TECHBRIEF

CONVERSION OF CARBON DIOXIDE TO CARBON MONOXIDE OR SYNTHESIS GAS BY REFORMING OR GASIFICATION USING OXYGEN CARRIERS/CATALYST

OPPORTUNITY:

Research is active on the development of metal ferrite oxygen carriers/catalysts for use in processes that convert carbon dioxide (CO_2) to carbon monoxide (CO) or synthesis gas by reforming or gasification. This invention is available for licensing and/or further collaborative research from the U.S. Department of Energy's National Energy Technology Laboratory.

CHALLENGE:

A variety of approaches have been employed to harness CO_2 activation in order to produce useful products for chemical processes and to control greenhouse gas emissions. These approaches include catalytic dry reforming of methane, chemical looping dry reforming of fuel, and coal gasification with CO_2.

CO and synthesis gas are very useful precursors for various chemical processes and can be used as a fuel for energy production. In catalytic dry reforming, the production of syngas from CO_2 and methane is achieved in the presence of a catalyst that offers several advantages, such as mitigation of greenhouse gases emissions and conversion of CO_2 and methane into syngas which can be used to produce valuable downstream chemicals. In chemical looping dry reforming, oxygen from an oxygen carrier or metal oxide is used for partial combustion of methane or coal to produce syngas or CO. The reduced oxygen carrier is then oxidized using CO_2 to produce CO and oxidized oxygen carrier. In coal gasification with CO_2, production of syngas from coal is achieved through the reaction of coal with CO_2 instead of air or steam, which can be enhanced by the presence of metal oxide/metal promoters. Since the gasification process does not require steam, significant cost reductions would be expected. However, finding low-cost and efficient catalysts/oxygen carriers for these processes has been a major challenge, limiting their commercial success.

OVERVIEW:

NETL researchers have developed and used low-cost novel materials that have been demonstrated to be efficient catalysts/oxygen carriers for the conversion of CO_2 to CO or synthesis gas by these processes. The use of these materials in commercial applications is expected to improve the efficiency of syngas production from methane or coal while reducing CO_2 emissions in an economically feasible way.

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ADVANTAGES:

- Complete conversion of methane and CO_2 to syngas was achieved at 800-900 °C using these catalysts for catalytic dry reforming process, with stable performance for more than 12 hours of testing.
- Novel materials were efficient oxygen carriers for chemical looping dry reforming with CO_2/fuel to produce CO achieving stable performance during multiple reduction and oxygen cycles at 800-900 °C.
- Efficient CO_2 coal gasification was demonstrated using these materials to produce high yields of CO or syngas with high rates at relatively low temperatures (800-900 °C).
- Novel oxygen carriers/catalysts can be produced using readily available materials at low cost.
- Oxygen carriers/catalysts are environmentally benign.

APPLICATIONS:

- Continuous production of syngas using catalytic dry reforming of methane using CO_2.
- CO production from CO_2 via chemical looping dry reforming of fuels (methane or coal).
- Production of CO from coal or other solid fuels via gasification of coal or other solid fuels using CO_2.

PATENT STATUS:

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Title: Metal Ferrite Catalyst for Conversion of CO_2 and Methane to Synthesis Gas via Reforming

Inventor: Ranjani V. Siriwardane

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Title: Metal Ferrite Oxygen Carriers for Conversion of CO_2 to CO and Fuel to Syngas or CO

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