

1. Hydrogen Economic Challenge: Storage and Transportation

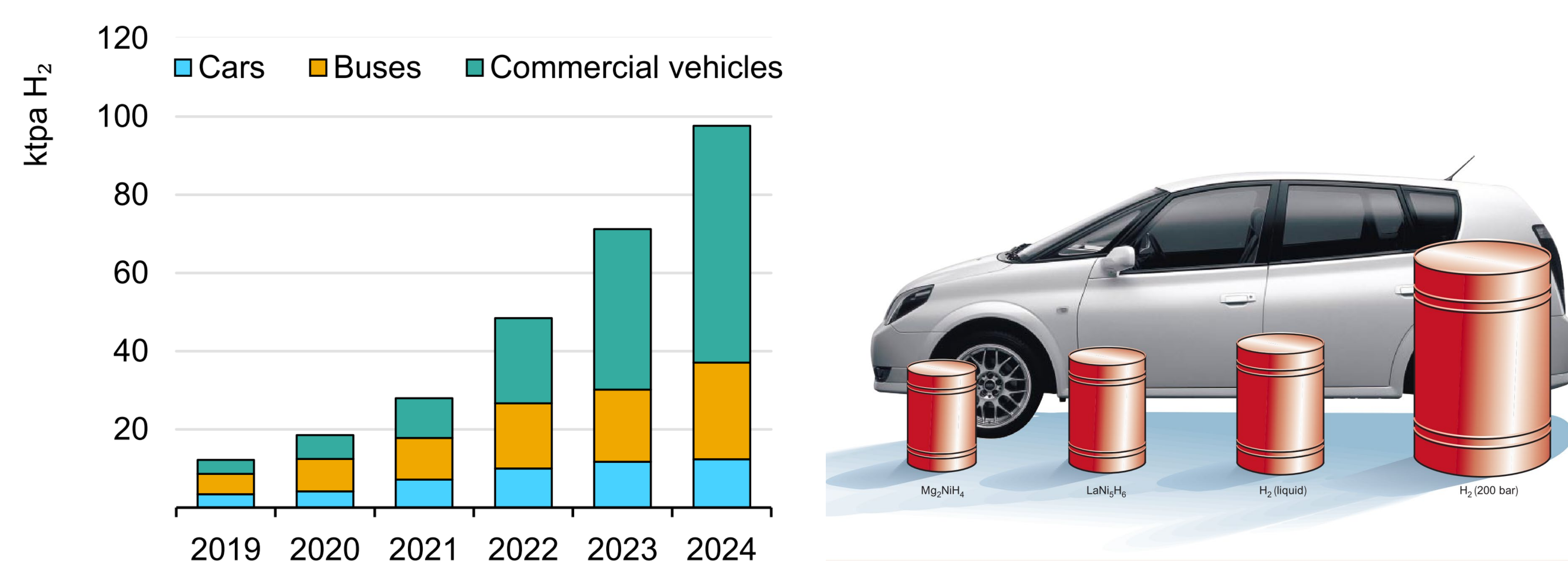


Figure 1. Hydrogen demand in road transport, 2019-2024. IEA. CC BY 4.0. Volume of 4 kg of hydrogen compacted in different ways, with size relative to the size of a car. (Toyota press information.)

Hydrogen **storage** is the bottleneck. Technologies like 350/700-bar tanks and cryogenic LH₂ are:
•**Energy-intensive, costly, and complex**

Our Goal is to design hydrogen storage systems that are:
•**Safe, high-capacity, and operable under ambient conditions**

2. Material-based Hydrogen Storage

1. 2D multilayer material: (*Nat. Nanotechnol.* 2021, 16, 331)
Incomplete etching creates confined interlayers for reversible H₂ storage.

