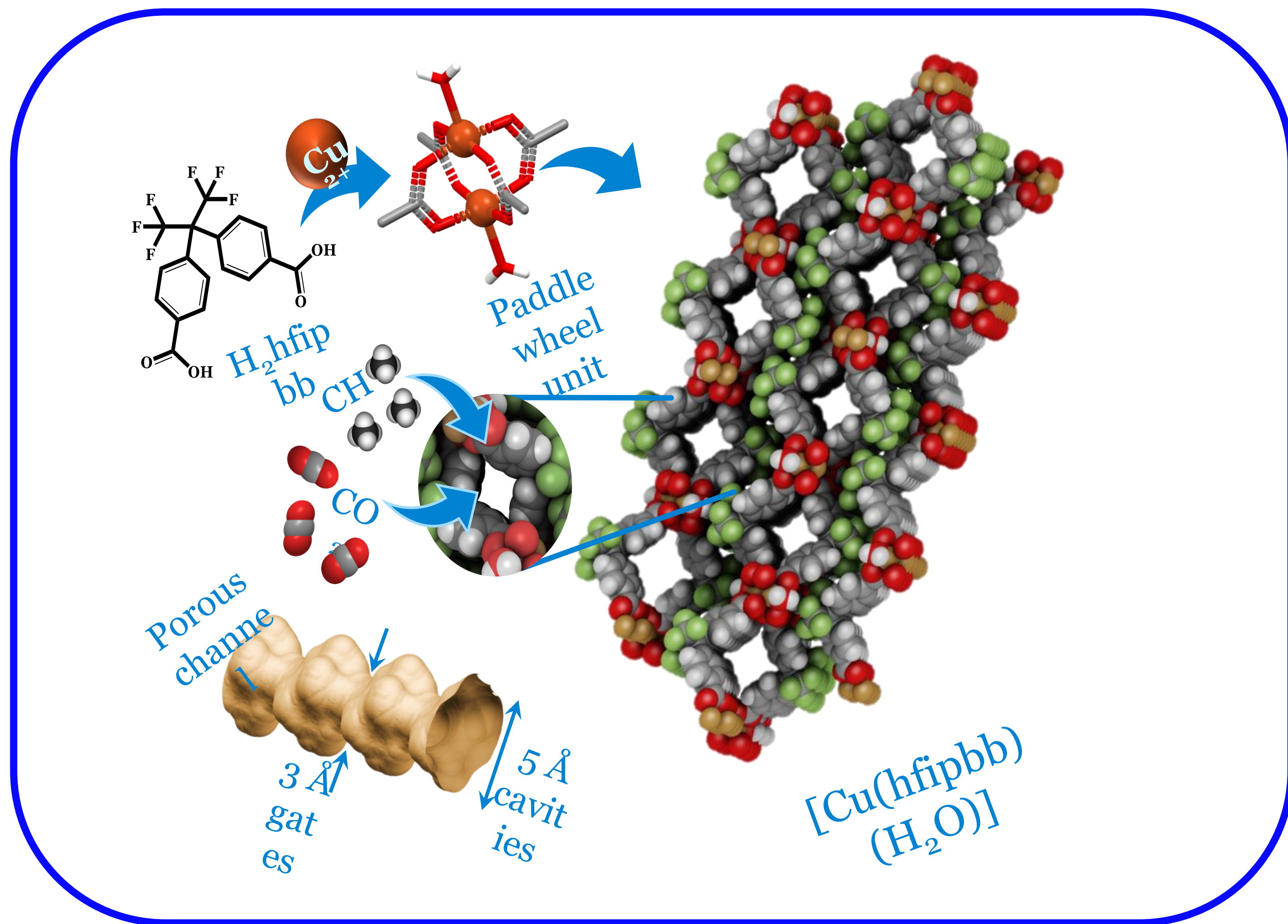
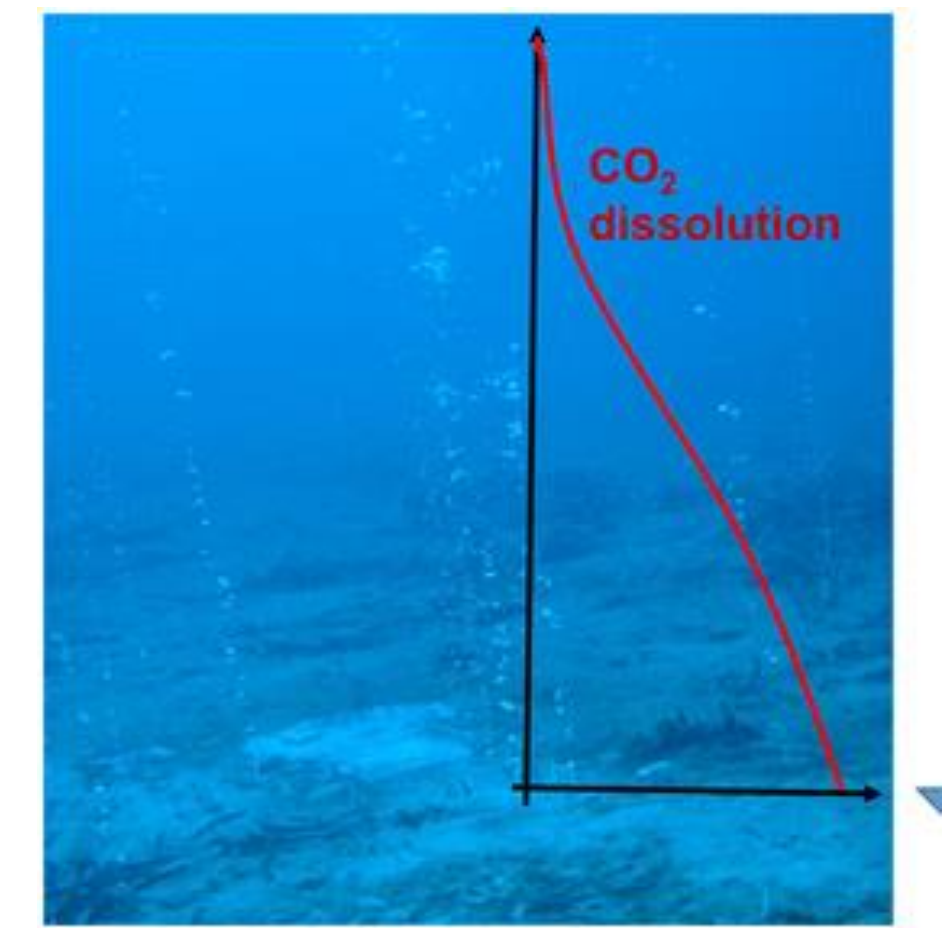


