

Nanoconfining H₂ - manipulation of the phase diagram and consequences of reduced freedom

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Condensed phases of molecular hydrogen (H₂) are highly desired for clean energy applications ranging from hydrogen storage to nuclear fusion and superconductive energy storage. However, in bulk hydrogen, such dense phases typically only form at exceedingly low temperatures or extremely high (typically hundreds of GPa) pressures, reducing accessibility of application.

Formation of solid-like H₂ at atmospheric pressure at temperatures above the critical point has been indicated in when H₂ is confined in nanoscale pores of carbon nanomaterials indicating an alternative route to access condensed phases at more accessible pressures and temperatures.^{1–3}

To understand the potential of nanoconfinement for manipulation of the hydrogen phase diagram, we explore which H₂ solids form and why when confined inside carbonaceous nanoscale pores, and investigating pore size and geometry effects.

Using a powerful combination of variable temperature and variable pressure inelastic neutron scattering and neutron diffraction we study the rotational dynamics, distribution and arrangement and structure of nanoconfined H₂.^{4,5}

Our results lead us to a general strategy for further manipulation of the H₂ phase diagram via nanoconfinement effects, and for tuning of anisotropic potential through control of confining material composition and pore size.

References

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Primary author: Dr TERRY, Lui

Co-authors: Prof. TING, Valeska (University of Bristol); Dr ROLS, Stephane (ILL); Dr DA SILVE, Ivan (ISIS); Dr TIAN, Mi (University of Exeter); Prof. BENDING, Simon (University of Bath)

Presenter: Dr TERRY, Lui

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