

Different Adsorption Behavior of D₂O and H₂O on Activated Carbon Fibers and The Application to Concentration of D₂O

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The understanding of water vapor adsorption on microporous carbons with a slight amount of surface functional groups is still challenging. Adsorption of water vapor occurs only slightly in the low relative pressure (P/P_0), whereas the predominant cluster-associated micropore filling is induced above P/P_0 of 0.5, depending pore width^{1,2}. Intermolecular interaction of a water molecule is not predominantly governed by dispersion interaction, but by hydrogen bonding. The hydrogen bond is a crucial factor to reveal the water clusters growth in the carbon micropores. D₂O forms hydrogen bonding different from H₂O³. Nevertheless no systematic study has been done on the influence of the effect of isotope on water adsorption in carbon micropores as a function of pore width. In the study we compared the adsorption isotherms of H₂O and D₂O on hydrophobic activated carbon fiber (ACF)s with different pore widths⁴ and attempted adsorption-desorption mediated separation of low concentrated D₂O from water with ACF.

The results showed an evident difference in the rising pressure and desorption pressure of H₂O and D₂O. The D₂O adsorption occurs at a higher P/P_0 than H₂O adsorption and the difference is more evident for the ACF having larger micropores. Then, the single adsorption-desorption procedure can decrease the deuterium concentration of desorbed water from 143 ppm to 131 ppm. This result indicate that D₂O is concentrated in carbon micropores. These evident differences should be associated with the difference of hydrogen bonding between H₂O and D₂O.

References

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