Organoboranes Encyclopedia Article

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Organoboranes

Organoboranes are organic compounds of **boron** having one or more alkyl or aryl functional groups attached directly to the boron **atom**. Alkylboranes can be conveniently prepared by the addition of diborane, B_2H_6, to a carbon-carbon double or triple bond:

$6\ RCH{=}CH_2 + B_2H_6\ 2\ (RCH_2CH_2)_3B$

$4\ (CH_3)_2C{=}CHCH_3 + B_2H_6\ 2\ ((CH_3)_2CHC(CH_3H)_2BH$

$2\ (CH_3)_2C{=}C(CH_3)_2 + B_2H_6\ 2\ (CH_3)_2CHC(CH_3)_2BH_2$

Alkylboranes can also be prepared from the reaction of boron halides and metal alkyls, such as alkyllithium compounds or Grignard reagents (RMgX, where R denotes an alkyl chain). Boron halides undergo metathesis (double decomposition) reactions with alkyllithium reagents according to the hard-soft acid-base principle. Boron is a softer acid than **lithium**, and **carbon** in these molecules is a very soft base. Metathesis generates the lithium **halide** and organoborane.

Hydroboration of most alkenes proceeds directly to the trialkylborane; however, it is possible to prepare dialkylboranes, R_2BH, and monoalkylboranes, RBH_2, if there is sufficient steric hindrance about the carbon-carbon double and triple bond. The partially substituted borane derivatives, R_2BH and RBH_2, form dimers with three- centered two-electron bonds between the borons and two bridging **hydrogen** atoms. Most alkylboranes spontaneously ignite in air. Controlled **oxidation**, followed by dissolution in **water**, yields dihydroxy(alkyl)boranes ($RB(OH)_2$). The various aryl derivatives can be prepared from boron halides using the Grignard reaction.

The term *organoborane* is generally reserved for boron-containing compounds that have at least one carbon-boron bond. Boron is trivalent, and two of the chemical bonds can involve non-carbon atoms. Other important organoboranes include: alkoxydialkylboranes (R_2BOR); dialkoxyalkylboranes ($RB(OR)_2$); chlorodialkylboranes (R_2BCl); dichloro(alkyl)borane ($RBCl_2$); hydroxydialkylborane (R_2BOH); and dihydroxy(alkyl)borane. Trialkoxyborane ($B(OR)_3$) is at times listed as an organoborane even though it does not have the boron-carbon bond required by definition. Organoboranes undergo substitution reactions with complete retention of **stereochemistry**. This facilitates the manufacture of stereoisomers of pharmaceutically important organic compounds. Organoboranes are used as synthetic reagents in organic **chemistry** in the preparation of acylic and cylic saturated and unsaturated hydrocarbons, terpenes, **amino acids**, steriods, carbohydrates, and numerous other organic molecules.