Opinion Article

Different Catalytic Technologies of a Chemical Reactions

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DESCRIPTION

Not the reactants or the products of the reaction, but the catalyst is frequently the most expensive part of a chemical reaction. Along with the benefits from an economic perspective, the catalyst's recovery and repurposing are crucial for reducing waste and making the process more environmentally friendly. Homogeneous catalysis is currently changing into heterogeneous catalysis, a trend that will likely increase soon. One common method for recovering and reusing a successful homogeneous catalyst starts with immobilising a suitable catalytic derivative on an insoluble solid substrate. The ultimate immobilisation approach is covalent attachment when the catalyst does not deactivate and is sufficiently stable under the reaction circumstances. The focus of this contribution is on providing an overview of the most significant categories of covalently anchored catalysts, such as Brönsted and Lewis acids, covalently anchored bases, and hydrogenation complexes, after introducing some general principles describing the fundamentals of the covalent anchoring [1].

Around 20% of the global GNP is produced by catalytic technologies, which are essential to the economic expansion and growth of the chemicals industry. Environmental pollution control is a significant emerging and difficult field of heterogeneous catalysis, with tighter regulations on the release of waste and hazardous pollutants having important repercussions for the chemical sector. While homogeneously catalysed liquid-phase reactions are frequently utilised by producers of fine and specialty chemicals, heterogeneously catalysed procedures are frequently used in the petrochemical sector. The environmental effects of inorganic waste and poisonous byproducts produced during the reaction were not taken into consideration when many of these techniques were being developed at the turn of the century [2].

Inorganic or mineral acids are used in a vast array of liquid-phase industrial processes. While many of these reactions are catalytic, some call for stoichiometric concentrations of acid (such as acylation using $AlCl_3$). When the product is finally isolated, water quenching and neutralization processes are required to

remove the acid. This produces vast amounts of hazardous waste, and the cost of disposing of this waste frequently exceeds the value of the product. The industry is moving toward the adoption of innovative "clean technology," such as the use of alternative heterogeneously catalysed processes, as a result of stricter regulations on the emission of dangerous pollutants. When compared to their homogeneous counterparts, heterogeneous catalysts have a number of inherent advantages, including the simplicity of product separation and catalyst reuse, the bifunctional phenomenon of reactant activation/spillover between support and active phases, and process advantages due to reactor operation in continuous flow rather than batch configuration. However, a viable heterogeneous system must also have activities and selectivities that are equivalent to or superior to those of the existing homogeneous route in order to preserve economic sustainability [3].

According to the number of papers in the last ten years, research toward this objective has examined metal-organic frameworks (MOFs), which have since emerged as the most prevalent supports used in heterogeneous catalysis. Metal cations (or clusters of metal cations) are used to create a class of porous materials known as MOFs. These metal cations are connected to one another by bridging organic linkers. They have remarkable tunability and record-breaking porosity, making it possible to molecularly engineer them to perform a specific function. MOFs can be altered utilising the entire toolkit of organic synthesis, and their pores can be embellished with catalytic sites, in contrast to their inorganic relatives (zeolites, aluminophosphates), whose structures are fixed and immutable. In addition, MOFs are typically crystalline [4].

As a result, we can examine the distribution of active sites within the framework and assess how the framework affects catalytic activity. As opposed to MOFs, siliceous mesoporous materials have amorphous walls, making it impossible to study them using crystallographic methods. Additionally, they frequently have pores larger than 100, which makes it challenging to regulate visitor occupancy. As they exhibit a well-balanced ratio of porosity, crystallinity, and tunability, MOFs have the potential to connect meso and microporous materials. The commercial use

of such materials in heterogeneous catalysis has a lot of potential [5].

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