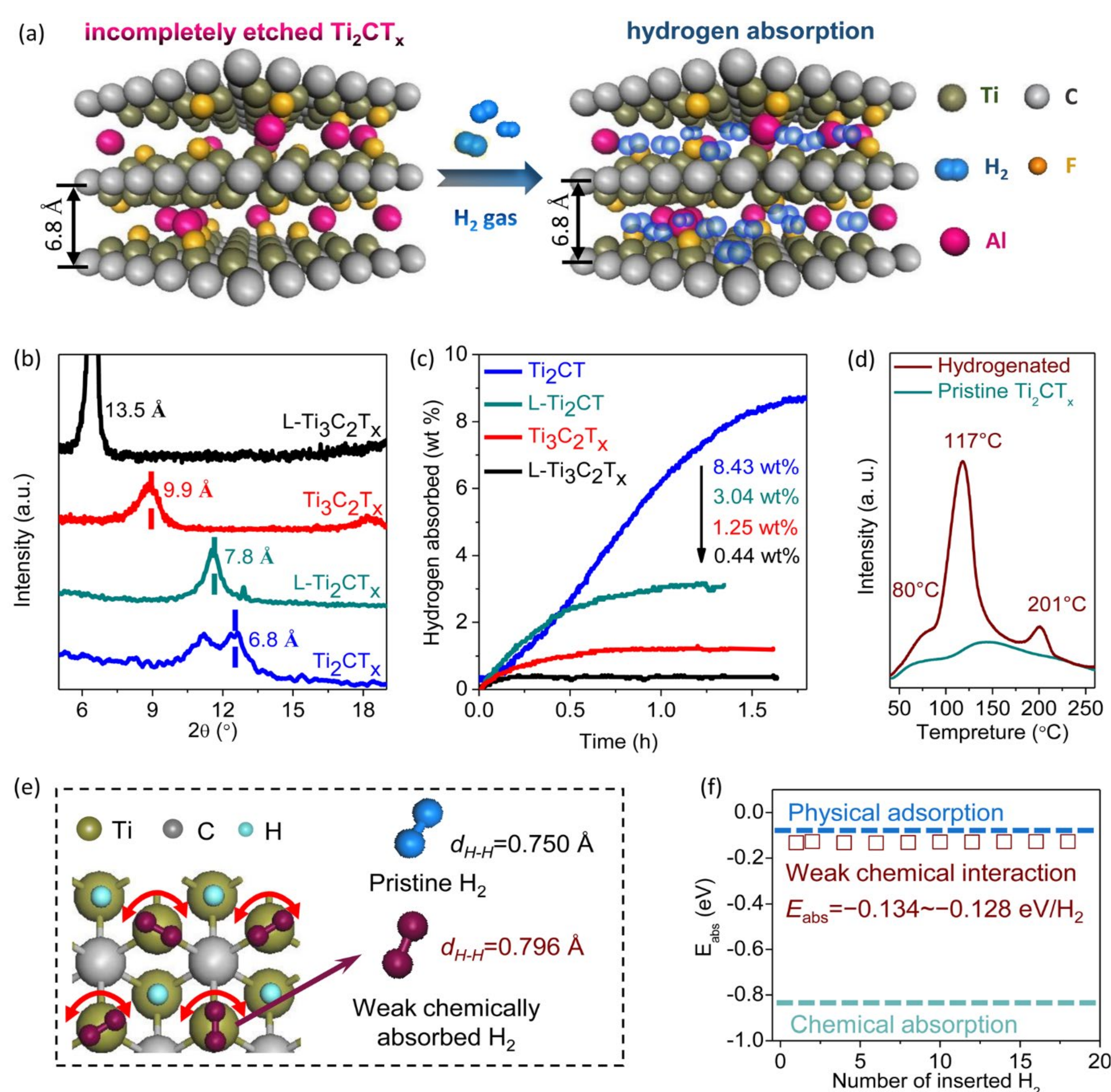


Figure 2. Hydrogen storage in MXenes: (a) Ti₂CT_x storage mechanism, (b) XRD patterns, (c) H₂ uptake, (d) TPD profiles, (e) DFT simulation of H₂ insertion and (f) absorption energy.

2. Mg-MOF-74 with Pt Catalyst (*Adv. Sci.* 2024, 2401868)

Highly defective framework exhibits both chemical hydrogen absorption capacity at above-ambient temperatures.

