

Why magnesium is used in grignard reactions?

[Science](#), [Chemistry](#)



Grignard Reagents were discovered by Victor Grignard in 1900.

They are classically formed by reacting magnesium turnings with alkyl halide in ether or THF solvents, to form solutions of alkylmagnesium halide. The atmosphere must be moisture -free and inert and magnesium must be of high purity. Magnesium is usually covered with a coating of magnesium oxide, so an activation agent like Iodine or Dibromoethane is added.

They can also be formed from by when an organolithium compound reacts with a magnesium halide.

In organic chemistry C-C bond is one of the most important bonds. To make these C-C bonds organometallics such as organolithiums, Grignard reagents and carbonyl compounds are used. Grignard reagents are our first source of carbanions (anions of carbon).

The polarity of a covalent bond between two different elements is determined by electronegativity. The more electronegative an element is, the more it attracts the electron density in the bond. Hence, the greater the difference in electronegativity, the more polarized a bond becomes. In the extreme case of complete polarization, the covalent bond ceases to exist and is replaced by electrostatic attractions between ions of opposite charge.

The reactivity of the carbonyl groups is due to the polarization of the carbon-oxygen bond toward the more electronegative oxygen.

For e. g. – Polarity inside a Formaldehyde molecule.

Thus organometallic reagents act as nucleophiles towards the electrophilic carbonyl group. In organolithium compounds and Grignard reagents, the key bond is polarized in the opposite direction, towards the carbon – making carbon a nucleophilic centre. This is true for most organometallics because, metals like Li, Na, K, Mg, Ca, Al, Cu, Zn etc. all have lower electronegativity than carbon. Also, the alkali metals (Li, Na, K etc.) and the alkaline earth metals (Mg and Ca, together with Zn) are good reducing agents, the former being stronger than the latter. Hence, these can be used to make organometallic reagents with carbon.

The alkyl magnesium halides are called Grignard Reagents after the French chemist, Victor Grignard, who discovered them. The other metals mentioned above react in a similar manner, but the Li & Mg are the most widely used.

These reactions are substitution reactions, but they cannot be classified as nucleophilic substitutions, as in the reactions above. Because the functional carbon atom has been reduced, the polarity of the resulting functional group is inverted (the original electrophilic carbon becomes nucleophilic). This change, shown below, makes alkyl lithium and Grignard reagents unique and useful reactants in synthesis.

Reactions of organolithium and Grignard reagents reflect the nucleophilic character of the functional carbon in these compounds. The nucleophilic carbon of these reagents also bonds readily with electrophiles such as iodine and carbon dioxide (fifth equation). The polarity of the carbon-oxygen double bonds of CO₂ makes the carbon atom electrophilic, shown by the formula in

the shaded box, so the nucleophilic carbon of the Grignard reagent bonds to this site.

Carbon has in consequence an unshared electron pair. Such a carbon would be a very strong base, much stronger than needed to take an H^+ from water to generate the weaker base OH^- . A practical consequence of this is that Grignard reagents must be kept dry, away from even the slightest traces of moisture, lest they be destroyed by reaction with water.

Works Cited

1. Clayden, greeves, Warden and Wothers, " Organic Chemistry", Oxford University press, 2001, ISBN 0-19-850346-6
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