

Challenges in Developing Materials for Large-Scale Energy Applications



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Abstract: Acid gases are pervasive in applications that span the oil and gas industry, the general chemicals industry, and the energy sector more broadly. Whether the target is natural gas upgrading, clean gas for solid oxide fuel cells, or flue gas treatment, advances in materials and methods for efficient and cost-effective removal of acid gases require a deep understanding of how materials adsorb, react, and behave in complex mixtures. Achieving this understanding necessitates the evaluation of sorbents, membranes, and catalysts in realistic, multicomponent mixtures. Unfortunately, academic research almost exclusively focuses on testing materials in highly idealized process streams, typically ignoring any potential contaminants. Multicomponent adsorption data are difficult to obtain, even for simple gas mixtures, but the inclusion of toxic gases such as H₂S and SO₂ adds several levels of complexity and difficulty to these types of measurements. Nevertheless, many future large-scale innovations in energy-intensive industries will require development or implementation of new materials that must operate under complex conditions. This presentation will discuss several challenges and “showstoppers” in developing novel materials for separations, with a particular focus on the impact of acid gases on adsorption separations.