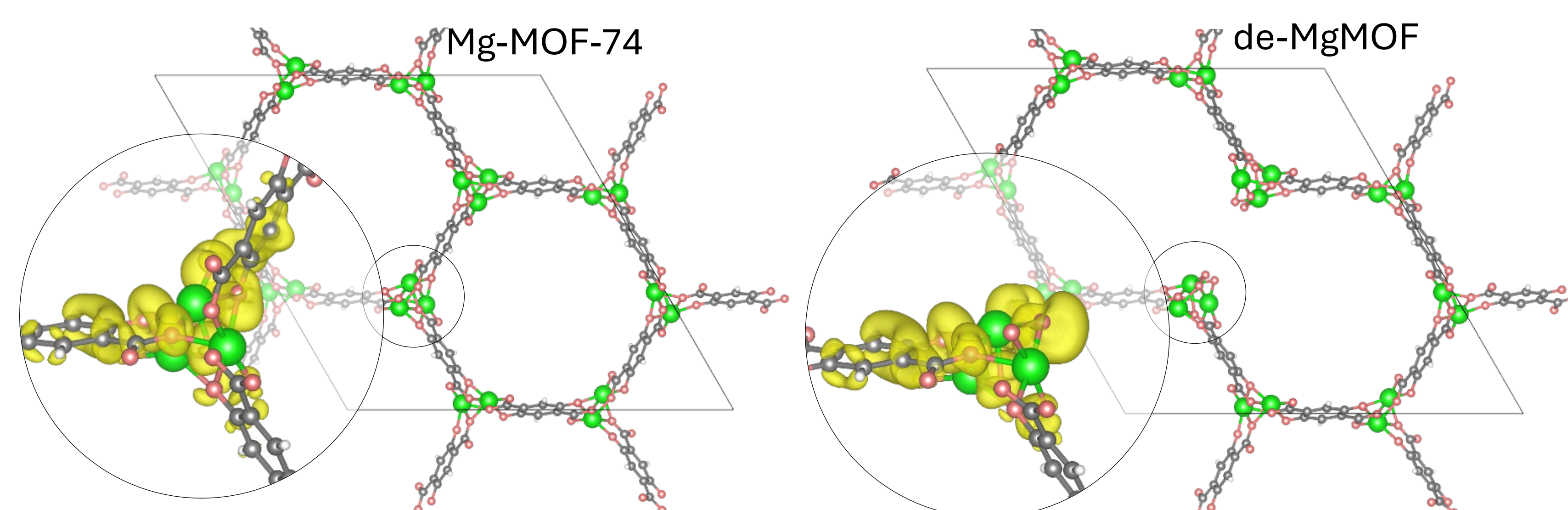


Figure 3. Structure and charge accumulation at MgO₅ knots in Mg-MOF-74 and defective Mg-MOF.

3. Organic hydrogen carrier

Advanced organic hydrogen carrier technology to make hydrogen storage and distribution safer, cheaper, and more practical..

