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Investigating Gas Adsorption and Diffusion Dynamics in Zeolite-Based Membranes for Post-Combustion CO_2 Capture

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Abstract
One of the most important technologies for reducing greenhouse gas emissions is carbon capture and storage (CCS). CO2 is the main gas responsible for global warming. Post-combustion carbon capture is a popular method of carbon capture that is used in power plants and industrial processes to extract CO_2 from flue gases that are created during the combustion of fossil fuels. Conventional techniques, including chemical absorption using solvents like amines, are limited in their large-scale application due to issues with high energy consumption, solvent degradation, and high operating expenses. In order to get over these restrictions, this study investigates the use of zeolite-based membranes as a CO2 capture substitute, with an emphasis on enhancing the post-combustion capture process's effectiveness and financial sustainability.
Given their high surface area, adjustable pore sizes, and superior adsorption capabilities, zeolite-based membranes present a viable option that allows selective CO2 separation via molecular sieving and chemical interactions. The project intends to maximize selectivity and capture efficiency while reducing the energy penalty related to regeneration by integrating these membranes into the CO2 capture process. The process's economic viability is further enhanced by the membranes' capacity to regenerate themselves through changes in pressure or temperature, which guarantees their reuse without causing a large amount of material loss. This strategy increases the effectiveness of CO2 capture while simultaneously adhering to the principles of the circular economy by allowing the captured CO2 to be used in a variety of industrial processes, like enhanced oil recovery or the creation of synthetic fuel. The results of this study will address significant inefficiencies in the current approaches and progress efforts to reduce CO2 emissions by assisting in the development of more affordable and sustainable CCS systems.
Key words: post combustion, carbon capture, zeolite based membranes

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