TECHBRIEF

SYSTEM FOR ENHANCED CHEMICAL REACTION, DISSOCIATION, OR SEPARATION BY ELECTROSTATIC/ MICROWAVE AND/OR RADIO FREQUENCY CONTROLLED RESONANT ELECTRON INTERACTION

OPPORTUNITY:

The U.S. Department of Energy's National Energy Technology Laboratory (NETL) has developed a system for enhancing chemical reactions by electrostatic/microwave and/or/ radio frequency controlled resonant electron interaction. The invention performs at a much lower temperature than conventional processes. The system can reduce the cost of many important industrial processes including nitrogen and hydrogen production. Although the focus of the invention is on producing hydrogen from hydrocarbon sources, many different reactions could be activated using the same physics. This invention is available for licensing and/or further collaborative research.

CHALLENGE:

Approximately 50 percent of natural gas is used by industry. The existing chemical reaction-based processes, such as, the Haber process, are very energy intensive and costly. This invention increases the rate and extent of chemical reactions at much lower temperatures resulting in higher product yield and overall production. It also allows for reduced energy requirements and reactor size of dry and partial oxidation reformers.

OVERVIEW:

NETL developed the process and invention to apply a specific energy source (radio frequency RF & microwave MW) to a specific electron emission material that will increase chemical reaction rates of gas phase chemistry for fuel reforming more than 10 times the rate of previous processes. The invention includes:

- Materials that will provide a strong source of electrons to the gas phase of a chemical mixture that are both conductive and possess low energy electron surface states.
- A microwave or radio frequency source to enhance the dielectric constant of the electron source material. The microwave source will further reduce the electron surface state of the material increasing electron yield.
- The electron source material that can maintain an adjustable electric field that enhances electron emission and controls the emitted electron energy.

The invention provides a high-density source of electrons that will activate the oxygen in the reactant mixture. This form of low energy attachment is highly specific to electron energy. The lower the temperature and the higher the electron density at the required electron energy, the lower the energy requirements and size of the reactor system. This invention is designed to accomplish both.

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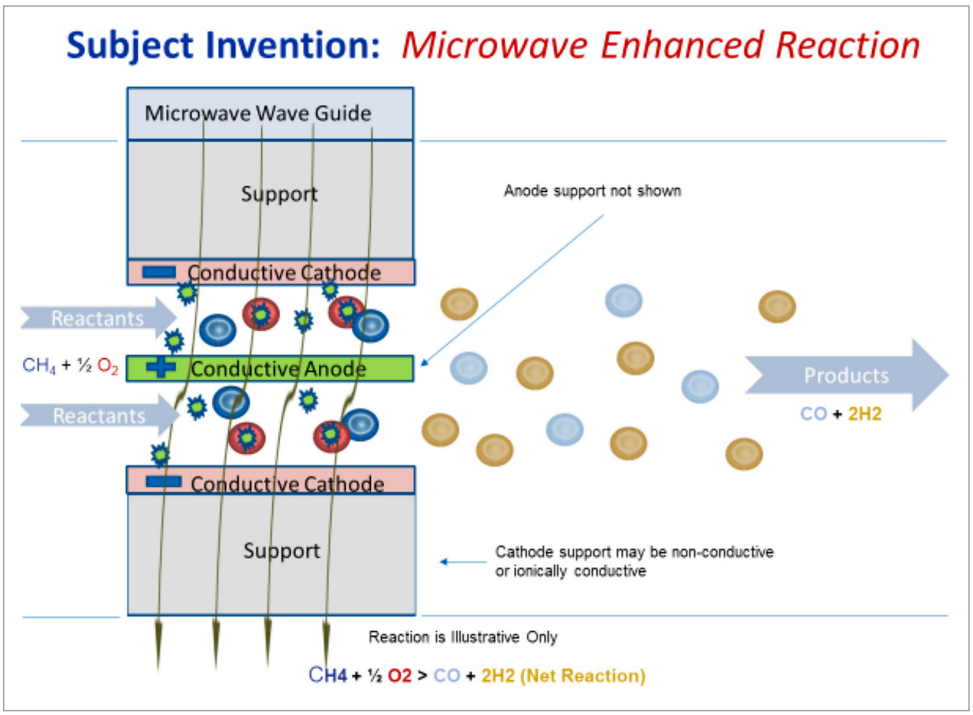

ADVANTAGES:

The invention is very specific. Although other reaction schemes to accomplish dry and partial oxidation reforming exist, none use the physics associated with this process. As noted, the invention, because of its unique approach, lowers the energy requirements of other processes and thus lowers the cost of production.

APPLICATIONS:

As noted, the focus of this invention is on producing hydrogen from hydrocarbon sources. In principle, many different reactions could be activated using the same physics. The proof of principle has been focused on reforming given the available equipment and resources. A follow-on process will address an ammonia/urea invention that could have very wide impact. The creation of ammonia requires hydrogen and urea requires carbon dioxide or monoxide. There is a synergy with the current invention.

PATENT STATUS:

- U.S. Non-provisional Patent Application No. 16/375,448

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  Title: System and Method for Enhanced Chemical Reaction, Dissociation, Separation by Electostatic/Microwave and/or Radio Frequency Controlled Resonant Electron Interaction

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