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Experimental evidence for empty cage methane clathrate hydrates grown using surfactants.[1] JEFFREY BOTIMER, DEREK DUNN-RANKIN, PETER TABOREK, Univ of California - Irvine — Clathrate hydrates are non-stochiometric ice-like crystalline compounds consisting of host water molecules forming a cage-like structure around guest molecules. The guest molecule is necessary for the stability of the hydrate. Surfactants have been shown to greatly enhance the kinetics of hydrate growth, which is important for many applications. We have built custom cells that allow in situ Raman and optical imaging of the growth of methane clathrate hydrates from liquid water. In our studies, above 0C, we observe the formation of solid that precedes the absorption of methane gas required to form clathrate hydrates. Our research shows that sodium dodecyl sulfate (SDS) causes a fundamental change in the growth mechanism of methane hydrates, creating a temporary empty cage clathrate structure. The existence of this transitional state is confirmed by in situ Raman measurements, in situ NMR. We have simultaneously monitored the gas uptake and the NMR signal of the growing hydrate in a high pressure NMR cell. The empty cage solid structure appears to be unique to surfactant assisted hydrate growth, and begins to disappear for low SDS concentrations (<25ppm).

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