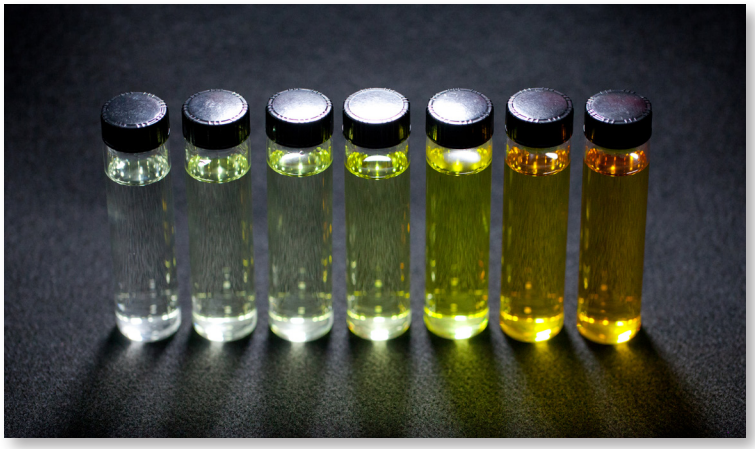
Carbon Capture with Ionic Liquid Sorbents

Opportunity

Research is active on technologies for application of ionic liquids to carbon capture or other separation processes in energy systems. Two related inventions: (1) "Triazolium-based Ionic liquids as CO_2 Capture Solvents and Membranes" and (2) "Fabrication of Fiber Supported Ionic liquids and Methods of Use" are available for licensing and/or further collaborative research from the U.S. Department of Energy's National Energy Technology Laboratory (NETL).

Overview

Fossil fuels will be used to provide clean, affordable energy well into the 21st century, but there are concerns about impacts of greenhouse gases (GHGs), particularly carbon dioxide (CO_2) from fossil fuels. Capture of carbon from fossil fuel plants can produce CO_2 in a concentrated stream that is amenable to geological storage. Carbon capture can be applied after fossil fuels are burned for electric power production (post-combustion capture), or in gasification plants (pre-combustion capture), where coal is converted into a clean low-carbon fuel gas that is burned in a gas turbine. Currently available carbon capture processes significantly reduce efficiency and increase electricity cost, but more efficient and economical processes for CO_2 capture are needed for these applications. Ionic liquids (IL), organic salts that are commonly liquid at room temperature, are promising materials for CO_2 capture. However, better methods are needed to produce effective IL materials; specifically, to incorporate them into practical sorbent materials or processes and to reduce costs and improve performance.



Significance

- These materials and methods promise to improve efficiency and economics of the carbon capture process in gasification-based or flue gas systems because of the wide range of compositions available and improved performance of the process relative to existing technologies.
- The materials can be used as solvents or sorbents and in membrane applications.

Applications

- Capture of carbon using absorption of CO_2 from integrated gasification combined cycle fuel gas (pre-combustion capture), or from flue gas and crude natural gas.
- Potential applications in other areas such as separation of chemical species from mixtures, battery electrolytes, solvents, coatings, lubricants, and biological systems

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One of these inventions (1) addresses a novel class of ILs that offers promising properties for use in CO_2 capture processes, as well as methods to use in applying the IL to gas separation. The invention guides synthesis of a class of IL compounds based on the triazolium chemical structure (compounds containing 3 nitrogen atoms in a 5-membered ring with 2 carbon atoms). Some of the compounds show increased CO_2 solubility and thermal stability, facilitating their use for CO_2 capture at high temperatures for high efficiency. The other invention (2) addresses a novel method to produce a fiber sorbent material comprised of a porous polymer network and an immobilized IL supported within the pores of the polymer network. These novel fiber materials may be designed for separation of chemical species such as carbon dioxide by inclusion of an IL that preferentially adsorbs the chemical species of interest. The novel fiber production method reduces fabrication steps, provides more rapid fabrication, prevents loss of the ionic liquid and provides a high surface-to-volume ratio to enhance adsorption performance and reduce cost in either cyclic sorption/desorption cycles or in a membrane configuration.

Patent Details

U.S. Non-provisional Patent Application No. 13/223,465, filed on September 1, 2011, titled "1,2,3 - Triazolium Ionic Liquids." Inventors: David R. Luebke, Hunaid Nulwala, and Chau Tang.

U.S. Non-provisional Patent Application No. 13/223,488, filed on September 1, 2011, titled "Method of Purifying a Gas Stream Using 1,2,3 - Triazolium Ionic Liquids." Inventors: David R. Luebke, Hunaid Nulwala, and Chau Tang.

U.S. patent 8,383,026, issued 2/26/2013, titled "Fabrication of Fiber Support Ionic Liquids and Methods of Use." Inventors: David R. Luebke and Shan Wickramanayake.

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