Supporting Information

"An Exceptional Kinetic Quantum Sieving Separation Effect of Hydrogen Isotopes on a

Commercially Available Carbon Molecular Sieve"

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Experimental Materials and Methods

Adsorbents and Gases.

Two kinds of different CMS materials were used in the experiments. The shaping 1.5GN-H with diameters in the 1.4-1.6 mm range were supplied by Kuraray Chemical Co. Ltd., Japan. 3KT-172 with diameters in the 1.5-1.8 mm range were supplied by EnviroChemicals, Ltd., Japan. Based on the information provided by the manufactor, the two CMS were prepared by direct carbonization of coal and coconut shell, respectively. On the other hand, the PC sample was a poly(vinylidene chloride)-based material, which was synthesized through carbonization polymer at 1073 K under N₂ atmosphere in a vertical tubular furnace and hold for 3 h. High-purity (99.999%) CO₂ and N₂, ultrahigh purity (99.9999%) H₂, and high-purity (99.5%) D₂ supplied by Heli Gas Co., Ltd., China were used in the whole experiments.

Adsorption Measurements.

N₂ adsorption measurements for PC were carried out at 77 K on a static volumetric sorption analyzer (ASAP2020, Micrometrics, USA). CO₂, H₂, and D₂ sorption measurements were performed on an Intelligent Gravimetric Analyzer (IGA-001, Hiden), which is an ultrahigh vacuum system and incorporates a microbalance capable of measuring weights with the resolution of $\pm 0.1 \mu g$. Significantly, H₂/D₂ were further purified using the activated alumina, zeolites, and activated carbons to remove probable trace amount of water and other impurities before introduction into IGA system. Before adsorption measurements, these adsorbents were evacuated for 5 h at 200 °C under high vacuum.



Figure S1, (a) Typical adsorption kinetics of CO_2 at 273 K with pressure increment of 2-10 mbar, (b) DR plot of CO_2 adsorption for the two CMS materials.



Figure S2, CO_2 adsorption at 273 K on PC and micropore size distribution determined from the well-known Dubinin-Radushkevich-Stoeckli model; N_2 adsorption at 77 K on PC and the whole pore size distribution determined non-local density functional theory.



Figure S3, The variation of molar ratios (nD_2/nH_2) for the equilibrium adsorbed amounts of





Figure S4, The typical adsorption kinetic profile of H_2 and D_2 at 77 K with the different pressure increments for 1.5GN-H.



Figure S5, The typical adsorption kinetic profile of H_2 and D_2 at 77 K with the different pressure increments for 3KT-172.



Figure S6, Variation of the SE model exponential parameters β with pressure for H₂/D₂ adsorption on: (a) 1.5GN-H, (b) 3KT-172, and (c) PC at 77 K.



Figure S7, The variation of ratios for kinetic rate constants of D_2/H_2 (kD_2/kH_2) with pressure increments at 77 K on: (a) 1.5GN-H, and (b) 3KT-172.