Article type: Rapid Communication

Home Page URL: https://www.alliedacademies.org/journal-pharmaceutical-chemistry-chemical-science/

Role of surface chemistry in catalysis: Fundamentals and industrial perspectives.

Chen Andersen*

Department of Chemical Engineering, Southeast University of Technology, China

***Correspondence to:** Chen Andersen, Department of Chemical Engineering, Southeast University of Technology, China. E-mail: chen.a@southeastuni.cn
Received: 1-March-2025, Manuscript No. aapccs-25-168725; **Editor assigned:** 4-March-2025, PreQC No. aapccs-25-168725 (PQ); **Reviewed:** 17-March-2025, QC No. aapccs-25-168725; **Revised:** 24-March-2025, Manuscript No. aapccs-25-168725 (R); **Published:** 31-March-2025, DOI: 10.35841/ aapccs - 9.1.179

Introduction

Catalysis is a cornerstone of modern chemical manufacturing, enabling the transformation of raw materials into valuable products with high efficiency. At the heart of catalysis lies surface chemistry, which governs how molecules interact with catalyst surfaces. By studying these surface interactions, chemists can fine-tune catalytic activity, selectivity, and stability—parameters that directly influence both laboratory-scale reactions and large-scale industrial processes [1].

Surface chemistry involves the study of chemical phenomena that occur at interfaces, particularly solid-gas or solid-liquid interfaces. In heterogeneous catalysis, where the catalyst and reactants exist in different phases, the surface of the catalyst serves as the reaction site. Key processes include adsorption of reactants onto the surface, surface diffusion, reaction at active sites, and desorption of products. These steps are influenced by surface structure, composition, and electronic properties [2].

Two primary types of adsorption—physisorption and chemisorption—play distinct roles in catalysis. Physisorption involves weak van der Waals forces and is often reversible, whereas chemisorption involves stronger covalent or ionic bonds and is more specific to particular reactants. Chemisorption is critical for catalytic activity, as it often activates the reactant molecules by weakening internal bonds and facilitating reaction pathways [3].

Not all surface atoms are equally reactive. Defects, edges, corners, and specific crystallographic planes often serve as active sites where reactions occur. These sites provide favorable geometries and electronic environments for bond formation and cleavage. Understanding the distribution and nature of active sites allows chemists to enhance catalytic efficiency and tailor catalysts for specific reactions [4].

Advances in analytical techniques have significantly improved our understanding of catalyst surfaces. Methods such as X-ray photoelectron spectroscopy (XPS), scanning tunneling microscopy (STM), and temperature-programmed desorption (TPD) provide insights into surface composition, morphology, and adsorption behavior. These tools are essential for developing structure-activity relationships and designing next-generation catalysts [5].

Conclusion

Surface chemistry forms the foundation of catalytic science, influencing how catalysts are designed, optimized, and applied across industries. By decoding surface interactions and tailoring active sites, scientists can develop more efficient, sustainable, and economically viable catalytic systems. As global demand for greener processes increases, the role of surface chemistry in catalysis will remain central to industrial innovation and environmental stewardship [1].

References

1. Wu H, Lima WF, Zhang H et al. Determination of the role of the human RNase H1 in the pharmacology of DNA-like antisense drugs. J Biol Chem. 2004;279(17):17181-17189.
2. Dominski Z, Kole R. Restoration of correct splicing in thalassemic Pre-MRNA

Citation: Andersen C. Role of surface chemistry in catalysis: Fundamentals and industrial perspectives. J Pharm Chem Sci. 2025;9(1):179.

by antisense oligonucleotides. Proc Natl Acad Sci USA. 1993;90:8673-8677.
3. Aartsma-Rus A, Straub V, Hemmings R et al. Development of exon skipping therapies for duchenne muscular dystrophy: A critical review and a perspective on the outstanding Issues. Nucleic Acid Ther. 2017;27:251-259.
4. Elbashir SM, Harborth J, Lendeckel W et al. Duplexes of 21-Nucleotide RNA's mediate RNA interference in cultured mammalian cells. Nature. 2001;411:494-498.
5. Marchese A, Paing MM, Temple BRS et al. G Protein–Coupled receptor sorting to Endosomes and Lysosomes. Annu Rev Pharmacol. Toxicol. 2008; 48:601-629.

Citation: Andersen C. Role of surface chemistry in catalysis: Fundamentals and industrial perspectives. J Pharm Chem Sci. 2025;9(1):179.