

# Reduction Reactions

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## *Lithium aluminum hydride (LAH)*

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Lithium aluminum hydride (LAH) is a **strong reducing agent** with chemical formula  $\text{LiAlH}_4$ . It can reduce a variety of functional groups such as **aldehydes, esters, acids, ketones, nitriles, epoxides and azides**. It vigorously reacts with water and all the reactions are performed in polar aprotic solvents.

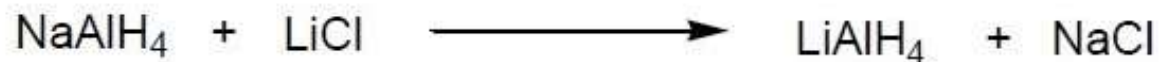
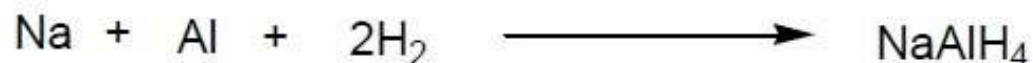
# Preparation

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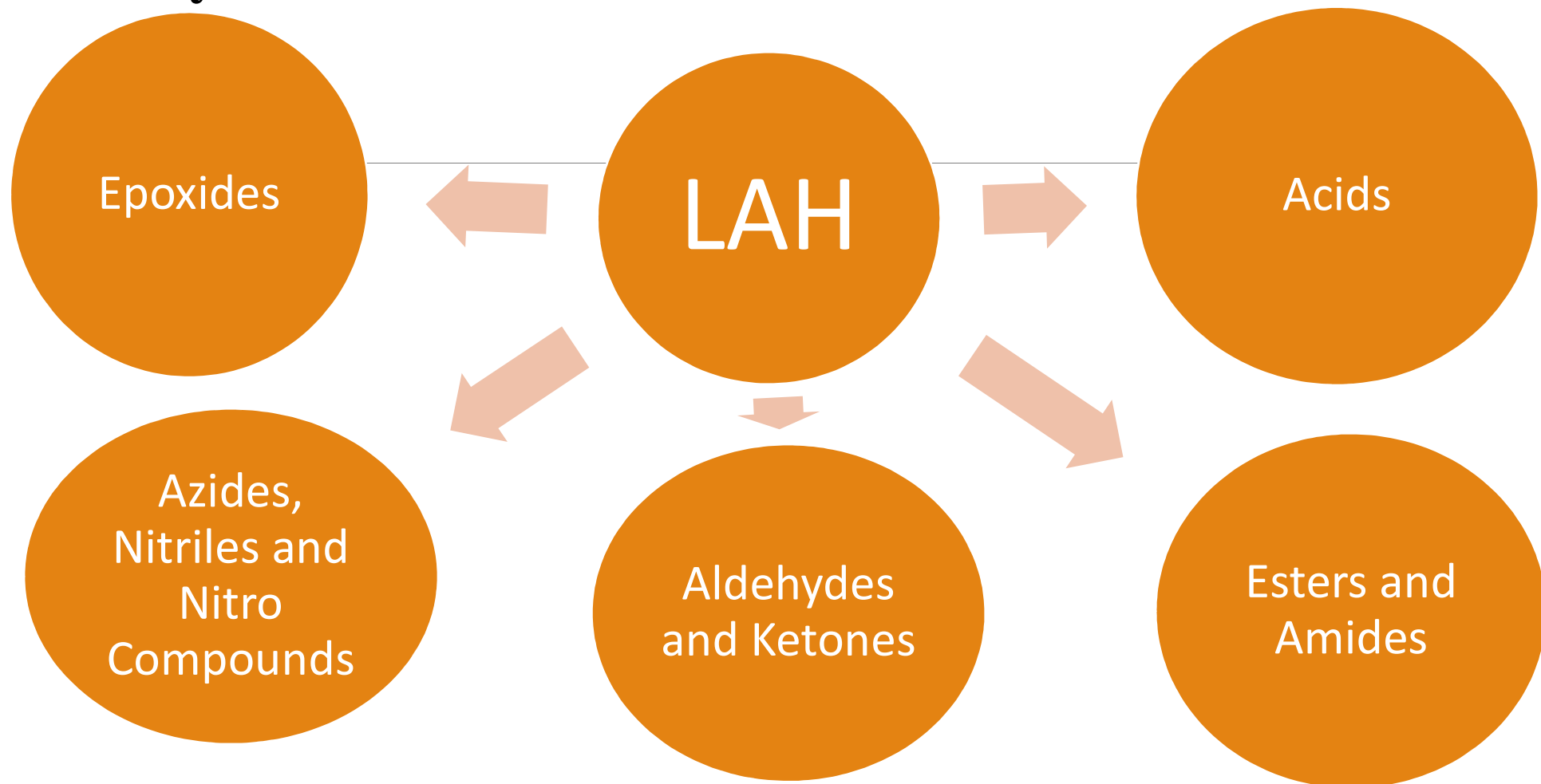
It was first prepared by treating lithium hydride (LiH) with aluminum chloride (AlCl<sub>3</sub>)