Development of CO2 surveillance sensing devices @ DTU Offshore

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Carbon storage in geological formation requires (EU-directive) active monitoring of integrity. Many solutions for leak detection have been proposed but might not fit the purpose as CO2 concentration levels very fast decrease up through the water column. We develop chemical sensing by applying tailored metal organic frameworks (MOF), here shown in two configurations for local or distributed sensing. MOFs can be designed for adsorption of specific target molecules (Here CO2) and when desorbed on a given detection device (QCM or Optic fiber) it can be used as an accurate surveillance tool.



Optical Fiber as permanent monitoring

Goal: Permanent passive surveillance system

Fiber optics allow for ease of deployment and telemetry covering large areas

Diagram showing an interrogator connected to an optical fiber. The fiber has several CO2 sensitive spots. A graph shows the reflectance spectrum for sparkling water and normal water. A cross-section of the fiber shows the core, cladding, and a CO2 sensitive spot.

Functionalized optical fiber with distributed specialized CO2 sensitive "spots".

Diagram showing a functionalized optical fiber with strain and optical sensing spots. The fiber is shown with a strain spot and an optical spot. A graph shows the reflected light (O) and absorbance for each spot.

Response is sensed as either optical or as a strain or a combination.

Known technology from other applications

Diagram showing an interrogator at a platform monitoring the water column, seabed, and shallow subsurface. The interrogator is connected to an optical fiber that is deployed in the water column and seabed.

Deployed at/in seabed.

Quartz Crystal Microbalance (QCM Resonator) based sensor

Single location measurement using QCM technology

QCM Sensor structure and design

Diagram showing the QCM sensor structure and design. It includes a 10 MHz quartz sensor, a 3-D printed flow cell, and a MOF-sensor. A graph shows the frequency change (Δf) over time.

Testing and response

Graphs showing gas phase analysis and CO2/water response. The top graph shows the frequency change (Δf) over time for a target gas (x% CH4/CO2) in N2/air. The bottom graph shows the frequency change (Δf) over relative time for 500 ppm CO2 in water at 25°C and 500 μL/min flow rate.

Gas phase analysis

CO2/water

Same sensing chemistry and philosophy – two different sensing and telemetric principles. Designed for different applications and needs.

