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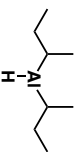
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Joyoshish Saha



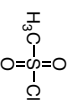
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Acetone	Silver nitrate	Polar aprotic solvent; see "Solvents" page
AgNO ₃	Silver oxide	SN1 reactions
Ag ₂ O		Used in the Tollens reaction
AIBN	Aluminum bromide	Initiator for free radical reactions
AlBr ₃	Aluminum chloride	Catalyst for additions to aromatic rings
AlCl ₃	Borane	Catalyst for additions to aromatic rings
BH ₃		Hydroboration
Br ₂	Bromine	Adds to alkenes, aromatic rings
BsCl	Benzenesulfonyl chloride	Converts alcohols to good leaving groups
CCl ₄	Carbon tetrachloride	Nonpolar solvent; see "Solvents" page
Cl ₂	Chlorine	Adds to alkenes, aromatic rings
CN [⊖]	Cyanide	Good nucleophile
CrO ₃	Chromium Trioxide	Oxidant for alcohols and aldehydes
CuBr	Copper Bromide	Adds Br to aromatic rings; forms organocuprates
CuCN	Copper Cyanide	Adds CN to aromatic rings
CuCl	Copper Chloride	Adds Cl to aromatic rings; forms organocuprates
CuI	Copper Iodide	Forms organocuprates
DCC	Dicyclohexane carbodiimide	Reagent for forming amides from carboxylic acids and amines
DMF	N,N'-dimethylformamide	Polar aprotic solvent (see "Solvents" page)
DMS	Dimethyl sulfide	For reductive workup in ozonolysis
DMSO	Dimethyl sulfoxide	Polar aprotic solvent; see "Solvents" page
Diazomethane	CH ₂ N ₂	Forms methyl esters, used in the Wolff Rearrangement
DIBAL	Diisobutyl aluminum hydride	Bulky reducing agent for esters, nitriles

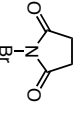


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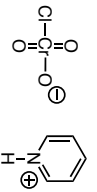

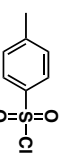
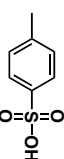
Ether	Diethyl ether	Solvent (see "Solvents" page)
FeBr ₃	Iron (III) Bromide	Catalyst for additions to aromatic rings
Grignard Reagents	R-MgX	Adds carbon groups to ketones, esters, aldehydes...
HBr	Hydrobromic acid	Strong acid, adds to alkenes and alkynes
HCl	Hydrochloric acid	Strong acid, adds to alkenes and alkynes
H ₂ CrO ₄	Chromic acid	Strong oxidant for alcohols
Hg(OAc) ₂	Mercuric Acetate	For oxymercuration of alkenes and alkynes
HI	Hydroiodic acid	Strong acid, adds to alkenes and alkynes
HONO	Nitrous acid	Forms diazonium salts from aromatic amines
HOI ₂	Hydroiodic acid	Oxidant, forms aldehydes/ketones from vicinal diols
H ₂ O ₂	Hydrogen peroxide	Oxidant, for hydroboration and ozonolysis
I ₂	Iodine	Adds to alkenes and alkynes
KMnO ₄	Potassium permanganate	Oxidant for alkenes, alcohols, aldehydes, alkanes
K ₂ Cr ₂ O ₇	Potassium Dichromate	See H ₂ CrO ₄
KCN	Potassium cyanide	See CN
KOtBu	Potassium t-butoxide	Bulky base
LDA	Lithium diisopropyl amide	Strong bulky base
LiAlH ₄	Lithium aluminum hydride	Strong reducing agent for carbonyl compounds
Lindlar's catalyst		Reducing agent for alkynes to give cis-alkenes
LiAl(Ot-Bu) ₃		Bulky reducing agent for acid chlorides to give aldehydes
mCPBA	m-chloroperbenzoic acid	Oxidant, gives epoxides from alkenes
MsCl	Methanesulfonyl chloride	Converts alcohols into good leaving groups



