Ammonia Cracking to Produce Hydrogen

UCF researchers have developed a practical new system for on-demand generation of hydrogen gas as a fuel through the cracking of a cheap safe-to-handle raw material (e.g. ammonia) using microwave plasma discharge.

Hydrogen gas represents an exciting alternative fuel for energy needs as it requires only minor modification to be used in existing engine, and power plant designs. On-site methods for the production of hydrogen gas have emerged to tackle concerns related to the safe handling of this promising fuel. However, existing systems, which thermally decompose readily available ammonia to generate hydrogen, suffer from their impractical use in promising bio-friendly technologies such as electric vehicles, mostly due to the excessive heat released from the reformers. Alternatively, described herein is an effective, and reliable process for the prompt production of hydrogen from ammonia in a practical, and safely storable manner with little heat escaping the system. The system design focuses on the simple production and operation of the plasma processor, selective release of hydrogen gas, controlled injection of a stabilizing gas, and the effective cracking of the hydrogen carrier material, i.e. the plasma processor completely breaks down ammonia in one pass, with all the heat being absorbed by the ammonia gas.

Technical Details
A new system for the effective production, and selective release of hydrogen gas as a promising fuel is comprised of two compartments that are separated by a chemically resistant plastic dielectric diaphragm such as TEFLO®. Hydrogen-rich gases such as ammonia are injected into a chamber where electromagnetic energy (TM011 E Field) generated from a copper or aluminum antenna coupled to a microwave generator or waveguide in a second compartment interact with the injected gas to form a plasma discharge in the chamber. The heat expelled from the plasma discharge decomposes ammonia into hydrogen. The resulting gases are then released through a nozzle of defined size and power (e.g. 1000 W at 2.45 GHz) that has been built at the end of the chamber and is coupled to a vortex that separates the generated hydrogen from the by-product nitrogen gas.

Benefits
• On-site hydrogen production
• Safe handling
• Heat is absorbed in production process

Applications
• Electric vehicles
• Oil and natural gas companies

Tech Fields
Aerospace, Hydrogen Fuels

Keywords
hydrogen fuel, reactors, plasma processor, ammonia cracking, hydrogen production

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