Boosting H_2 Release in $NaBH_4$ through Structural Control

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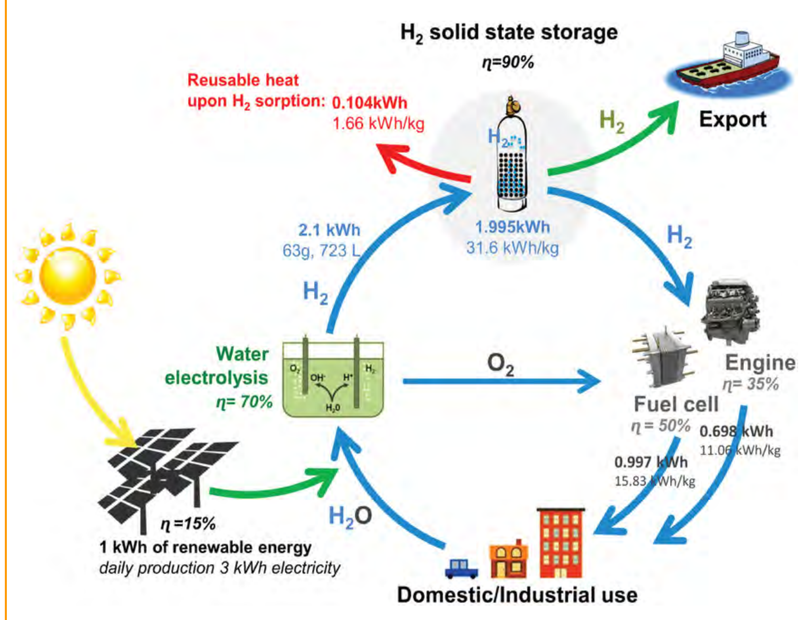
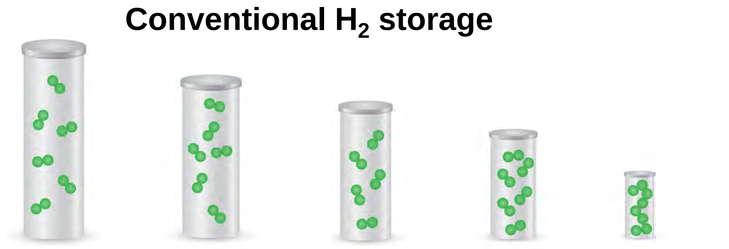
Hydrogen – A Key Contributor to the Energy Transition



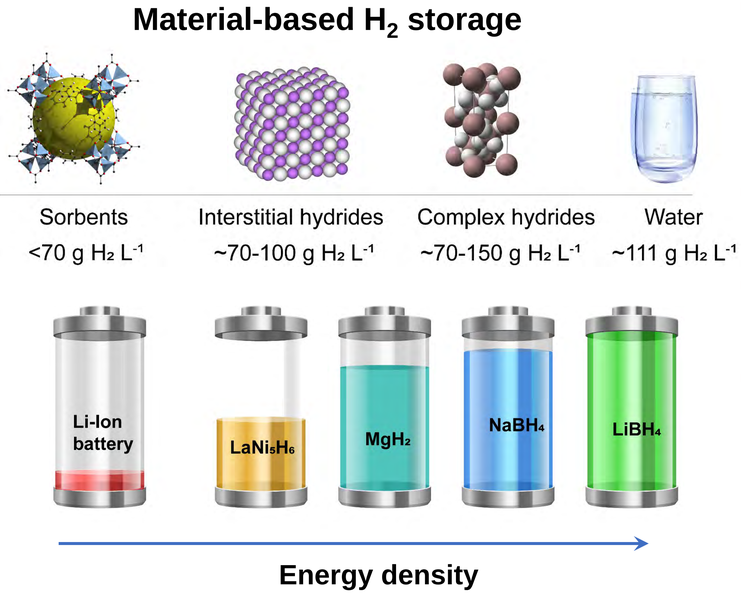
- Hydrogen is a potential energy vector
- Provides more reliability and flexibility in enabling the use of renewables across industries
- Hydrogen production, storage and distribution/utilization are the key players for the global hydrogen economy
- The most demanding – H_2 storage

Hydrogen Storage – Quo Vadis?

