TECHNOLOGY OPPORTUNITY

PRODUCING HYDROGEN FROM COAL VIA CATALYTIC/CHEMICAL LOOPING PROCESSES

OPPORTUNITY:

The invention describes a novel catalytic method combined with a chemical looping process to produce a hydrogen (H_2)-rich synthesis gas (syngas) stream free of the nitrogen from coal. The catalytic process uses reduced metal oxide/coal/steam to produce a H_2-rich syngas stream that is free of nitrogen (N_2) from coal while the chemical looping combustion (CLC) of fuel with the metal oxide is used for production of the heat required for the catalytic process. CLC processes also produce a concentrated stream of carbon dioxide (CO_2) that is ready for sequestration. This technology is available for licensing and/or further collaborative research from the U.S. Department of Energy's National Energy Technology Laboratory.

CHALLENGE:

Traditional coal gasification requires an expensive air separation unit to produce N_2-free syngas. However, NETL's novel catalytic process using reduced metal oxide/coal/steam does not require an air separation unit for production of nitrogen free syngas stream. Heat is traditionally produced via fuel combustion, which generates a CO_2 stream mixed with N_2. This stream requires expensive separation technologies for CO_2 sequestration. The novel catalytic process uses the heat from CLC of fuel, which generates a sequestration ready CO_2 stream. Integration of the processes, addressing contaminant issues and scaling up the technology for commercialization are necessary.

OVERVIEW:

Researchers at NETL have developed a catalytic process to produce H_2-rich syngas from coal that does not require an air separation unit. Syngas and H_2 production from coal is commercially conducted via coal gasification process. The goal is to get a concentrated syngas stream that has a higher energy value and that can be used for many applications, including production of pure H_2. Typically, the gasification process involves partial coal combustion with either oxygen (O_2) or air. When air is used, N_2 can enter the syngas, diluting the syngas and making syngas extraction difficult. When O_2 is used, expensive oxygen production units are needed that tend to generate high parasitic losses.

Using steam for coal gasification can avoid the need for an expensive air separation unit to produce nitrogen-free syngas. A novel catalytic process using reduced metal oxide with coal/steam will produce H_2/syngas at a high rate and address the issues encountered during coal gasification process.

Additionally, the heat required for traditional gasification is generated by combusting some type of fuel in air. This results in flue gas containing CO_2 and N_2. CO_2 must be separated from N_2 prior to any sequestration, further adding to the cost of CO_2 mitigation. CLC is a combustion process that utilizes oxygen from an oxygen carrier such as a metal oxide for fuel combustion. Significantly, the CO_2 that is produced via CLC is sequestration-ready and does not require any further processing or incur associated costs prior to storage.

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In the novel catalytic process, reduced metal oxide is used as the catalyst for H_2-rich syngas production from coal/steam while using the same metal oxide as an oxygen carrier for the CLC to produce heat for the process.

This NETL CLC process for producing hydrogen from coal offers multiple advantages over conventional technologies.

ADVANTAGES:

- Direct method to produce N_2-free H_2-rich syngas from coal
- Does not require an air separation unit
- Does not require costly separation of CO_2 from N_2 for CO_2 sequestration
- Does not undergo physical and chemical degradation during multiple cycles
- High syngas production rates
- Cost-effective
- Simple process

APPLICATIONS:

Syngas is the precursor for production of many chemicals and products we use every day. It is also used for hydrogen production. Hydrogen is used in oil refineries, to make ammonia, for methanol production, and in fuel cells.

RELATED PATENTS:

U.S. Patent Pending (non-provisional patent application)

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Title: Process for Production of H_2 Rich Synthesis Gas from Coal/Steam via a Catalytic/Chemical Looping Process using CuO-Fe_20_3-Alumina or Iron Oxide

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