Metal alloy nano-foams as Catalysts for Methane Dry Reforming during GTL (Ramot)

code: 6-2015-911

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THE NEED

Today, about 90% of catalysts for GTL technology take the form of supported nanocatalysts. In these materials, metallic nanocrystals (the active catalytic phase) are dispersed about a highly porous ceramic oxide (inactive). These materials are advantageous because they provide exceptionally large surface areas for processing large amounts of gas, however, they all suffer from a variety of drawbacks. Supported nanocrystaline materials can to be unstable over time due to phenomena such as:

a. Sintering - compacting and aggregation of small nanocrystals (active phase) to form larger crystals when heated. This decreases the active surface area.

b. Surface carbon formation (coking) – solid carbon can deposit on the catalyst surface effectively killing the catalyst by blocking the active sites

c. Oxidation – the catalytic properties of catalysts are highly dependent on the oxidation state of the active site. Irreversible oxidation can render metallic crystals inactive

d. Temperature gradients – ceramic nanoparticle (supports) are not good heat conductors, which means that the use of these materials can lead to cold/hot spots in the reactor, influencing activity and stability

e. Pressure gradients – nanopowder catalysts can create large pressure drops inside industrial reactors due to the force required to push gas through the pores. Such pressure drops can negatively influence speed and efficiency of processing large amounts of gas

Our novel approach offers nanostructured metal alloy foams as a novel catalyst material for the conversion of methane into synthetic fuels and commodity chemicals.

- Improve resistance to sintering
- Alleviate coke formation
- Alleviate oxidation
- Highly reproducible synthesis
- Surface area enhancement

APPLICATIONS AND MARKET

The worlds proven oil reserves are predicted to peak in approximately 40 years. After this peak, alternative feedstocks for portable energy will be required in order to account for the lost supply of oil. Natural gas, comprising mostly of methane, can be a viable candidate for this task as our proven natural gas reserves can meet our current energy demands for possibly hundreds of years. Synthetic fuels derived from methane can therefore be an abundant feedstock for a cleaner carbon economy.

STAGE OF DEVELOPMENT

Currently progressing towards catalyst material with 90% efficicency at gas hourly space velocity (GHSV) larger than 100 liters/gr.hours. In parallel, reproducibility of catalyst production is studied.

PATENTS

SYNTHESIS OF LANTHANIDE-SUPPORTED TRANSITION METAL CATALYSTS USING HIGH-NITROGEN ENERGETIC PRECURSORS, application #62/519,996 filed in 2017

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