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Surface characteristics and carbon dioxide capture characteristics of oxyfluorinated carbon molecular sieves

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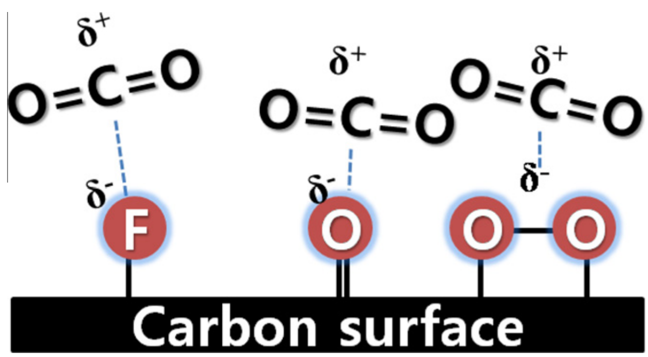
HIGHLIGHTS

- ▶ To investigate the properties of CO_2 uptake, surface-treated CMSs were prepared by oxyfluorination.
- ▶ The CO_2 uptake capacities of the modified CMSs increased compared with the unmodified CMS.
- ▶ Interactions between functional groups (consisting of F and O atoms) and CO_2 gas were noted.
- ▶ The CO_2-adsorption capacity of 2.0 mmol/g obtained for the oxyfluorinated CMS.

GRAPHICAL ABSTRACT

To investigate the properties of CO_2 capture, carbon materials with enhanced adsorption performance were prepared by oxyfluorination using physical treatment at various reaction conditions.



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ABSTRACT

A carbon molecular sieve (CMS) was modified through oxyfluorination to investigate its carbon dioxide (CO_2) adsorption characteristics. The oxyfluorination was performed at various F_2/O_2 ratios at room temperature. The surface chemical properties and pore size distributions on the CMSs were altered by oxyfluorination and analyzed through XPS and isothermal gas adsorption. The CO_2 adsorption capacity on the oxyfluorinated CMSs was different from that of unmodified CMSs due to changes in the functional groups on the carbon surface. The CO_2 uptake at 273 K was unchanged compared with untreated CMS and measured approximately 2.5 mmol/g. However, at 298 K, the CO_2 adsorption capacity increased from 1.61 mmol/g for an unmodified CMS to 2.07 mmol/g for the oxyfluorinated CMS. We suggest that introduced oxygen and fluorine functional groups on carbon surface by oxyfluorination increased basicity on carbon surface. Consequently, interaction energy between functional groups and CO_2 molecular are increased at room temperature and it contributed to enhance CO_2 adsorption amount.

1. Introduction

The emission of carbon dioxide into the atmosphere due to the combustion of fossil fuels has created a serious environmental problem [1]. Therefore estimates from the Intergovernmental Panel on Climate Change (IPCC) suggest that CO_2 emissions could be reduced by 80% by equipping modern power plants with suitable carbon dioxide capture and storage (CCS) technologies [2]. Several capture technologies have been suggested, and three CO_2 capture and separation options have been adopted: (1) pre-combustion capture; (2) oxy-fuel combustion; and (3) post-combustion capture [3].

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