Historically, the atmospheric concentration of carbon dioxide fluctuated naturally on the timescales of ice ages. Concerns, however, stem from the recent dramatic increase in the CO₂ concentration, which coincides with global industrial development. This rise is mainly due to the high use of fossil fuels. In order to meet the ever-increasing global energy demands while stabilizing the CO₂ level in the atmosphere, it is widely believed that current carbon emissions must be reduced by at least a factor of three. The containment of carbon dioxide involves CO₂ 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. CO₂ capture fluids based on the nanoparticle organic hybrid materials (NOHMs) are currently developed and their absorption isotherms are characterized as a function of CO₂ partial pressure and temperature (i.e., combustion and gasification conditions). NOHMs are a new class of organic-inorganic hybrids that consist of a hard nanoparticle core functionalized with a molecular organic (sometimes polymeric) corona. NOHMs are non-volatile and stable over a very wide temperature range, which make them interesting alternatives to various energy and environmental applications. Once captured, CO₂ needs to be stored for permanent disposal. The geological storage of carbon dioxide has been considered to be the most economical method of carbon sequestration, while mineral carbonation is a relatively new and less explored method of sequestering CO₂. The advantage of carbon mineral sequestration is that it is the most permanent and safe method of carbon storage, since the gaseous carbon dioxide is fixed into a solid matrix of Mg-bearing minerals (e.g., serpentine) forming a thermodynamically stable solid product. These carbon sequestration technologies can be integrated into the existing or new energy conversion systems in order to achieve their overall sustainability.

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