

Catalyst Synthesis And Their Application

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Abstract

Introduction

The term *catalysis*, proposed in 1835 by Jöns Jakob Berzelius (1779-1848), which comes from the Greek words *kata* meaning down and *lyein* meaning loosen,

Catalysts are defined as those substances which increase or decrease the [rate of reaction](#). Most of the catalyst can be added to a reaction to increase the reaction rate without getting consumed in the process. It is also used to speed up or increase the rate of the reaction. Catalysts encourage molecules to react and make the reaction process easier and efficient.

Catalysts usually work by

1. Lowering the energy of the transition state, thus lowering the activation energy, and/or
2. Changing the mechanism of the reaction. They also change the nature and energy level of the reaction in transition state.

Characteristic Of Catalysts

1. A catalyst does not initiate a chemical reaction.
2. A catalyst does not be consumed in the reaction.
3. Catalysts tend to react with reactants to form intermediates and at the same time facilitate the production of the final reaction product.

A catalyst are of three types- solid, liquid or gaseous catalysts. Some of the solid catalysts include metals or their oxides, for example –sulphides, and halides. Semi-metallic elements such as boron, aluminum, and silicon are also used as catalysts.

Types Of Catalysts

Catalysts are primarily categorized into four types. They are

1. Homogeneous,
2. Heterogeneous ,and
3. Biocatalysts

Homogeneous Catalyst

In homogeneous catalysis, reaction mixture and catalyst both are present in the same phase. Both catalyst and reactants show high homogeneity which results in high interaction between them that leads to high reactivity and selectivity of the reaction under mild reaction conditions. Chemical processes that occur through homogeneous catalysis are carbonylation, oxidation, hydrocyanation, metathesis, and hydrogenation.

Heterogeneous Catalyst

In heterogeneous catalysis, catalysts exist in a different phase than the reaction mixture. Heterogeneous catalysts dominate major industrial processes because of the easy separation of product and recovery of catalyst. Heterogeneous catalysts may be used as fine particles, powders, granules. Heterogeneous catalysts may be deposited on the solid support (supported catalysts), or used in bulk form (unsupported catalysts).

Supported catalyst play a pivotal role in the industrial revolution., solid supports considered to have high chemical, mechanical and thermal stability. Generally used organic solid supports can be polymers e.g. polystyrene, copolymers e.g. styrene-di vinyl benzene and inorganic supports such as silica, zeolites, alumina, activated carbon, titanium dioxide.

Unsupported catalysts occupy the large section of industrial catalysis. This includes metals, metals alloys, metal oxides, metal sulphides, zeolites etc.

Biocatalysts

Enzymes are proteins that accelerate biochemical reactions by lowering the activation energy of reactions. Enzymes are a special class of biocatalyst that can accelerate biochemical reactions.

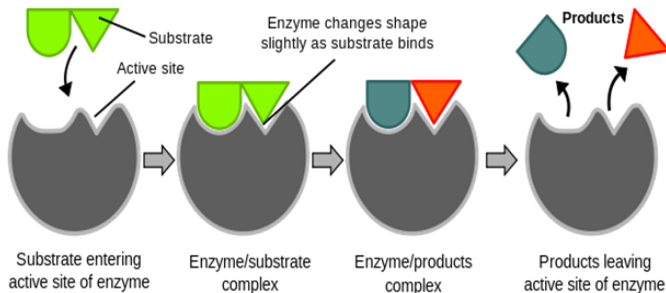
1. Enzymes are proteins that bind reactants, or substrates, in regions called active sites.

2. Upon binding, conformational changes in enzymes result in stabilization of the transition state complex, lowering the activation energy of a reaction

Enzyme: A globular protein that catalyzes a bio- chemical reaction.

Substrate: The reactant involved in a biochemical reaction catalyzed by an enzyme.

Active site: The site within an enzyme where the substrate binds.



Application Of Catalysts

In the recent years, specific development and advancement have been made in the field of chemical catalysis. there are some application of catalysts-

Hydrogenation is a chemical process widely used in industrial applications, from food products, such as margarine, to petrochemical industry and pharmaceutical industry. The process classically involves the use of heavy metals, such as palladium or platinum, to catalyze the reaction.

Methanol Production is an important industry and methanol is one of the largest used carbonylation products.

The most important reaction based on methanol is the decomposition of methanol to yield carbon monoxide and hydrogen. Methanol is also an important raw material for production of CO and H₂ that can be used in generation of fuel. Increasing demand of non-renewable natural resources, clean air, chemicals and pharmaceuticals, catalysts will remain at the forefront of chemical research and development.

Catalysts have enabled us to synthesize complex molecules in fewer steps, and also have been successfully utilized in refineries to produce low Sulphur fuel.

Catalysts have also been applicable in the reduction in emission of CO, NO, and unburned hydrocarbons from the vehicles that operate on the combustion of petrol, diesel and jet fuel.

Scientists and Chemists focus on the designing of catalysts with high selectivity, reactivity, stability, low catalyst loading with a high turnover number.

Recent developments in nano technology develop new opportunities for structure and synthesis of nano structured catalysts with high surface area and exposed active sites, which leads to high catalytic activity.

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