Learning Objectives

In this lecture you will learn the following

- The hydroformylation reaction and its mechanism.
- The C–C cross-coupling reactions and their mechanisms.

It is truly an exciting time for the field of organometallic chemistry as its potentials in homogeneous catalysis are being realized in an unprecedented manner. The growth in the field organometallic chemistry has been rightly acknowledged by the award of three Nobel prizes in over a decade in the areas of asymmetric hydrogenation (Nyori and Knowles in 2001), olefin metathesis (Grubbs, Schrock and Chauvin in 2006) and palladium mediated C–C cross coupling reactions (Suzuki, Negishi and Heck, 2010). A few representative examples of such landmark discoveries of homogeneous catalysis by organometallic compounds are discussed below.

**Hydroformylation reaction**

Hydroformylation, popularly known as the "oxo" process, is a Co or Rh catalyzed reaction of olefins with CO and H₂ to produce the value-added aldehydes.

The reaction, discovered by Otto Roelen in 1938, soon assumed an enormous proportion both in terms of the scope and scale of its application in the global production of aldehydes. The metal hydride complexes namely, the rhodium based HRh(CO)(PPh₃)₃ and the cobalt based HCo(CO)₄ complexes, catalyzed the hydroformylation reaction as shown below.
Hydroformylation, also known as oxo synthesis or oxo process, is an important homogeneously catalyzed industrial process for the production of aldehydes from alkenes.[1] This chemical reaction entails the addition of a formyl group (CHO) and a hydrogen atom to a carbon-carbon double bond. This process has undergone continuous growth since its invention in 1938: Production capacity reached $6.6 \times 10^6$ tons in 1995. It is important because the resulting aldehydes are easily converted into many secondary products. For example, the resulting aldehydes are hydrogenated to alcohols that are converted to plasticizers or detergents. Hydroformylation is also used in specialty chemicals, relevant to the organic synthesis of fragrances and natural products. The development of hydroformylation, which originated within the German coal-based industry, is considered one of the premier achievements of 20th-century industrial chemistry.

Figure 25.5D.1: Hydroformylation of an Alkene ($R_1^1$ to $R_3^3$ organyl groups (i. e. Alkyl- or Aryl group) or hydrogen).

Contributors and Attributions

- Wikipedia
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