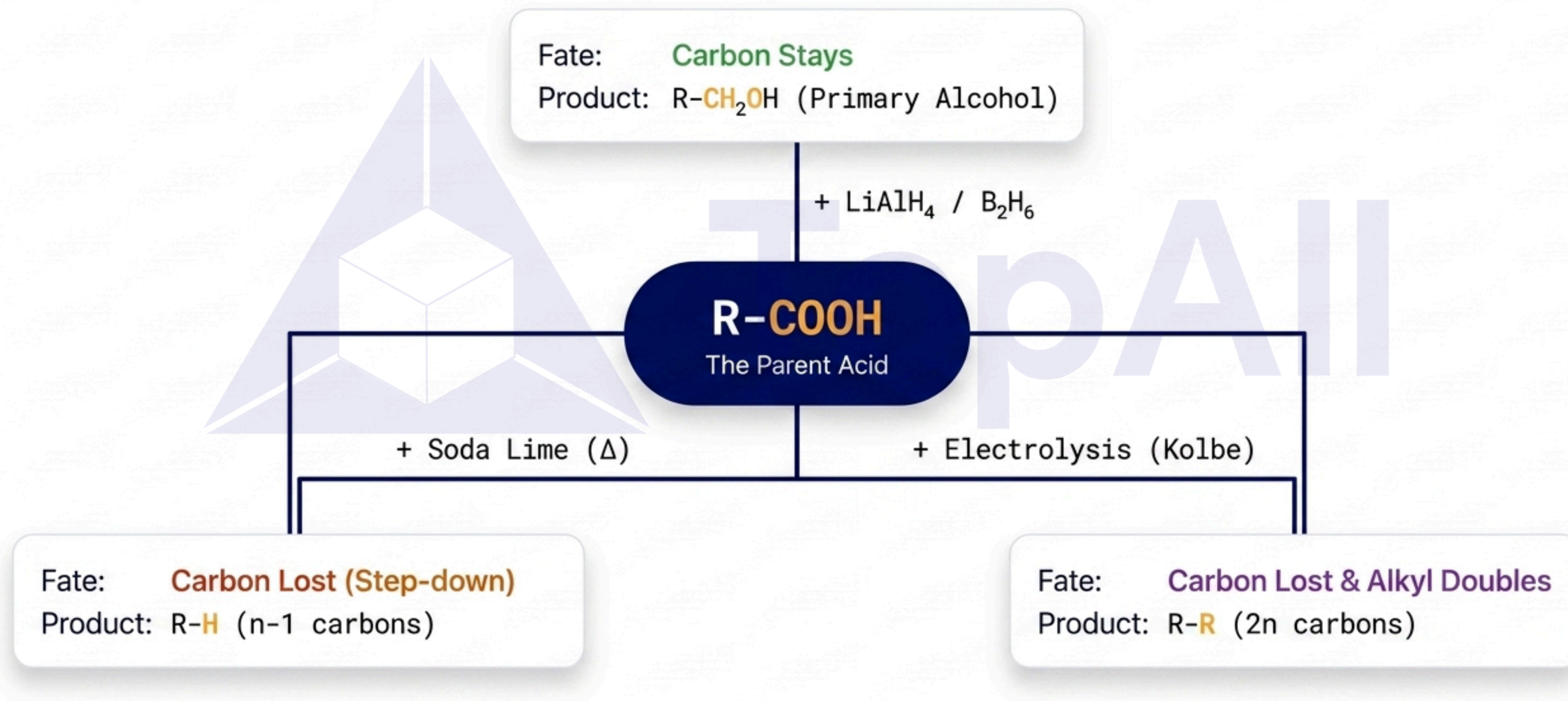
If the parent acid's alkyl group (R) contains n carbons, the resulting hydrocarbon (R-R) contains $2n$ carbons.



This is the premier synthetic method for generating symmetrical alkanes with an even number of carbon atoms.

The Fate of the Carboxyl Carbon

A strategic overview of -COOH transformations.





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