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Selective carbon-based adsorbents for carbon dioxide capture from mixed gas streams and catalytic hydrogenation of CO_2 into renewable energy source: A review

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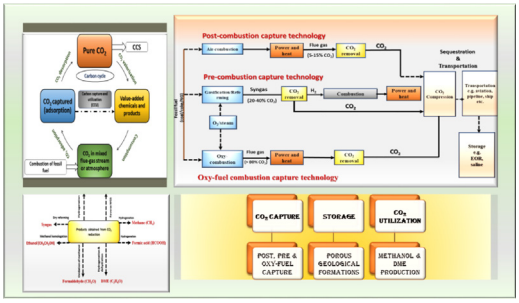
HIGHLIGHTS

- A critical review on carbon-based adsorbents prepared from renewable sources.
- The tailored carbon samples have shown considerable improvement in CO_2 capture.
- CO_2 capture and sequestration would allow implication of the resource efficiently.
- CO_2 as a feedstock for catalytic hydrogenation reactions is presented.
- The generation of methanol and DME can contribute towards a sustainable future.

GRAPHICAL ABSTRACT



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ABSTRACT

The rise in the temperature contributing to global warming is attributed to the increased human-generated greenhouse gas emission in the ambient atmosphere. In this paper, firstly, a comprehensive overview of the capture technologies is presented, highlighting the post-combustion capture technology as one of the promising CO_2 mitigation strategies. The performance of activated carbon, amine-functionalized and metal-oxide impregnated materials prepared from renewable precursors as the acknowledged adsorbents are well assessed and presented systematically. Conversion of CO_2 is proposed as a sustainable practice to substitute for dwindling fossil fuels. A strong emphasis is put on the conversion of CO_2 into value-added chemicals like higher hydrocarbons via series of catalytic-hydrogenation reactions. The specific aim of this study is to assist researchers by providing a holistic overview of different aspects of carbon-based adsorbents for post-combustion capture instead of the current-state-of art technology and enhancing the pathways for CO_2 valorization to clean and renewable end-products.

1. Introduction

CO_2 belongs to the Lewis acid family with slight toxicity, pungent smell and acid taste, and it is an odourless, colourless gas. It is present in small concentrations and is produced by the respiration of all living organisms, the combustion of hydrocarbons, and the fermentation of glucose or sucrose, but an essential constituent of the atmosphere. The molecular structure of CO_2 gas molecule is described as consisting of a covalently bonded carbon atom to two oxygen atoms that occur naturally in the atmosphere as a trace gas (Shirley et al., 1995). It is present as a

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