Particulate Catalyst for Dry Reforming of Methane

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Opportunity

Steam-methane reforming (SMR) is currently used to meet 90% of the global hydrogen demand, but it requires excessive energy and co-produces large amounts of CO_2. As the demand for hydrogen production is expected to reach ~530 million tones in 2050, there's a pressing need for upgraded catalytic processes that can effectively utilise the natural resources and reduce carbon footprint. Dry reforming of methane (DRM) offers a CO_2-free reaction pathway and has the added advantage of utilisation excess CO_2 from the environment. However, DRM faces critical process limitations such as carbon deposition on the catalyst (coking), metal sintering on catalyst, and durability under high temperatures.

Technology

Particulate catalysts are designed and synthesised for dry reforming of methane (DRM) and have successfully overcome the above deficiencies. Our researchers have developed new Ni/SiO_2 based catalysts that are stable and durable, exhibit favourable catalytic activity, and resist coke formation during continuous DRM reactions over an extended reaction duration of up to 1000 hours. In fact, our catalysts are stable for longer than any other produced/researched catalyst, as published in Science, 2020 (DOI: 10.1126/science.aav2412).

The particulate catalysts use silica and Nickel, which is more economical than other products comprising more expensive noble metals. By using the catalysts, industrial equipment runs more efficiently and with reduced risk of blockage.

The research team is committed to continuous improvement and is working on establishing even more stable catalyst products that can endure over 2000 hours of continuous reaction time.

With the particulate catalysts, dry reforming of methane (DRM) can fully replace SMR for hydrogen production. Our catalytic process overcomes the stability and durability issues that have previously hindered large-scale implementation of DRM, making it a cost-effective and sustainable solution for meeting the growing demand for hydrogen production.

Potential Commercial Applications

- Landfill gas utilisation: Methane gas produced from landfill can be used as a feedstock for hydrogen production using the catalysts, providing a sustainable and environmentally friendly solution for waste management.
- Synthetic natural gas production: The catalysts can be used to produce synthetic natural gas (SNG) by converting biomass or other carbon-containing feedstocks to methane. SNG can be used as a substitute for natural gas in heating and power generation applications.
- Methane conversion for value-added chemicals: Methane can be converted to syngas ($CO + H_2$) using the catalysts, which can then be further converted to value-added chemicals such as methanol and higher alcohols.
- Hydrogen production for industrial use: The catalysts can be used to produce hydrogen for various industrial applications such as refining, chemical processing, and power generation.
- Renewable energy storage: Hydrogen produced using the catalysts can be stored and used as a renewable energy source for applications such as fuel cells and transportation.
- Carbon capture and utilisation: The excess CO_2 used in the dry reforming process can be captured and utilised for various applications such as enhanced oil recovery, carbonated beverages, and industrial processes.
- Petroleum and gas refining: The catalysts can be used in petroleum and gas refining to remove sulfur and other impurities from crude oil and natural gas, improving their quality and value.

TRL 1-3 | TRL 4-6 | TRL 7-9

Inventors

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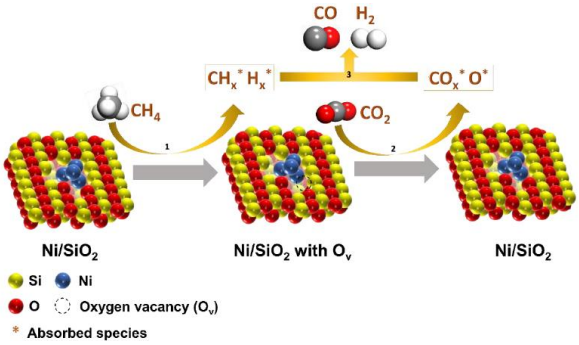
Intellectual Property Status

This IP is wholly Sydney-owned and is protected by PCT patent application PCT/AU2022/050697.



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