PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Carbon Sequestration

08/2007

METAL MONOLITHIC AMINE-GRAFTED ZEOLITES FOR CO_2 CAPTURE

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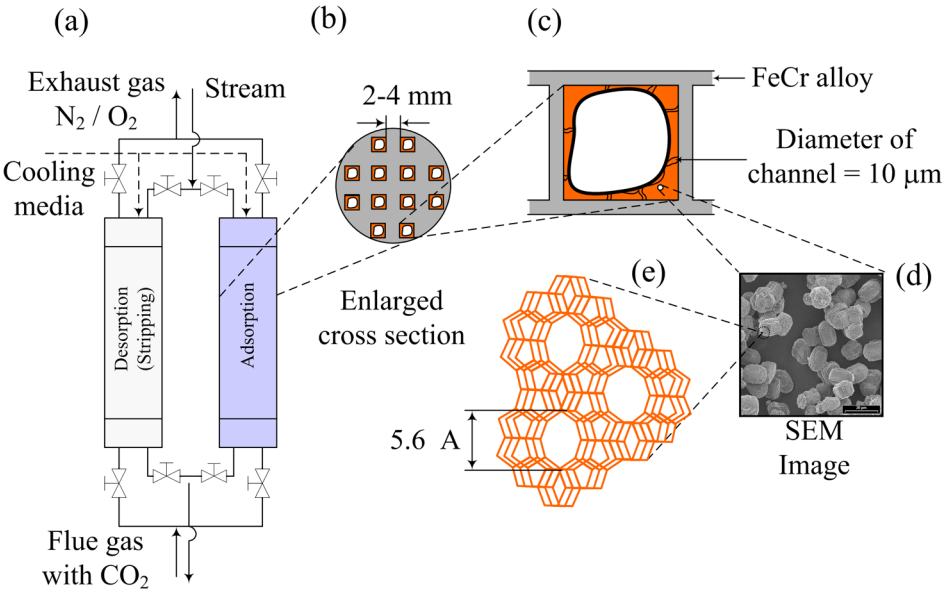
Background

Current aqueous amine and membrane technologies are cost-effective for separation of CO_2 from natural gas in liquefaction process and ammonia synthesis process due to the high value of end products. These current technologies, when applied for CO_2 capture from coal-fired power plants, result in significant increases in the cost of electricity produced. The cost of CO_2 capture and storage can be reduced if an effective CO_2 capture sorbent is developed which has:

- High CO_2 adsorption capacity.
- Long term regeneration capacity in power plant flue gas environment.
- Low energy requirement for regeneration compared to large amount of energy required for aqueous amine process.



CO_2 capture unit with metal monolithic amine-grafted zeolites

COST

Total Project Value
$1,119,257

DOE/Non-DOE Share
$764,995 / $354,262

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This project is investigating a CO_2 capture system that involves the novel integration of a metal monolith with amine-grafted zeolites. Key features of this CO_2 capture system are the use of metal monoliths coated with a low cost amine-grafted zeolite which eliminates the use of corrosive liquid amine and decreases the energy required for sorbent regeneration. The metal monoliths consist of straight channels: one row of channels coated with amine-grated zeolite; one used for heat transfer media for either cooling for adsorption or heating for regeneration. The alternative arrangement of CO_2 adsorption and cooling media (i.e., water or air) channels will allow effective removal of adsorption heat.

Primary Project Goal

The primary goal of this project is to develop a highly efficient and low-cost CO_2 capture system consisting of metal monoliths with parallel square channels of which the surface is coated with a nanostructured/hydrophobic zeolite-grafted amine.

Objectives

- Prepare and test the performance of various amine-grafted zeolite sorbents. Performance testing will evaluate CO_2 and SO_2 capacity along with long term stability.
- Develop an optimized amine-grafted zeolite based upon stability and capture capacity.
- Design, fabricate, and test a metal monolithic absorber coated with the optimal sorbent.
- Determine the performance capabilities of final CO_2 capture system through the development of an engineering system model and economic analysis of a large scale system.

Benefits

The low cost of raw materials for the synthesis of zeolite-grafted amine sorbents combined with the innovative application of metal monoliths as an adsorber structure may lead to a breakthrough technology for the effective capture of CO_2 from flue gas of coal-fired power plants.

Planned Activities

- Prepare, characterize, and determine the CO_2 capture capacity of at least 15 alkyl amine-grafted zeolites.
- Prepare, characterize, and determine the long term CO_2 capture capacity of at least 12 alkyl amine-grafted zeolites.
- Prepare, characterize, and determine the SO_2 capture capacity of at least 3 aryl amine-grafted zeolites.
- Fabricate metal monolith CO_2 absorber coated with amine-grafted zeolites.