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A method to measure adsorptive-poroelastic properties for nanoporous adsorbents

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The characterization of adsorbents has been long established in material science. However, the interplay of adsorptive and mechanical response (such as induced strain and stress) at high pressure and high stress is relatively new. The typical dilatometer test used in adsorption science is just one particular case of the full range of poroelastic response with varing fluid (pore) pressure and external total (or confining) stress. Here we show a general method to measure directly the adsorption stress developed by adsorbents in the presence of a non-zero effective stress consistent with the Biot theory for poroelastic solids. The method follows an extension of a procedure to measure the Biot coefficient for non-adsorptive materials. We show the application of the method for compacted activated carbon and synthetic monolithic porous carbon (carbon xerogel) in the presence of He, CH₄ and CO₂. Helium serves to measure the base poroelastic response in the absence of adsorption. The adsorbates, methane and carbon dioxide, help measure the adsorptive response. The method can be also extended to other adsorbents such as clays, zeolites and kerogen.

Participation

In-Person

References

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