Conventional H_2 storage

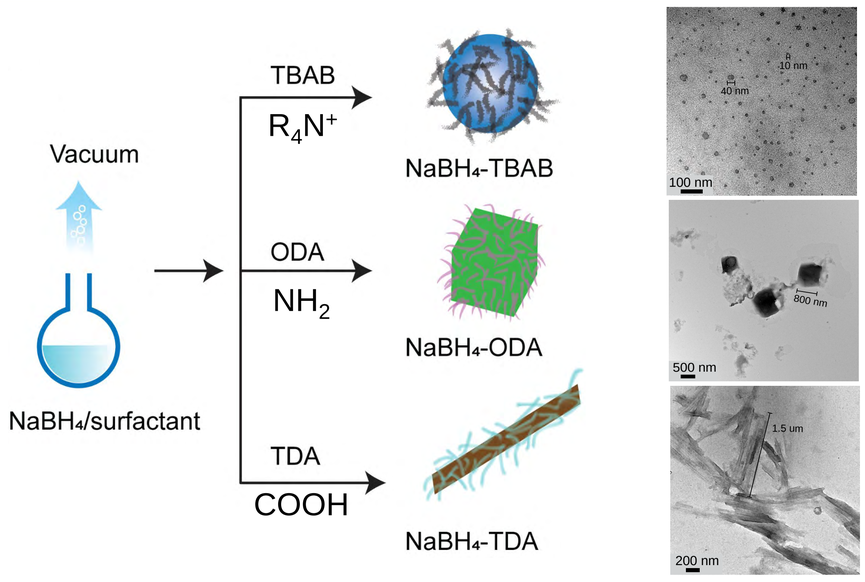


Material-based H_2 storage



- Gaseous-state H_2 storage; the most mature and simple technique to store hydrogen
- Material-based H_2 storage is advantageous – offers higher energy densities and safety
- Borohydrides are potential candidates. $NaBH_4$ with ~10.6 mass% H_2 is most widely used but requires >500 °C to release H_2
- Strategies to destabilize $NaBH_4$ are needed
- Structure-dependent H_2 release has never been realized
- Nanosizing has the potential to overcome the thermodynamic and kinetic barriers