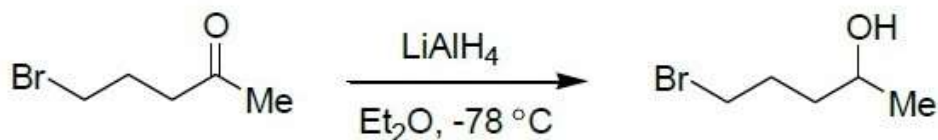
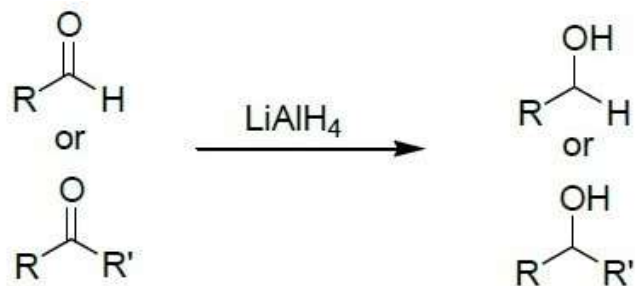
In industrial scale, it is prepared from sodium aluminum hydride which is prepared by reaction of sodium, aluminum and hydrogen at high temperature and pressure.



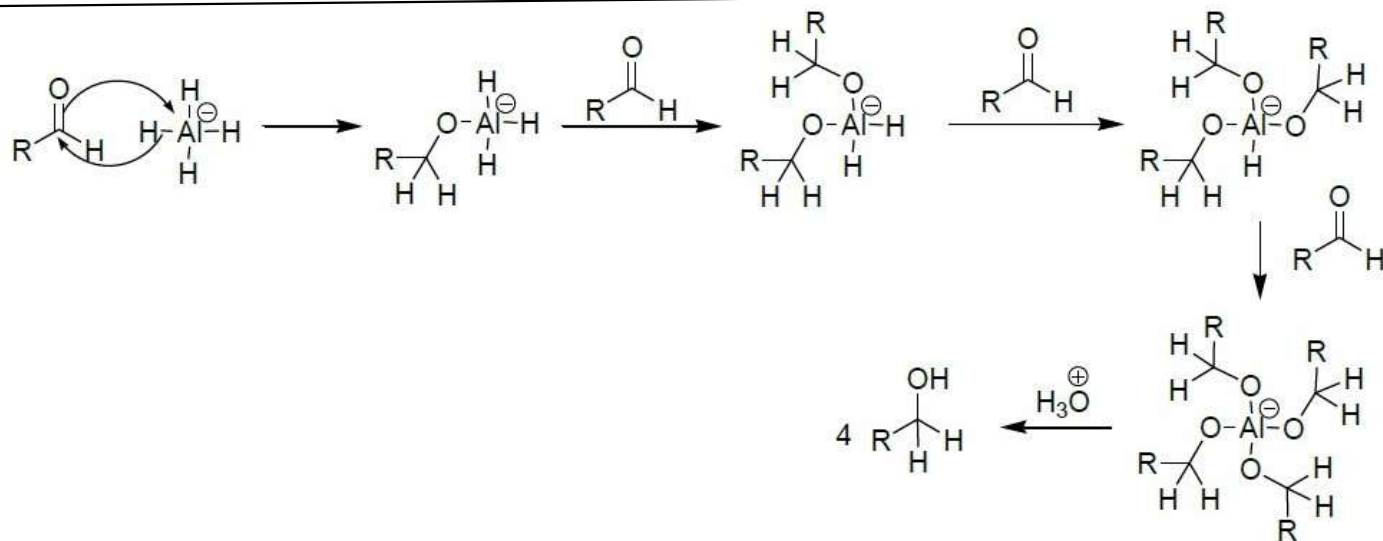
# LAH catalyzed Reduction reactions



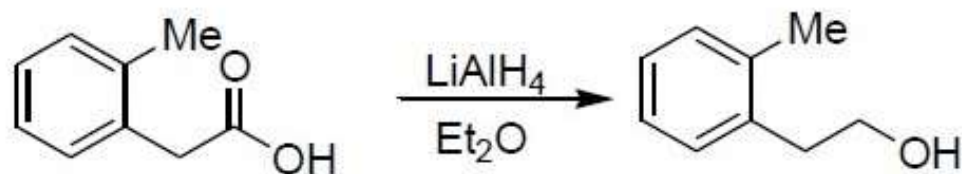
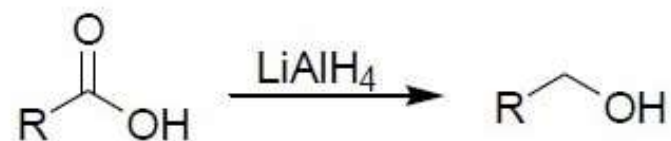
# Reduction of Aldehydes and Ketones



