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Review

Chemically modified carbonaceous adsorbents for enhanced CO_2 capture: A review

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ABSTRACT

The rapidly-increasing concentration of atmospheric carbon dioxide (CO_2) gas has become one of the most pressing environmental concerns in recent years. CO_2 capture has become a vital technical solution to minimize environmental CO_2 emissions from various sources. The development of advanced adsorbents for effective CO_2 adsorption is a growing area that has gained significant attention in the materials science field. Hence, in this review we systematically discuss carbonaceous materials including carbon allotropes (carbon nanotubes (CNTs) and graphene oxide (GO)), carbon aerogels (CAs), biochar, polymer-derived carbons, microporous carbons, and mesoporous carbons that are extensively utilized for CO_2 uptakes. The functionalization of carbon materials that have also been reviewed here involved physical/chemical activations using activating agents (KOH, NaOH, K_2CO_3, and $ZnCl_2$), doping (N, O, and S), amine modification, carboxylation (-COOH), hybrid/composites formation, and metal oxide impregnation. Studies demonstrated that these all modifications play a very essential role in enhancing the CO_2 adsorption performance as compared to pristine carbons. It is well-acknowledged that the existence of extremely microporous network with ultra-high specific surface area exhibits a dominant role in enhanced CO_2 capture. Among various functionalized carbon-based adsorbents, modified porous activated carbons proved an excellent adsorbent for efficient CO_2 uptakes because of their brilliant textural properties and economical nature. Additionally, modified carbonaceous adsorbents possessed feasible isosteric heat of adsorption, excellent regeneration ability, and shows efficient selective CO_2 adsorption over N_2. Besides, these studies also summarize future challenges and prospective research pathway that could be commenced for developing effectual adsorbent for an efficient CO_2 storage application by considering various factors.

Contents

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