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Towards Sustainable Energy:
Synthesis of Green Fuels with Integrated Carbon Capture and Storage (CCS)

By

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A large percentage of the United States energy demands are currently met using energy sources imported from politically unstable parts of the world. Such imports pose a potential threat to our national security and therefore, finding an alternative source to supply our country's ever growing energy demand is critical. The synthesis of green fuels from domestic carboneous sources such as coal, biomass and municipal solid wastes are particularly attractive, particularly if it is integrated with the carbon capture and storage (CCS) schemes in order to achieve both energy and environment sustainability.

Predictions of global energy usage suggest a continued increase in carbon emissions and rising concentrations of CO_2 in the atmosphere unless major changes are made to the way energy is produced and used. The containment of carbon dioxide involves CO_2 separation, transportation, and storage. Until now, these technologies have been developed independently of one another, which has resulted in complex and economically challenged large scale designs. CO_2 capture fluids based on the nanoparticle ionic materials (NIMS) are currently developed and their absorption isotherms are characterized as a function of CO_2 partial pressure and temperature (i.e., combustion and gasification conditions). NIMS are a new class of organicinorganic hybrids that consist of a hard nanoparticle core functionalized with a molecular organic (sometimes polymeric) corona. NIMS are nanoscale analogs of ionic liquids (ILs), which are often non-volatile and stable over a very wide temperature range. Once captured, CO_2 is chemically fixed into solid matrix that is thermodynamically stable for permanent storage. The tailored synthesis of mineral carbonates will allow its use as carbon-neutral filler materials and this will further improve the life cycle of the CCS technology.

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