

Development of Nanoparticle-Enhanced Membranes for CO₂ Capture in Diesel Vehicle

Exhaust Systems

The transportation sector is a major contributor to air pollution and greenhouse gas emissions, with diesel vehicles emitting significant amounts of carbon dioxide (CO₂), particulate matter (PM), and nitrogen oxides (NO_x). While diesel engines are valued for their efficiency and durability, their emissions exacerbate climate change and pose health risks. Addressing these issues requires innovative solutions that enhance exhaust treatment without compromising vehicle performance. Nanotechnology offers a promising strategy for emission reduction, particularly through nanoparticle-enhanced membranes for CO₂ capture. These membranes incorporate metal-organic frameworks (MOFs), carbon-based nanomaterials, and metal oxides such as titanium dioxide and cerium oxide, known for their high surface area and adsorption capacity. By selectively capturing CO₂ while allowing other gases to pass, these membranes effectively mitigate greenhouse gas emissions from diesel vehicles. Integrating them into exhaust systems enables CO₂ removal before atmospheric release.

This proposal aims to develop and optimize nanoparticle-infused membranes for enhanced CO₂ capture and seamless integration into vehicle exhaust systems. Research will focus on material selection, membrane fabrication, and performance evaluation in real-world conditions. Laboratory experiments and prototyping will assess their efficacy, while computational simulations will optimize design and functionality. Environmental impact assessments and lifecycle analyses will evaluate the sustainability of this technology. The anticipated outcomes include a measurable reduction in vehicular CO₂ emissions, broader adoption of nanoparticle-based emission control technologies, and progress toward sustainable transportation. By leveraging nanotechnology for CO₂ adsorption, this approach offers a viable solution to mitigate climate change while maintaining vehicle efficiency and performance.