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Advanced Characterization of Disordered Mesoporous Solids

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Mesoporous solids have found wide uses in catalysis, adsorption, molecular separations, gas and energy storage, among others. Indeed, precise structure-function relations of guest molecules in pores are rightly obtained when accurate knowledge of the confining space is available. At present, most approaches for pore characterization consider disordered porous materials as individual collection of pores where fluid phase transition occurring in one pore has no effect on adjacent pores. However, pore interconnectivity renders fluid phase behavior in one pore dependent on the phase state in its neighboring pore. We show systematically how a model of statistical chain of pores can be applied for solid-liquid phase transitions of porous solids. By creating a kernel-based approach incorporating a variable non-frozen layer thickness between solid core and pore wall and eliminating any a priori assumption of phase transition occurring by metastable or equilibrium transition, we refine the thermoporometry characterization technique. For verification, we show how this approach works well with ordered materials like MCM-41 porous silica and reveals disorder in SBA-15 materials. This approach can be extended to other phase transition phenomena such as gas adsorption.

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