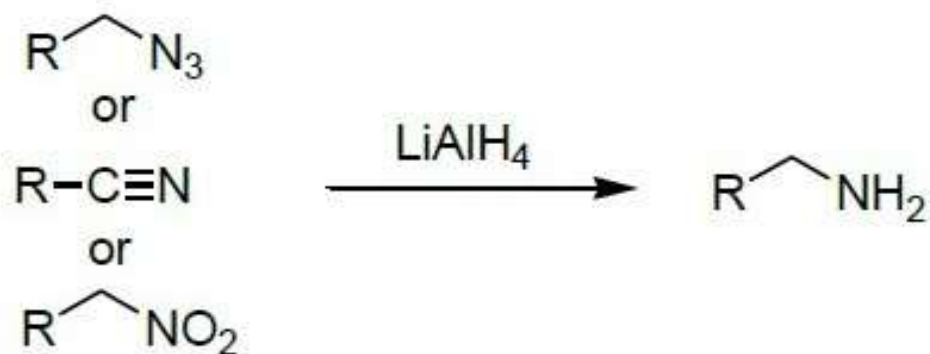
## Mechanism



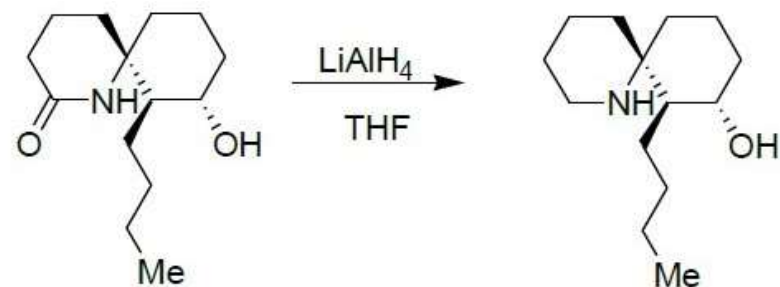
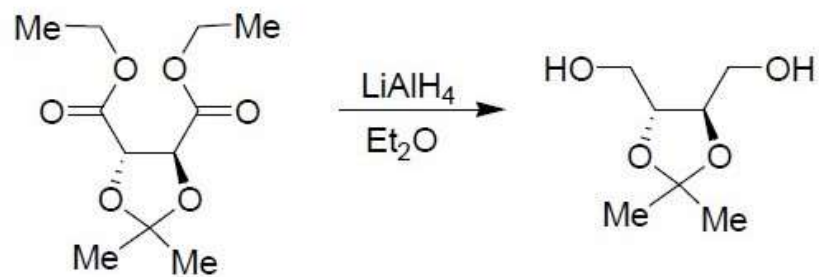
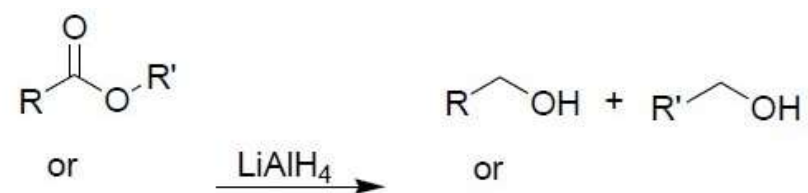
## Reduction of Acids



## Reduction of Azides, Nitriles and Nitro Compounds

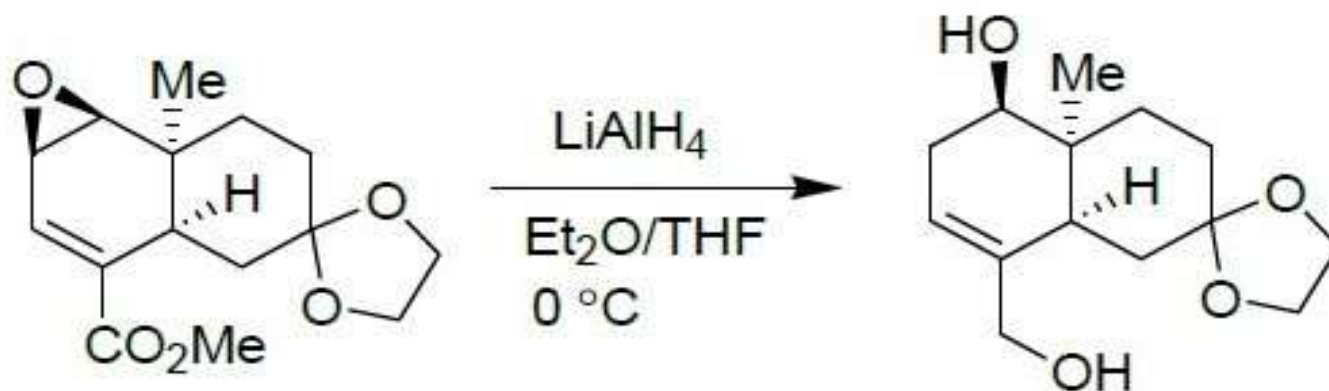
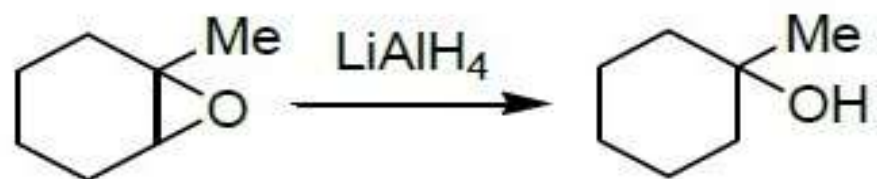


# Reduction of Esters and Amides



# Reduction of Epoxides

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## *Lithium Trialkoxyaluminum Hydride* *[LiAlH(OR)<sub>3</sub>]*

