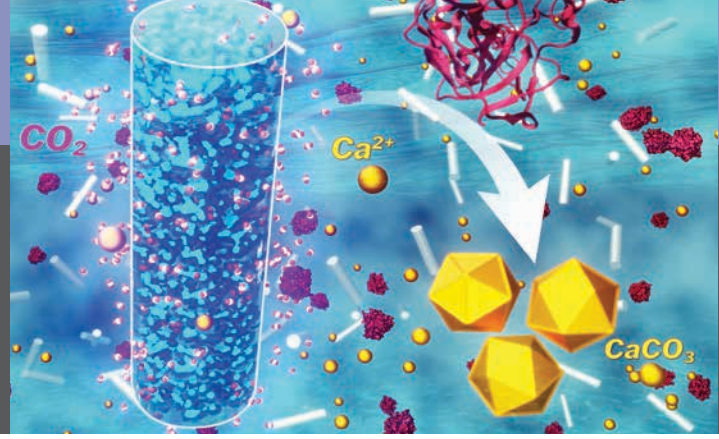
Removing CO_2 from Atmosphere



Problem Statement: The greenhouse gases and their excessive emission from anthropogenic activities (fossil fuel combustion, deforestation, fertilisers) escalate environmental degradation. Carbon dioxide (CO_2) emissions are 37 G tonnes per year worldwide, leading to disastrous environmental change. By 2018, only ~ 4-5 M tonnes of CO_2 per year had been captured and stored, which is much lower than the given guidelines by IEA. Thus, scientists' efforts are underway to overcome this; however, the ultimate solution to this problem will be to sequester, store, and convert the trapped CO_2 to industrially relevant materials. A type of porous liquids (that combines permanent and intrinsic porosity required for liquids to flow in pipes) has been developed and, available for sequestration and storage of CO_2, has gained massive recognition. However, none of them converts CO_2 into industrially valuable products, which calls for developing catalytically active porous liquid. This team's work addresses this issue.

Uniqueness of the Solution: The team has developed a composite porous liquid with a honey-like consistency at room temperature. The porous liquid comprises polymer surfactant (PS) grafted hollow silica nanorods and bioconjugated calcium carbonate ($CaCO_3$). Silica nanorods enable the sequestration and storage of CO_2. In contrast, bioconjugated carbonic anhydrase catalytically converts released CO_2 to carbonic acid (HCO_3^-), which reacts with pre-added calcium chloride to form industrially relevant calcium carbonate. The synthetic process is facile and easily scalable.

Current Status of Technology: The recyclable sequestration, storage, and catalytic performance have been investigated at a laboratory scale and found to be an excellent method for sequestration.

Societal Impact: The technology is beneficial for India and worldwide by helping sequestration/conversion of CO_2 into utility chemicals. It reduces CO_2 and converts it into industrially relevant and valuable products such as $CaCO_3$ polymorphs. It is applicable for healthcare, pharmaceuticals, agriculture, households, and many industries such as cement, glass, steel and paper.

Patent(s): Nil

Relevant Industries: Clean Energy, Materials, Environment.

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