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Study of Chemical Compounds that Contain Chemical Bond between a Carbon Atom of an Organic Molecule and a Metal

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Description

Organometallic chemistry is the study of chemical compounds that contain at least one chemical bond between a carbon atom of an organic molecule and a metal, such as alkali, alkaline earth, or transition metals, and sometimes broadened to include metalloids like silicon, boron, or selenium. In addition to bonds to organic fragments or molecules, bonds to inorganic carbon, such as carbon monoxide (metal carbonyls even though, strictly speaking, they are not necessarily organometallic, discussions of related compounds like transition metal hydrides and metal phosphine complexes frequently include them. Metal-containing compounds with organic ligands but no direct metal-carbon bonds are referred to as metal organic compounds, a term that is related but distinct. Metal β-diketonates, alkoxides, dialkylamides and metal phosphine buildings are agent individuals from this class. Organometallic compounds are widely used both stoichiometrically in research and industrial chemical reactions and as catalysts to increase the rates of such reactions (*e.g.,* in uses of homogeneous catalysis), where target molecules include polymers, pharmaceuticals and many other types of practical products. Organometallic chemistry combines aspects of traditional organic and inorganic chemistry.

Bond between a Metal Atom and a Carbon Atom

Organometallic compounds are distinguished by the prefix organo and include all compounds that have a bond between a metal atom and a carbon atom of an organic group. In addition to the traditional metals (alkali metals, alkali earth metals, transition metals, and post transition metals), lanthanides, actinides, semimetals, and the elements boron, silicon, arsenic and seleni organometallic compounds like tetracarbonyl nickel and ferrocene are examples of transition metal-containing compounds. Organolithium compounds like n-butyllithium (n-BuLi), organozinc compounds like diethylzinc (Et_2Zn), organotin compounds like tributyltin hydride (Bu_3SnH), organoborane compounds like triethylborane (Et_3B), and organoaluminium compounds like trimethylaluminium (Me_3Al) are additional examples of organometallic. Methylcobalamin, a form of Vitamin B12, is a naturally occurring organometallic complex that has a cobalt-methyl bond. Distinction from coordination compounds with organic ligands Many complexes feature coordination bonds between a metal and organic ligands. This complex and other biologically relevant complexes are frequently discussed in the subfield of bio organometallic chemistry. Coordination compounds are complexes in which the metal is bound by the organic ligands through a heteroatom like oxygen or nitrogen. However, the complex is considered organometallic if any of the ligands form a direct Metal-Carbon (M-C) bond. Some chemists use the term metal organic to describe any coordination compound with an organic ligand despite the absence of a direct M-C bond. The status of compounds, such as enolates, in which the canonical anion shares a negative charge with an atom more electronegative than carbon (delocalized) may vary depending on the nature of the anionic moiety, the metal ion, and possibly the medium. These compounds are not considered organometallic because there is no direct structural evidence for a carbon–metal bond. For instance, lithium enolates typically only contain Li-O bonds and are not organometallic. On the other hand, zinc enolates also known as Reformatsky reagents have both Zn-O and Zn-C bonds and are organometallic in nature.

Subfield of Bio Organometallic Chemistry

Structure and properties organometallic compounds typically have a metal-carbon bond that is highly covalent. The carbon ligand of highly electropositive elements, like lithium and sodium, has a carbanionic nature; however, free carbon-based anions are extremely uncommon, like cyanide. The majority of organometallic compounds are solids at room temperature, but there are some that are liquids, like methylcyclopentadienyl manganese tricarbonyl, or even volatile liquids, like nickel tetracarbonyl. Many organometallic compounds are air sensitive (reactive to oxygen and moisture), so they must be handled in an inert atmosphere. Some organometallic compounds, like triethylaluminium, are the stability of organometallic complexes like metal carbonyls and metal hydrides can be predicted using the 18-electron rule. The hapticity of a metal-ligand complex can influence the electron count. Hapticity describes the number of contiguous ligands coordinated to a metal. For instance, ferrocene, has two cyclopentadienyl ligands giving a hapticity of 5, where all five carbon atoms of the C_5H_5 The Greek letter kappa, which binds non-contiguous atoms, is an example of a ligand. Chelating 2-acetate is an example. The three ligand classes X, L and Z are identified by the covalent bond classification method; which are based on the ligand's electron-donating interactions. The 18e rule is not followed by many organometallic compounds. The d electron count and oxidation state of metal atoms in organometallic compounds are frequently used to describe them. Predicting their reactivity and preferred geometry can be made easier with the help of these concepts. The isolobal principle is frequently used to discuss organometallic compounds' chemical bonding and reactivity. The organometallic compounds' structure, composition, and properties can be figured out using a wide range of physical methods. Infrared spectroscopy and nuclear magnetic resonance spectroscopy are also frequently used to obtain information on the structure and bonding of organometallic compounds. Ultraviolet-visible spectroscopy is a common method used to obtain information on the electronic structure of organometallic compounds. X-ray diffraction is a particularly important technique that can locate the positions of atoms within a solid compound and provide a detailed description of it is also used to track the progress of organometallic reactions and their kinetics. Dynamic NMR spectroscopy can be used to study the dynamics of organometallic compounds. Other notable methods include elemental analysis, X-ray absorption spectroscopy, electron paramagnetic resonance spectroscopy, and elemental analysis. Organometallic compounds frequently require air-free handling. Organometallic compounds typically require the use of laboratory equipment like a glove box or Schlenk line for air-free handling.