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The Importance of Catalysis and its Classification

Kunming Liu*
Department of Chemistry, Jiangxi University of Science and Technology, Ganzhou, China

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Description

The chemical reaction brought about by a catalyst is called catalysis. Catalyst doesn't undergo any permanent change, but it is a material that increases the rate of a chemical reaction. In 1836 by Berzelius, the term "catalysis" was introduced. There are two classes:

1. Positive catalyst: Positive catalysts increase the rate of the reaction.

2. Negative catalyst: Negative catalyst decreases the rate of the reaction.

In activation energy for a chemical reaction to take place requires a certain minimum amount of energy. If a substance can lower this activation energy without itself being modified or consumed during the reaction, it is called a catalyst or catalytic agent. Catalysis is defined as the action of a catalyst. By providing an alternative pathway for the reaction to occur the catalyst reduces the activation energy.

Importance

- It makes a reaction possible under achievable conditions.
- Reduce the necessity of dangerous conditions.
- Generate high yields and high product purity.
- Reduce the amount of side-product and waste created generates non-racemic mixtures of enantiomers.
- Make a chemical process "greener".

Classification of catalysts

Whereas the classification is based on its physical state: Catalyst can be gas, liquid and solid.

Classification based on the substances from which a catalyst is made: whether by Inorganic (gases, metals, metal oxides, inorganic acids, bases, etc.) or Organic (organic acids, enzymes, etc.)

Classification based on the mechanism of the catalysts: This includes homogeneous and heterogeneous catalysis.

In homogeneous catalysis, the reactants, products, and catalysts are all in the same phase. Often the products, catalysts, and reactants are all dissolved in the same solvent. The solvent is frequently water due to environmental considerations. With the other reactant, this is then reduced back to the original form by the reaction. Homogeneous catalysts have advantages over heterogeneous catalysts such as controlled and tunable reaction sites, the possibility of carrying out the reaction at milder conditions, higher activity, ease of spectroscopic monitoring, and selectivity. Generally the homogeneous catalysis reaction occurs in the liquid phase or gas phase. This catalyst is typically involved in the chemical reaction, from the products of the reaction the catalyst cannot be easily separated. The homogeneous rate of reaction does not depend on the surface area of the catalyst.

Heterogeneous catalysts are chemical catalysts whose physical phase is different from the physical phase of the reactants and/or products that take part in the catalysed chemical reaction. In order to facilitate the chemical reaction between two gaseous reactants, solid-phase heterogeneous catalysts are employed. In such cases, the catalysis reaction takes place over the following three steps mentioned below:

- On the surface of the solid heterogeneous catalyst, the adsorption of the gaseous reactants takes place.
- The chemical reaction between the adsorbed reactants, resulting in the formation of the product.
- Desorption of the product compound from the surface of the catalyst, resulting in the regeneration of the active catalytic surface.

A heterogeneous catalyst plays a major role because on a relatively large scale they enable the production of several commercially important products. For example, oxides of iron placed on alumina (a chemical compound with the formula Al2O3) are widely used as heterogeneous catalysts in the Haber process for the industrial production of ammonia.

Contact: Liu K, E-mail: 8678569@qq.com