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Raman spectroscopy and imaging of "natural" gas hydrates

The natural occurrence of large quantities of gas hydrates in deep oceans, permafrost and plausibly in planets or comets of the solar system, is certainly at the origin of numerous developments and researches on gas hydrates in fields ranging from physical-chemistry, geosciences or astrophysics to chemical engineering and innovative technologies [1,2]. Gas hydrates are ice-like systems made of water molecules forming nano-cages stabilized by the encapsulation of foreign molecules. At a fundamental level, the understanding of their physical-chemistry properties (trapped-gas selectivity, kinetics formation mechanism, influence of sedimentary matrices, etc.) is of prime importance to track the evolution of the abundances of species taking part in the compositions of hydrate-bearing deposits not only on Earth, but also potentially on extraterrestrial bodies. The understanding of their molecular interactions plays a key role, requiring multi-scale approaches and the combination of advanced experimental and theoretical approaches for which Raman spectroscopy and imaging plays a key role. After a short review of some of the recent physico-chemical achievements (e.g. metastability [3,4,5], molecular selectivity [6,7], formation kinetics [8,9], etc.) relevant in gas hydrates sciences, the presentation will focus on the contribution of Raman spectroscopy and imaging for investigating gas hydrates naturally occurring in deep-ocean sea-floors [9,10].

References

[1] Broseta et al, Gas hydrates 1, Wiley-ISTE: London (2017)
[2] Ruffine et al, Gas hydrates 2, Wiley-ISTE: London (2018)
[3] Métais et al, J. Phys. Chem. C 125(11) 6433-6441 (2021)
[4] Petuya et al, J. Chem. Phys. 150(18) 184705 (2019)
[5] Petuya et al, J. Phys. Chem. C 122(1) 566 –573 (2018)
[6] Petuya et al, J. Phys. Chem. C 123(8) 4871-4878 (2019)
[7] Petuya et al, Chem. Comm. 54 4290-4293 (2018)
[8] Métais et al, to be submitted (2022).
[9] Guimpier et al, to be submitted (2022).
[10] Agnissan et al, to be submitted (2022).

Figures

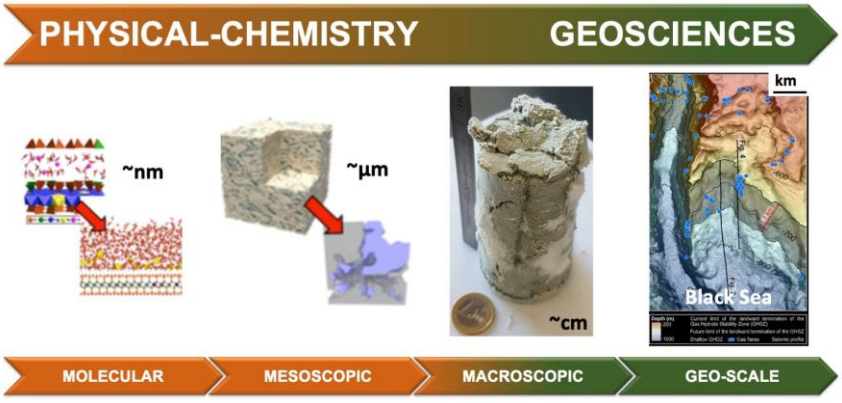

Figure 1: *Illustration of the multi-scale investigations required for understanding the formation of gas hydrate in natural environment.*