Electronic Supplementary Information for

Extremely Permeable Porous Graphene with High H₂ and CO₂ Separation Ability Achieved by Graphene Surface Rejection

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Figure S1. Schematics of (a) the conditions used for graphene synthesis and (b) the mass spectrometer system.



Figure S2. (a) Optical images of graphene sheets directly synthesized on stainless-steel mesh substrates and mapping images for C, O, and Fe components obtained by energy-dispersive X-ray spectroscopy. (b) Left: Energy-dispersive X-ray spectra for graphene synthesized for 1.0 (blue), 1.5 (red), and 2.5 h (green). The black curve represents the spectrum for a stainless-steel mesh. Right: Component ratios of C/Fe, O/Fe, and C/O.



Figure S3. XRD patterns of graphene samples synthesized on stainless-steel mesh for 1 (blue), 1.5 (red), and 2.5 h (green). The XRD pattern of the stainless-steel mesh (black) was included for comparison.



Figure S4. Snapshots of H_2 , CO_2 , CH_4 , and He permeation through graphene gates with a diameter of 0.3 nm. Each H_2 , CO_2 , CH_4 , and He species is depicted as two yellow spheres, a black and two green spheres, a black and four red spheres, and a blue sphere, respectively. Porous graphene is depicted as a black sheet.



Figure S5. Snapshots of H_2 , CO_2 , CH_4 , and He permeation through graphene gates with a diameter of 0.4 nm. Each H_2 , CO_2 , CH_4 , and He species is depicted as two yellow spheres, a black and two green spheres, a black and four red spheres, and a blue sphere, respectively. Porous graphene is depicted as a black sheet.



Figure S6. Snapshots of H_2 , CO_2 , CH_4 , and He permeation through graphene gates with a diameter of 0.7 nm. Each H_2 , CO_2 , CH_4 , and He species is depicted as two yellow spheres, a black and two green spheres, a black and four red spheres, and a blue sphere, respectively. Porous graphene is depicted as a black sheet.



Figure S7. Snapshots of H_2 , CO_2 , CH_4 , and He contacted on graphene containing gates with a diameter of 0.4 nm after 0.3 ns. Each H_2 , CO_2 , CH_4 , and He species is depicted as two yellow spheres, a black and two green spheres, a black and four red spheres, and a blue sphere, respectively. Porous graphene is depicted as a black honeycomb.