Particle Generators for Heterogeneous Catalysts

Heterogeneous catalysts are revolutionizing how we approach chemical reactions, playing a pivotal role in various industrial processes. At Nikalyte, we recognize their immense importance and strive to advance their development and application.

Understanding Heterogeneous Catalysts

Heterogeneous catalysis occurs when the phase of catalysts differs from that of reactants or products, typically involving solid-phase catalysts and gas-phase reactants. This process contrasts with homogeneous catalysis, where reactants, products, and catalysts exist in the same phase. In heterogeneous catalysis, molecular adsorption, reaction, and desorption cycles occur at the catalyst surface, influenced by thermodynamics, mass transfer, and heat transfer.

The importance of heterogeneous catalysts cannot be overstated. They enable faster, large-scale production and selective product formation, significantly impacting global economies. About 35% of the world's GDP is influenced by catalysis, with the production of 90% of chemicals (by volume) assisted by solid catalysts1. For example, the chemical and energy industries rely heavily on these catalysts for processes like the Haber-Bosch process in ammonia synthesis.

Challenges and Opportunities in Heterogeneous Catalysis

Expanding on the challenges and opportunities in the field of heterogeneous catalysis, particularly in the context of single-cluster catalysts (SCCs), reveals a landscape marked by both complexities and potential breakthroughs.

SCCs, characterized by atomically precise and isolated metal clusters, offer a broad spectrum of structural diversity. This diversity enables the engineering of catalysts with novel properties, opening doors to new chemical reactions. However, there are significant challenges in fully harnessing these capabilities. Synthetic and analytical hurdles often impede a comprehensive understanding of surface chemistry under realistic conditions. The intricate nature of the catalyst environment in SCCs demands robust metal-support interactions, precise control over the ligand sphere, and a nuanced understanding of the reaction media and dynamic behavior of the catalysts.

Addressing these challenges involves tailoring the entire catalytic ensemble in SCCs for stable and selective performance, especially with practically relevant metal coverages. Successfully navigating these complexities improves current applications and expands the scope of these catalysts from model reactions to more complex and technically relevant ones. This evolution underscores the critical need for innovative approaches in SCC design, suggesting a future ripe with opportunities for groundbreaking developments in heterogeneous catalysis.

Nikalyte's Contribution to Heterogeneous Catalysts

At Nikalyte, we specialize in providing state-of-the-art nanoparticle deposition equipment essential for developing heterogeneous catalysts. With over 20 years of experience, we offer

a range of equipment tailored to various applications, including benchtop recipe-controlled deposition and ultra-high vacuum (UHV) equipment. Our systems create ultra-pure, non-agglomerated nanoparticles under vacuum, free from hydrocarbons and other contaminants.

Our NL50 system, for instance, deposits monodisperse nanoparticles, non-clumping, ultra-pure, crystalline, and hydrocarbon and ligand-free. These properties are crucial for boosting performance and sensitivity in applications like catalysis, reducing the required loading of expensive materials.

Why Choose Nikalyte?

Selecting Nikalyte for your nanoparticle deposition needs ensures you're equipped with the best tools to tackle the complexities of heterogeneous catalysis. Our equipment is designed to address the current challenges in the field, providing precise control over nanoparticle properties, essential for developing effective and efficient catalysts.

Your Next Steps

As we continue to innovate and support advancements in heterogeneous catalysis, we invite researchers, engineers, and industry professionals to explore the potential of our nanoparticle deposition systems. Whether you're an experienced user or just starting, Nikalyte has the solution to meet your needs. Discover how our technology can enhance your work in heterogeneous catalysis and drive your research and industrial applications forward.

Visit us at Nikalyte to learn more about our products and services and how we can assist you in navigating the fascinating world of heterogeneous catalysts.

References

Ma, Z., & Zaera, F. (2006). Heterogeneous catalysis by metals. In R. B. King, R. H. Crabtree, C. M. Lukehart, & D. A. Atwood (Eds.), *Encyclopedia of inorganic chemistry*. John Wiley & Sons, Ltd. https://doi.org/10.1002/0470862106.ia084