

Studying heterogeneous porous materials with neutron scattering

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Neutron scattering has been widely used to study complex porous materials due to its high penetration power, good sensitivity to light elements, and flexibility to control the contrast of gas/liquid inside pores. In this talk, I will provide a few research examples to demonstrate the power of neutron scattering to study porous material by using different neutron scattering instruments. The first example is to study the kerogen distribution in shale rocks. Even though kerogens are believed to be responsible for shale gas/oil storage, it has been challenging to study the kerogen distribution inside shale rocks. Aided by a recently developed simultaneous neutron and x-ray tomography system at NIST, we had systematically studied the kerogen distribution in a few rocks and have found an interesting correlation between the enriched kerogen distribution and its orientation relative to the bedding.[1] The second example discusses a new approach using small angle neutron scattering (SANS) to measure the variation of pore surface properties when the surfaces have heterogeneous chemical compositions. By loading gas at different pressures to vary the scattering contrast between pore surfaces and the filling gases, we demonstrated that the variation of the scattering length density of the pore surfaces can be quantitatively obtained. As the scattering length density is related with only chemical formula and density of the pore matrix, this allows us to probe the surface compositional heterogeneity of porous materials non-invasively.[2-3] In the last example, we investigated the methane adsorption in model mesoporous materials, such as MCM-41 and SBA-15. The effects of the pore size and surface roughness on the methane gas adsorption are quantified. [4-5]

References:

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