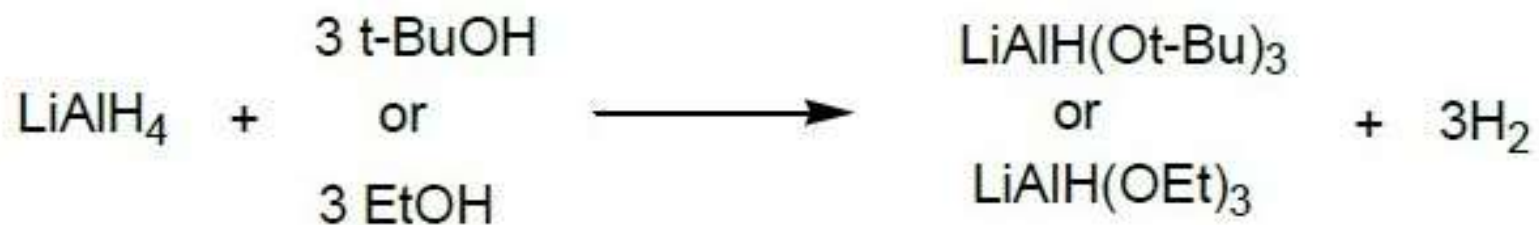
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Though LAH is a powerful reducing agent but is less selective. The reactivity and selectivity can be modified by replacing the three hydride ion with alkoxy groups such as *tert*-butoxy or ethoxy group. The resulting reagents are less reactive but more selective than LAH.

# Preparation

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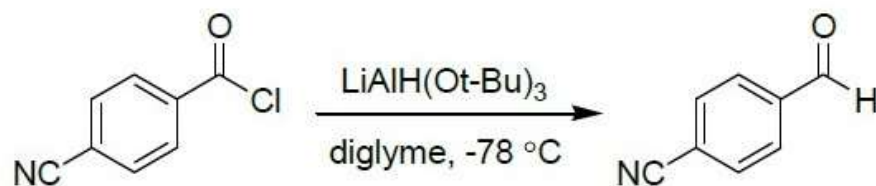
The lithium trialkoxyaluminum hydride can be prepared by treating LAH with the alcohol and better to prepare *in situ* prior to use.



# Lithium tri-*t*-Butoxyaluminum Hydride [LiAlH(Ot-Bu)<sub>3</sub>]

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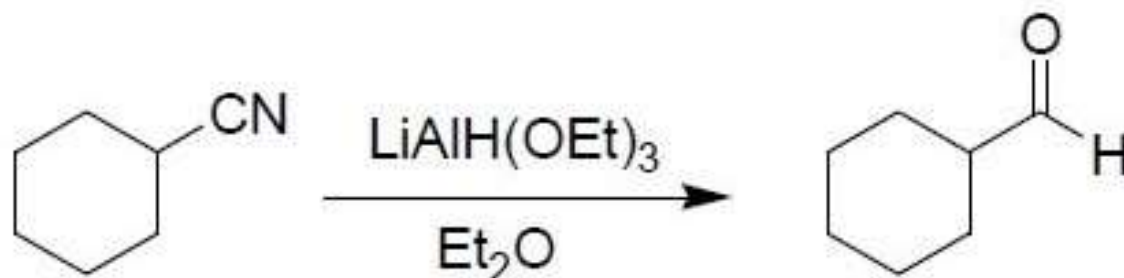
This is less reactive compared to LAH and reduces aldehydes and ketones to alcohols and acid chlorides to aldehydes (Scheme 10). The other functional groups such as acids, amides and nitriles do not react or react very slowly.



# Lithium tri-Ethoxyaluminum Hydride [LiAlH(OEt)<sub>3</sub>]

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Lithium tri-ethoxyaluminum hydride is comparatively stronger reducing agent than lithium tri-*t*-butoxyaluminum hydride (Scheme 11). It can reduce amides and nitriles to the corresponding aldehydes in good yield.

