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Commentary

Oxidation Reactions in Mixture Metal Catalysts

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DESCRIPTION

Oxidation reactions are at the heart of chemical synthesis. The indiscriminate use of harsh and corrosive chemicals in this endeavour, on the other hand, endangers ecosystems, public health, and terrestrial, aquatic, and aerial flora and fauna. Heterogeneous catalysts with various supports are gaining attention due to their exceptional ability to accelerate the rate of chemical reactions at a low cost. They also reduce the use of chemicals in industries, making them environmentally friendly and green. However, heterogeneous oxidation catalysis is not covered in depth in the literature. In this brief analysis, we illustrated the current state of catalytic oxidation reactions in the chemical industry, with a focus on heterogeneous catalysts. We have discussed both the synthesis and applications of important oxidation reactions.

Heterogeneous metal catalysts in oxidation reactions

Over the last few decades, scientists have focused heavily on heterogeneous catalysts in order to overcome the limitations of their homogeneous counterparts in order to increase product yields while minimising side reactions. We presented a summary of selected oxidation reactions catalysed by supported metal catalysts in this paper.

Conversion of glucose to gluconic acid: Because of its water-soluble cleansing properties and application in food additives and beverage bottle detergents, the aerobic oxidation of glucose to gluconic acid has recently received a lot of attention. Previously, glucose oxidation was carried out biochemical pathways, which are time-consuming, multi-step processes that are not recyclable and are costly. The development of a catalytic route is most likely an alternative pathway for large-scale gluconic acid production from glucose. Researchers used to dope Pt or Pd onto heavy metals like bismuth in the 1970s. However, without any supporting materials, this procedure had several limitations, including instability, poor selectivity, and a low conversion rate. Bismuth on palladium or Pt/Pd on carbon supports, on the other hand, demonstrated high selectivity and stability.

Oxidation of alcohol: The oxidation of alcohols to their respective aldehydes or ketones is an important reaction in organic synthesis. Acetone, in particular, is widely used in the production of various organic and fine chemicals. Traditional chemical routes use expensive and hazardous stoichiometric chemicals such as chromium (VI) reagents, dimethyl sulfoxide, permanganates, periodates, or N-chlorosuccinimide. Several homogeneous catalysts, including Pd, Cu, and Ru, have been discovered to selectively catalyse alcohol oxidation. However, homogeneous catalysis necessitates the use of high pressure oxygen and/or an organic solvent, which adds to the cost and environmental burden. The current state of the environment has compelled researchers to seek out novel and environmentally friendly catalytic schemes for the oxidation of alcohol. Prati and Porta demonstrated that an Au/C catalyst has a higher selectivity toward aldehyde during the oxidation of primary alcohols.

Chaki et al. investigated gold's catalytic activity by incorporating silver (5–30% Ag concentration) into gold particles for aerobic alcohol oxidation. It was discovered that a concentration of 10% Ag increases the catalytic activity of Au. Gold nanoparticles (AuNP) are very active in alcohol oxidation when hydrogen peroxide is used as an oxidant, according to Kidwai and Bhardwaj. They discovered that AuNPs with a larger surface area have stronger catalytic activity than those with a smaller surface area. Furthermore, gold catalysed reactions are free of chemical dangers and hazardous solvents, and the sole byproduct is water. This methodology made a significant contribution to the advancement of green chemistry that is both sustainable and environmentally friendly.

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