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IIT Madras team produces gas hydrates under 'space' conditions

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IIT Madras team achieve rare feat

Researchers at Indian Institute of Technology (IIT) Madras have experimentally shown that methane and carbon dioxide (CO2) can exist as gas hydrates at temperatures and pressures seen in interstellar atmosphere. Gas hydrates are formed when a gas such as methane gets trapped in well-defined cages of water molecules forming crystalline solids. In terrestrial conditions, gas hydrates are formed naturally under the sea bed and glaciers under high pressure, low temperature conditions. Methane hydrate is a potential source of natural gas.

The methane and CO2 hydrates were produced in the lab at very low pressures (ten thousand billionth of atmospheric pressure) and temperature (as low as -263 degree C) to simulate the conditions of deep space.

Applications

The carbon dioxide hydrate produced in the lab raises the possibility of sequestering or storing carbon dioxide as hydrates by taking advantage of ice existing in environmental conditions favourable for hydrate formation. "In these environments, the carbon dioxide will have enough energy to interact with ice. So both molecules will have enough mobility to allow interaction to form carbon dioxide hydrate," he said.

"CO2 hydrate is thermodynamically more stable than methane hydrate. So if methane hydrate has remained stable for millions of years under the sea bed, it would be possible to sequester gaseous CO2 as solid hydrate under the sea bed," said Prof. Rajnish Kumar, Department of Chemical Engineering, IIT Madras and a co-corresponding author of a paper published in the *Proceedings of the National Academy of Sciences*.

IIT Madras, in collaboration with GAIL, is working to recover methane from methane hydrate from the Krishna-Godavari Basin and sequester CO2 simultaneously, said Prof. Kumar.

"We have been conducting such experiments for the last five years but have never seen gas hydrates forming," says Prof. T. Pradeep from the Department of Chemistry at IIT Madras

who led the team. That was because the researchers conducted the experiments only for a few hours.

Water and methane were originally deposited at -263 degree C (10 K). When the temperature was increased to -243 degree C (30 K), the researchers could observe methane hydrate forming after 25 hours. About 10% of methane present was found in the hydrate form at the end of 25 hours. “By the end of 75 hours, most methane got converted into hydrate,” says Jyotirmoy Ghosh from IIT Madras and the first author of the paper.

Though both ice and methane are in a frozen state, prolonging the experiment at a very low temperature enhanced the mobility of methane molecules and led to their insertion into the cage of water molecules to form methane hydrate.

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