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A Unified Plot for Fluid Phase Transitions

Thursday, 3 June 2021 19:00 (15 minutes)

While many mesoporous materials are found naturally (clays, coal, and shale), many others are synthetized for industrial applications like sensing, fluid separations, and energy storage. For the optimization of these materials for various applications, an accurate determination and understanding of the pore size distribution and morphology is vital.

Fluid phase transitions employ the alteration of physical properties of confined fluids as markers for pore space characterization. This is expressly revealed by the Kelvin equation for gas-liquid transitions and the Gibbs-Thomson equation for solid-liquid transitions. As may be thought, for one and the same material, both methods are expected to yield the same pore size distribution with little or no deviations. However, it has been shown that, both approaches may yield slightly different results.

Herein, we introduce a unified plot for both gas-liquid and solid-liquid transitions based on the Kelvin and Gibbs-Thomson equations. We analyze three mesoporous silica solids; SBA-15, Vycor and MCM-41, in order of decreasing pore size. Remarkable similarity is observed in the fluid phase transitions in the SBA-15 material of pore size approximately 9nm. With decreasing pore size, a divergence between both transitions is observed. We postulate that, this may primarily be due to the increasing influence of thermodynamic fluctuations with decreasing pore size.

Time Block Preference

Time Block B (14:00-17:00 CET)

References

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[4] Enninful H.R.N.B., Schneider D., Kohns R., Enke D. and Valiullin R., 2020, "A novel approach for advanced thermoporometry characterization of mesoporous solids: Transition kernels and the serially connected pore model", Microporous and Mesoporous Materials 309, 110534.
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