Artificial Photosynthesis

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In news : Scientists have found a method to mimic nature's own process of reducing carbon dioxide in the atmosphere, namely photosynthesis, to capture excess carbon dioxide in the atmosphere.

How does Artificial Photosynthesis (AP) work?

- AP harnesses solar energy and converts the captured carbon dioxide to carbon monoxide (CO), which can be used as a fuel for internal combustion engines.
- In artificial photosynthesis (AP), scientists are essentially conducting the same fundamental process in natural photosynthesis but with simpler nanostructures.

Who designed this?

A team of Scientists from Jawaharlal Nehru Centre for Advanced Scientific Research(JNCASR), an autonomous institute of the Department of Science & Technology (DST), have designed the Artificial Photosynthesis

More about Artificial Photosynthesis

- **The scientists from** JNCASR designed and fabricated an integrated catalytic system based on a metal-organic framework (MOF-808) comprising of a photosensitizer (molecules which absorb light and transfer the electron from the incident light into another nearby molecule) that can harness solar power and a catalytic centre that can eventually reduce CO2.
- They have have immobilized a photosensitizer, which is a chemical called ruthenium bipyridyl complex ([Ru(bpy)2Cl2]) and a catalytic part which is another chemical called rhenium carbonyl complex ([Re(CO)5Cl]), inside the nanospace of metal-organic framework for

artificial photosynthesis.

- Both these molecular entities stay in close proximity in the confined nano-space of a porous metal-organic framework system resulting in excellent CO2 uptake capability at room temperature.
- This synthetic strategy empowers efficient solar light-driven photocatalysis.
- The developed catalyst exhibited excellent visible-light-driven CO2 reduction to CO with more than 99% selectivity. The catalyst also oxidizes water to produce oxygen (O2).
- The photocatalytic assembly, when assessed for CO2 reduction under direct sunlight in a water medium without any additives, showed superior performance of CO production.
- Being heterogeneous, the integrated catalytic assembly can be reused for several catalytic cycles without losing its activity.

Significance:

The team of scientists believe this intricate design and synthetic approach will pave the way to develop new integrated catalytic systems for CO2 capture and conversion of different energy-rich C1 and C2 chemical feedstocks by mimicking artificial photosynthesis.

Other carbon capture technologies

Carbon capture and storage (CCS), or carbon capture and sequestration and carbon control and sequestration, is the process of capturing waste carbon dioxide (CO2), transporting it to a storage site, and depositing it where it will not enter the atmosphere.

Carbon capture, utilisation and storage(CCUS) technologies involve the capture of CO2 from fuel combustion or industrial processes, the transport of this CO2 via ship or pipeline, and

either its use as a resource to create valuable products or services or its permanent storage deep underground in geological formations.

CCUS technologies also provide the foundation for carbon removal or negative emissions when the CO2 comes from bio-based processes or directly from the atmosphere

Following are the some of the carbon capture technologies

technology:

- Metal-organic frameworks(for carbon capture in power plants)
- Nanosponges
- Membrane/ Hybrid membranes
- Oxyfuel combustion
- Absorption
- Crystals
- Multiphase absorption
- Adsorption
- Chemical looping combustion
- Calcium looping
- Cryogenic
- Turning carbon to rock