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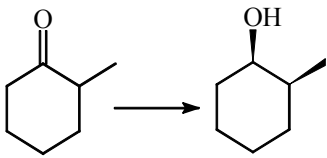
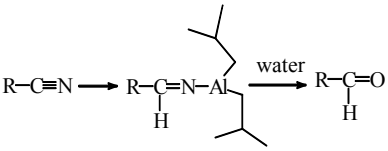
N_3^-	Azide	Good nucleophile
Na	Sodium	Reducing agent for alkynes, aromatic groups
$NaBH_4$	Sodium Borohydride	Reduces aldehydes/ketones to alcohols
NaCN	Sodium cyanide	See CN
$Na_2Cr_2O_7$	Sodium Dichromate	See H_2CrO_4
NaH	Sodium Hydride	Strong base, poor nucleophile
$NaIO_4$	Sodium periodate	Cleaves 1,2-diols to carbonyls
$NaNH_2$	Sodium amide	Strong base
$NaOtBu$	Sodium t-butoxide	See KOtBu
NBS	N-Bromo succinimide 	Source of bromine, used for allylic bromination
NCS	N-chloro succinimide	Source of chlorine, used in alkene addition reactions
NH_2OH	Hydroxylamine	Formation of oximes
NIS	N-iodo succinimide	Sources of iodine, used in alkenes addition reactions
NH_3	Ammonia	Base, occasional solvent
NH_2NH_2	Hydrazine	Good nucleophile, used in the Wolff-Kishner reaction
Ni_2B	Nickel Boride	Reduces alkynes to cis-alkenes
OsO_4	Osmium Tetroxide	Converts alkenes to cis-diols (glycols)
O_3	Ozone	Cleaves double and triple bonds to carbonyl compounds
Organocuprates R_2CuLi		Adds carbon groups to double bonds, alkyl halides
Organolithium reagents $R-Li$		Adds carbon groups to carbonyl compounds
$Pb(OAc)_4$	Lead tetra-acetate	Cleaves 1,2-diols to carbonyl compounds
PBr_3	Phosphorus Tribromide	Converts alcohols/ acids to alkyl / acyl bromides
PCl_3	Phosphorus Trichloride	Converts alcohols/ acids to alkyl / acyl chlorides
P_2O_5	Phosphorus Pentoxide	Converts acids to anhydrides, amides to nitriles
Pt	Platinum	For reduction of double / triple bonds with H_2
Pd/C	Palladium on carbon	For reduction of double / triple bonds with H_2

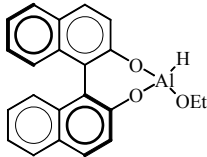
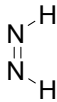
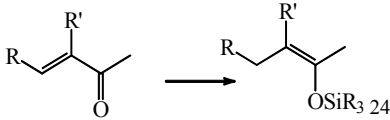
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PCC	Pyridinium chlorochromate 	Oxidizes alcohols to aldehydes/ketones
Ph_3P	Triphenyl phosphine	Used in the Wittig reaction
Pyr	Pyridine 	Weak base
Raney Nickel		Reducing agent, replaces sulfur with H
RO-OR	"Peroxides"	Free radical initiator
SO_3	Sulfur Trioxide	For installation of SO_3H on an aromatic ring
$SOBr_2$	Thionyl bromide	Converts alcohols/acids to alkyl / acyl bromides
$SOCl_2$	Thionyl chloride	Converts alcohols/acids to alkyl/acyl chlorides
Sn	Tin	For reduction of nitro groups to amines
THF	Tetrahydrofuran	Solvent (see "Solvents" page)
TsCl	Tosyl chloride 	Converts alcohols to tosylates (good leaving group)
TsOH	Tosic acid 	Strong acid
Zn	Zinc	Reducing agent, for ozonolysis and nitro groups
$Zn(Hg)$	Zinc amalgam	For Clemmensen reduction, ketones to alkanes
$Zn(Cu)$	Zinc-copper couple	For cyclopropanation reactions with CH_2I_2

