AIST
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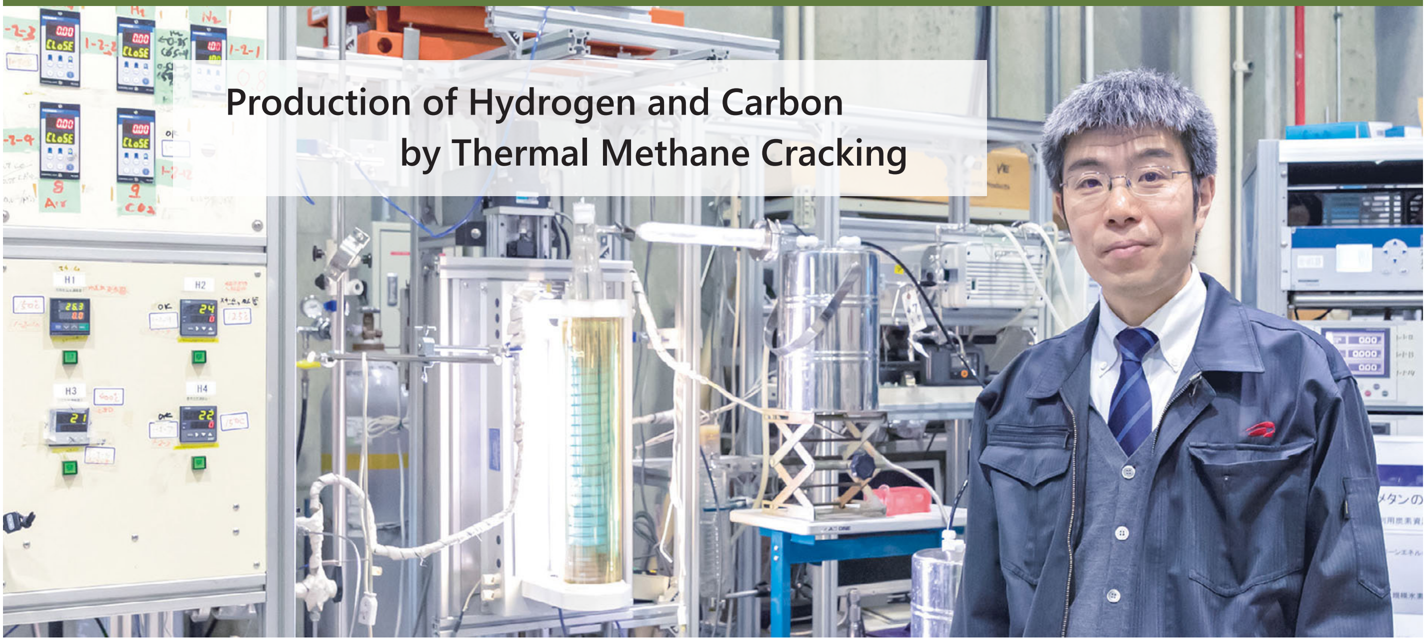
GZR
Global Zero Emission Research Center

Moving toward Zero CO2 Emissions
— Energy Technology for the Future —



KEY POINTS

The development of technology to **produce hydrogen by thermal methane cracking** is ongoing. With **no CO_2 emissions**, this technology produces **carbon in a solid form**, **eliminating the need for carbon capture and storage (CCS)**. It has been attracting attention as a technology that can **realize a decarbonized "hydrogen society"** in the future.

No CO_2 emissions, no need for CCS

Dr. TAKAGI Hideyuki from the Global Zero Emission Research Center, AIST, and his team members have been engaged in developing new catalysts and materials for the highly efficient production and usage of hydrogen and methane (CH_4) energy, and to this end, have conducted structural analyses and evaluations. His team now focuses on hydrogen production technology with thermal methane cracking. Thus far, steam reforming has been typically employed to obtain hydrogen from methane. This method is applied in ENE-FARM residential fuel cells, which are commercially available. Hydrogen is produced by the catalytic reaction of methane with steam. This production method is an industrially established technology, but causes carbon dioxide (CO_2) emissions. To reduce CO_2 emissions, it is necessary to install carbon capture and storage (CCS) systems.

Dr. Takagi and his team have proposed a new hydrogen production method in which methane is thermally cracked into solid carbon and hydrogen.

"This technology produces carbon and hydrogen from methane using a catalyst. A key aspect is that hydrogen and carbon are separated from CH_4. Thus, only hydrogen and solid carbon are generated without emitting CO_2, thereby eliminating the need for CCS technology."

The energy efficiency of this new technology is lower than that of steam reforming; nevertheless, the retrieved carbon can be stored and utilized as an energetic material, and possibly be used to fabricate functional materials. Methane can be sourced from organic waste (biogas) as well as natural gas. This research is benefited by the fact that AIST facilitates research collaborations among laboratories not only on catalyst development but also on reactors such as rotary kilns or fluidized beds.

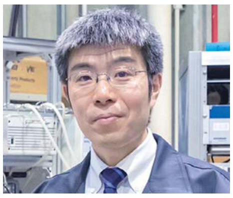
Realizing a low-carbon society in 2050

The technology is still in its incipient stages. Many challenges remain to be overcome before its practical application, such as improving the performance of the catalyst and analyzing reaction systems. It is necessary to make progress in this research to achieve the 2050 target of realizing a low-carbon society. In this regard, technologies such as the one presented here, which produce energy without emitting CO_2, are the need of the hour.

"The energy sector thrives on innovation; to this end, AIST's mission is to provide a roadmap with a long-term perspective, identify and nurture research seeds, and promote technological development."

Various technologies, including thermal methane cracking, are to be employed to realize the 2050 target. Dr. Takagi envisions a future where natural gas and biogas derived from waste treatment sites or sewage treatment facilities will be sources of methane. Methane will be cracked into hydrogen and solid carbon. The hydrogen will be consumed at hydrogen stations or power plants, while the solid carbon will be used as a carbon material or for energy storage, contributing to energy security.

With this roadmap in mind, Dr. Takagi has been collecting data on catalytic reactions, developing highly efficient catalysts and reactors, and exploring innovative carbon utilization methods. He looks forward to the day this hydrogen production technology will be realized.



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