

# Structural Characterization of Nanoporous Materials by Physical Adsorption

Matthias Thommes

*Quantachrome Corporation, 1900 Corporate Dr., Boynton Beach, FL 33426, USA*

Assessing adsorption properties of nanoporous materials (e.g. for gas storage applications) and their structural characterization is crucial for advancing the application of nanoporous materials such as mesoporous zeolites in catalysis, separations, and other industrial processes. Gas adsorption is well suited for this task because it assesses a wide range of pore sizes, spanning the entire micro- and mesopore range. Within the last two decades major progress has been achieved in the understanding of the adsorption and phase behaviour of fluids in ordered nanoporous materials and in the development of advanced approaches based on statistical mechanics such as molecular simulation and density functional theory of inhomogeneous fluids (see reviews [1,2] and references therein). This progress, coupled with the availability of high resolution experimental procedures for the adsorption of various subcritical fluids, has led to major advances in the structural characterization by physical adsorption. These advances and corresponding recommendations for physisorption characterization are also summarized in a new IUPAC technical report which has been very recently published (in 2015, ref. [3]).

Within this context we will discuss in this tutorial important fundamental aspects of the underlying adsorption mechanisms (e.g. pore condensation and hysteresis) of fluids in nanoporous materials (e.g., micro-mesoporous materials with hierarchical pore structure) in connection with the recommendations given in the 2015 IUPAC report. In addition, we will also address some important aspects of high pressure gas adsorption methodology with regard to gas storage applications of advanced nanoporous materials.

## References

- [1] M. Thommes, K.A. Cychosz, . *Adsorption* **20**, 233 (2014).
- [2] J. Landers, G.Y., Gor, A.V. Neimark, A.V. *Colloids Surfaces A* **437**, 3 (2013).
- [3] M. Thommes, K. Kaneko, A.V. Neimark, J.P. Olivier, F. Rodriguez Reinoso, J. Rouquerol and K.S.W Sing, *Pure Appl. Chem.* **87**, 1051 (2015)