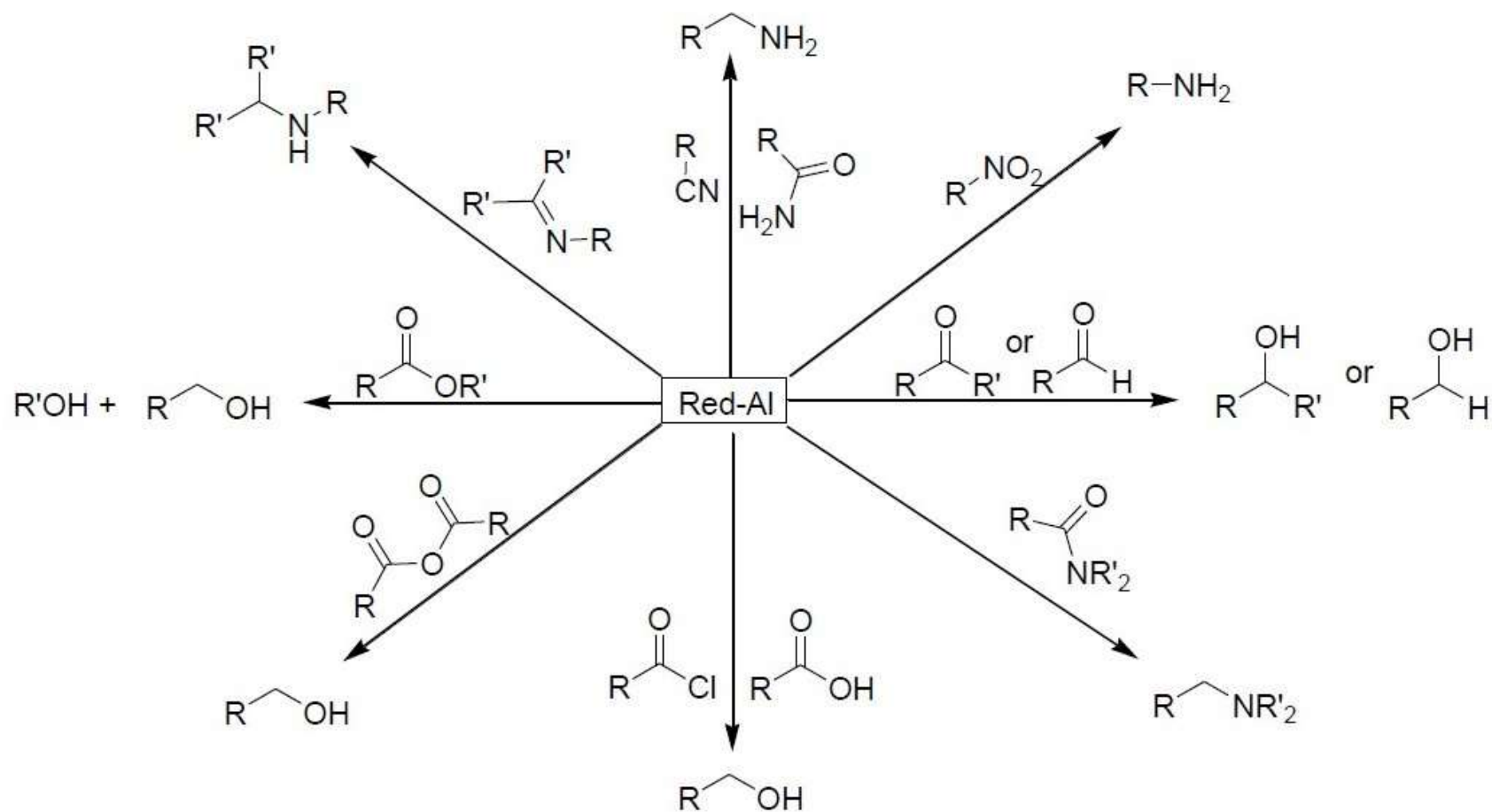


***Sodium bis(2-Methoxyethoxy)aluminum  
Hydride (SMEH)  
[NaAlH<sub>2</sub>(OCH<sub>2</sub>CH<sub>2</sub>OMe)<sub>2</sub>]***

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Sodium *bis*(2-methoxyethoxy)aluminum hydride (SMEAH) is a commercially available reducing agent with trade name Red-Al. It is more selective than LAH and the reduction can be carried out in aromatic hydrocarbons as well as other ethers solvent

# Reactions of SMEH/Red-Al



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Thank You