Chem 535 Synthetic Organic Chemistry – Common Reducing Agents for the Conversion of Alcoholic, Carboxylic and Nitrogen-Containing Related Functionality **Page - 1 -**

Name/composition	Typical Use and Comments	Scope & Limitations
NaBH ₄ /ROH	ketone and aldehydes alcohols	reactivity decreases with decreasing proton availability, $k_{\text{water}} > k_{\text{MeOH}}$
NaBH ₄ /CH ₃ CN + Cd ⁺² ref ¹	RCOCl aldehydes	aprotic solvent moderate reactivity
Ph ₃ PCuBH ₄ ²	same as above	very mild can be done in the presence of ketones and esters, reagent in active form as an indefinite shelf life
NaBH ₄ /DMF-THF ³	same as above	aprotic solvent moderate reactivity
Zn(BH ₄) ₂ ⁴	ketone and aldehydes alcohols 	nonbasic avoids cleavage of esters, good for enone 1,2 reduction avoids 1,4 reduction
NR ₄ BH ₄ ⁵	Selective reduction of aldehydes over ketones	
NaBH ₃ CN ^{6,7}	RCHO + R'NH ₂ + NaBH ₃ CN RCH ₂ -NHR'	mild, will not attack ketones without H ⁺ (cat)
BH ₃ (for refs see Scope & Limitations column)	Alkene hydroboration	will reduce an amide in the presence of an ester ⁸ and RCO ₂ H in the presence of ester or ketone!! ⁹

$\text{Li}^i\text{sec-Bu}_3\text{BH}^{10}$ $\text{Nasec-Bu}_3\text{BH}$	 <p>α, β-enones enolates 1,4-reduction¹¹</p>	Nicknamed Selectride, “an $\text{S}_{\text{N}}2$ H^+ donor, bulky reagent selects the least hindered approach.
LiEt_3BH	reduces epoxides to alcohols ¹² tosylates to alkanes (alcohol defunctionalization) ¹³	similar chemical reactivity and selectivity as above
LiAlH_4	RCN or RCONR_2 amines halocarbons to alkanes ketones, esters, carboxylic acids, aldehydes, acetals (sometimes) alcohols	“LAH” Highly reactive, hard to control; explodes on heating, grinding, or on exposure to water
$\text{NaAlH}_2(\text{O}(\text{CH}_2)_2\text{OCH}_3)_2$	as above ¹⁴	Nicknamed Red-Al [®] less reactive than above
above reagent + CuBr	1,4-reduction of enones ¹⁵	
$i\text{Bu}_2\text{AlH}^{16}$	ketones to alcohols nitriles to aldehydes  <p>lactones to lactols¹⁷ ester to aldehyde (tricky)¹⁸ enones allylic alcohols 1,2-reduction¹⁹ </p>	DIBAL

	<p>enantioselective reductions of ketones to optically active alcohols. Both enantiomers are available.²⁰</p>	
<p>$\text{Bu}_3\text{SnH}^{21}$</p>	<p>$\text{R-X} \mid \text{R-H heat} + \text{AIBN radical}$ $\text{X}=\text{Br, I, SePh, NO}_2, \text{SH}$</p>	
<p>$\text{Bu}_3\text{SnH}^{22}$</p>	<p>$\text{R-O-COX} \mid \text{RH}$ $\text{X}=\text{OR, SR, NR}_2$</p>	<p>Barton deoxygenation</p>
<p>Diimide²³</p> 	<p>(H-N=N-H) generated by $\text{NaO}_2\text{C-N=N-CO}_2\text{Na}$, RCO_2H, or NH_2NH_2, Cu(II), O_2, or TosNH-NH_2, organic(aq) solvent</p>	<p>selectively reduces electronically symmetrical double bonds, in the presence of amines thioethers, ab-unsat ketones, etc.</p>
<p>$\text{Et}_3\text{SiH}^{24}$ With $\text{RhCl}\cdot\text{P(Ph)}_3$</p>		<p>1,4-reduction of enones to silyl enol ethers</p>

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