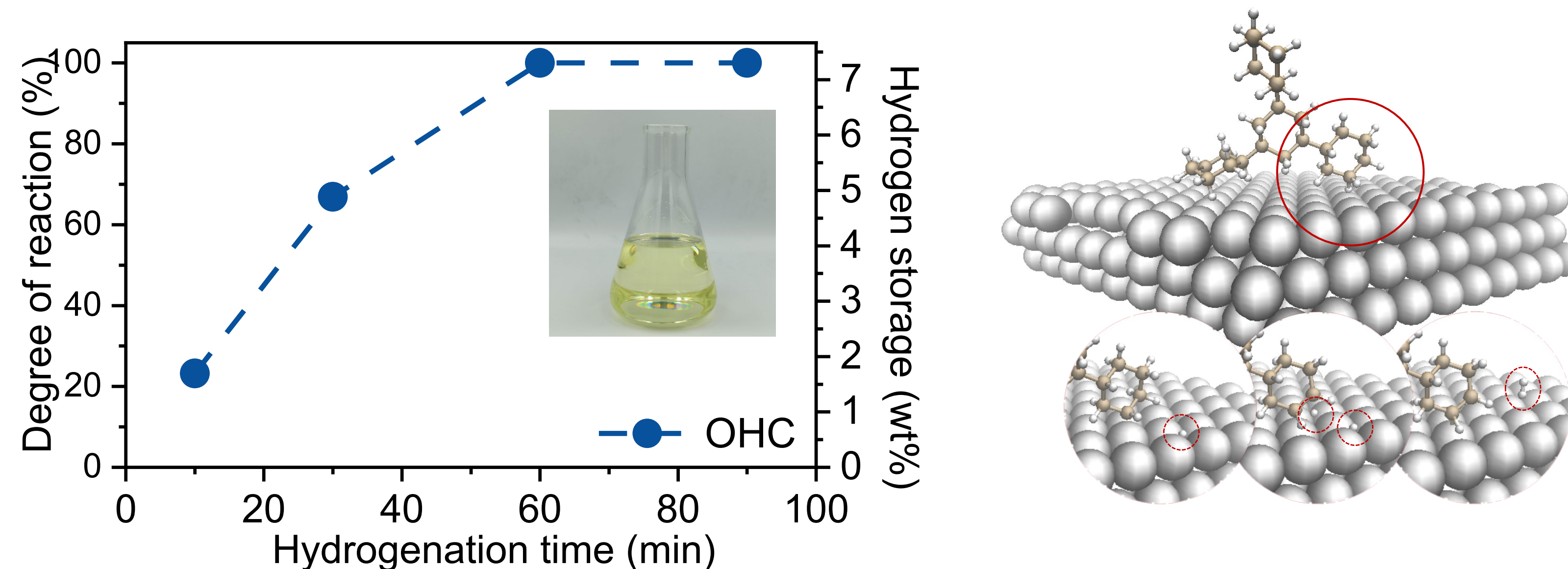
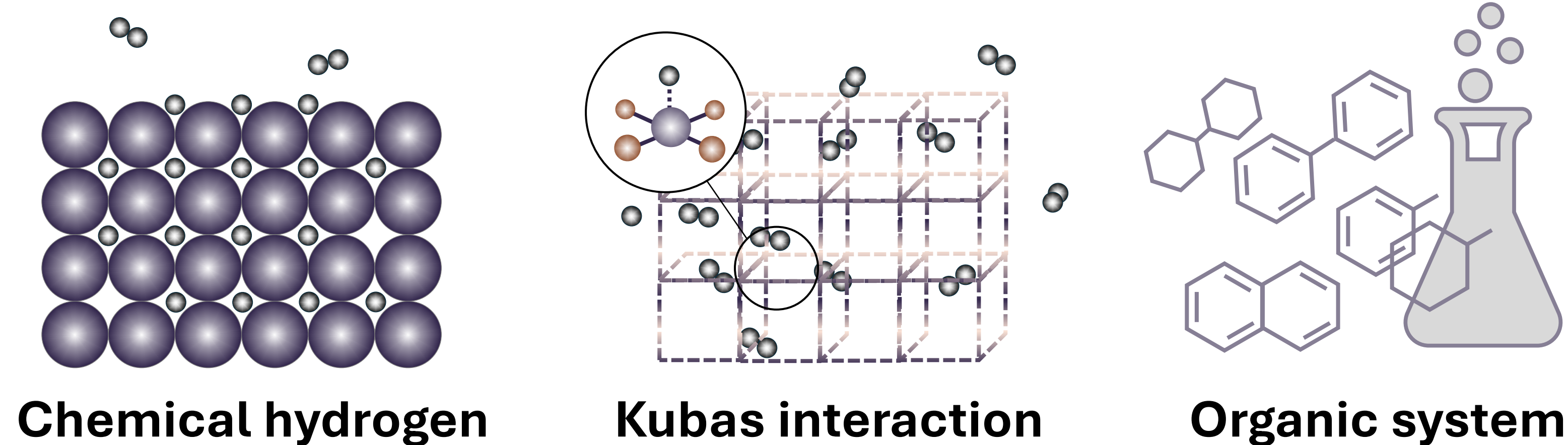


Figure 4. Experimental hydrogenation performance of the organic hydrogen carrier system and corresponding catalytic dehydrogenation simulation.

3. Future Directions

We are advancing **non-classical hydrogen storage mechanisms** to overcome the limitations of hydrogen physisorption and chemisorption in materials.

Research Focus:



Application Goal:

Scale-up of advanced hydrogen storage systems for real-world deployment.

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Organizers