U.S. Department of Energy
Office of Fossil Energy
National Energy Technology Laboratory

Development and Evaluation of Nanoscale Sorbents for Mercury Capture from Warm Fuel Gas

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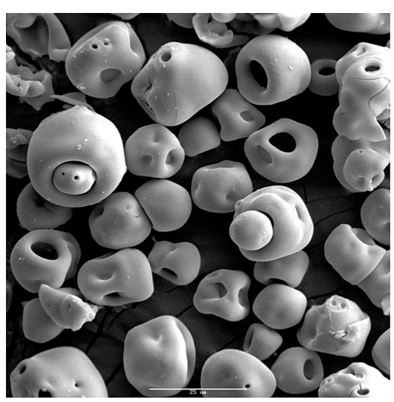
Background

Control of mercury emissions from coal gasifier systems is a difficult task, in part due to its high volatility and much lower concentration in a large volume of fuel gas. In addition, mercury in the fuel gas exists predominantly in the elemental form, the most difficult form to capture. Activated carbon-based processes are currently available for removal of mercury at lower temperatures (< 250 °F). However, for IGCC systems, such low-temperature processes result in severe energy penalty and reduced efficiency. Therefore, current focus is on developing sorbents for removal of mercury from warm fuel gas in the temperature range of 300–700 °F and at high pressures (300–1000 psi). Highly reactive mercury sorbents with a potential to remove other pollutants (such as H_2S and arsenic) are desired. In addition, there is a need of fundamental understanding of sorbent-mercury interaction in realistic fuel gas conditions, so that reactive and high-capacity sorbents can be developed.



The SEM picture on left shows clusters of a NanoActive™ metal oxide with agglomerates in 10–30 micrometer size range. These porous agglomerates consist of highly reactive nanocrystals, typically 2–10 nanometers in size, that can be granulated into even larger clusters or pellets for practical application as shown in the photograph on the right side.

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Gas Technology Institute, in collaboration with NanoScale Materials, Inc., is evaluating novel nanocrystalline sorbents for removal of mercury from coal-gasifier fuel gas. These nanomaterials exhibit a wide array of remarkable chemical and physical properties. These materials have large surface areas due to their unique morphology and porous nature. Such unusual morphology results in enhanced chemical reactivity of the sorbent. These sorbents have a potential to reduce mercury concentration in fuel gas to ultra-low levels to meet the DOE requirement for future Vision 21 power plants.

Objective

The overall objective of this project is to develop and evaluate nanocrystalline sorbents with a potential to remove 100% mercury from post-gasification warm fuel gas (300–700 °F). Another objective is to carry out detailed experimental studies to understand the mechanism of mercury capture by the sorbents.

Goals

- Synthesize nanocrystalline metal oxides and binary metal oxides with high surface area and pore volume.
- Evaluate metal oxides/sulfides for their potential to remove mercury from vapor phase.
- Analyze reacted sorbents to understand the fundamental nature of interaction between the sorbent and mercury.

Benefits

Nanocrystalline sorbents, because of their higher reactivity, have the potential to remove mercury (and possibly H_2S and arsenic) from fuel gas to ultra-low levels, and they could drastically reduce the overall cost of pollutant control.