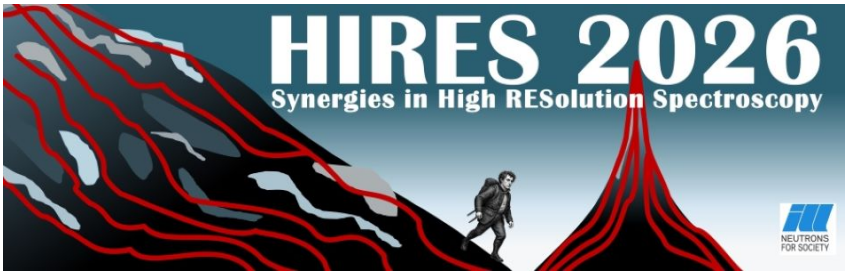

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Quasielastic neutron scattering study of clathrate hydrate formation from mixed gas fluxes (CH_4, H_2, C_2H_6) in nanoporous media.

Gas hydrates are crystalline solids formed by a three-dimensional network of cages formed by water molecules that are capable of trapping gas molecules inside. These compounds form when water and gases such as methane interact under low-temperature, high-pressure conditions. Current research increasingly focuses on synthesizing gas hydrates under milder conditions to develop them as gas storage systems, an approach particularly attractive for hydrogen. Promising strategies include forming hydrates inside nanoporous materials, where nanoconfinement effects can facilitate crystallization, or creating mixed methane/hydrogen hydrates, using methane as a seed to store hydrogen at pressures far lower than those required for pure hydrogen hydrates.

To advance these technologies, it is essential to understand how gas hydrates form and how guest molecules behave inside their cavities. Quasielastic neutron scattering is well suited for this, as can probe molecular motions on the picosecond to nanosecond scale. This makes it possible to follow the evolution of gas molecules from the initial mobile stages of nucleation to the regime where they become localized and behave as free rotors at low temperatures.
In this work, gas hydrate formation was monitored inside a high surface area activated carbon using pure methane and two gas mixtures: methane–hydrogen (80%/20%) at 50 bar, and methane–hydrogen–ethane (5 bar of ethane plus 50 bar of the previous mixture). The aim was to study the dynamics of methane and ethane during hydrate formation and to assess whether hydrogen can be incorporated into methane or methane–ethane hydrates. The entire process was followed using quasielastic neutron scattering on the IN5 spectrometer at the Institut Laue-Langevin.

Session

Materials Science

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