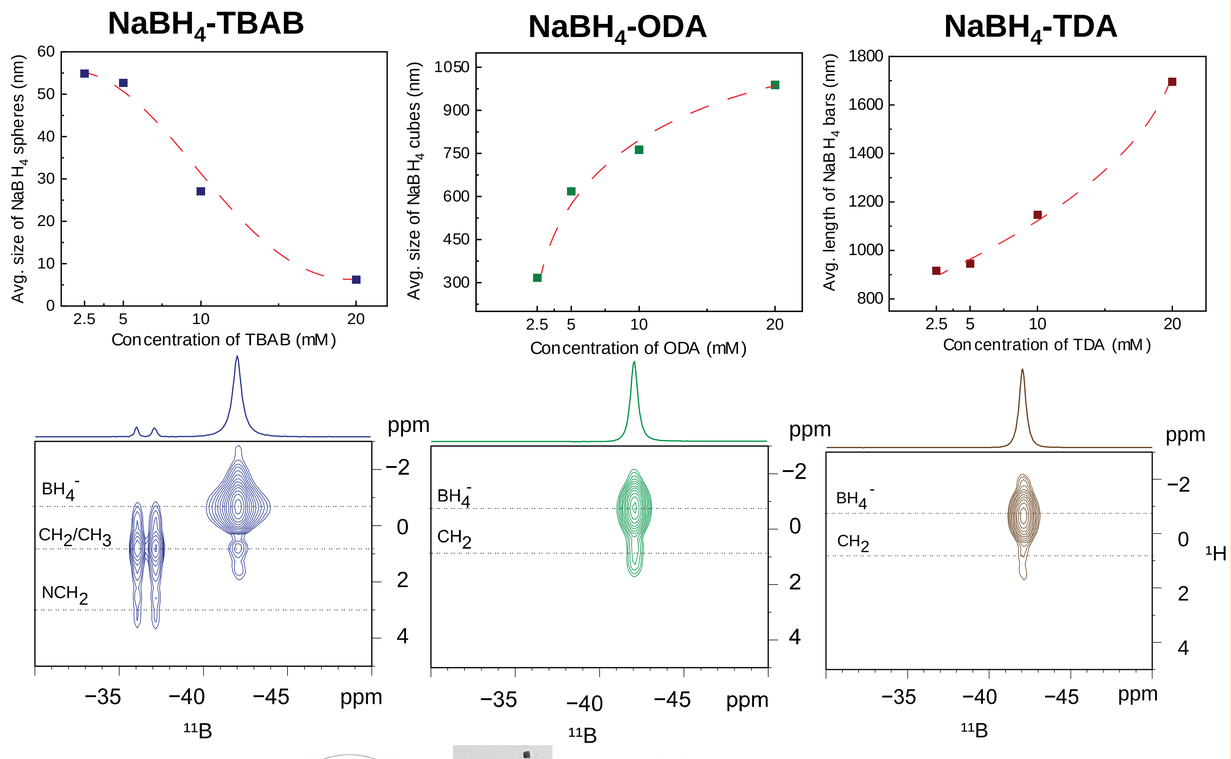
First-step Toward Tailoring $NaBH_4$ at the Nanoscale

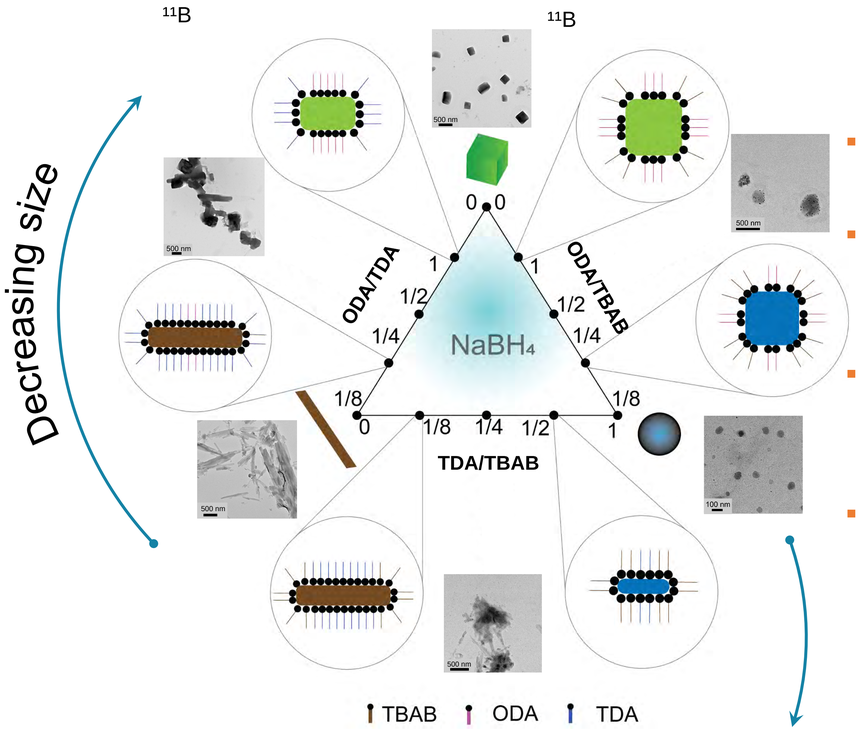


TBAB Tetrabutylammonium bromide **ODA** Octadecylamine **TDA** Tridecanoic acid

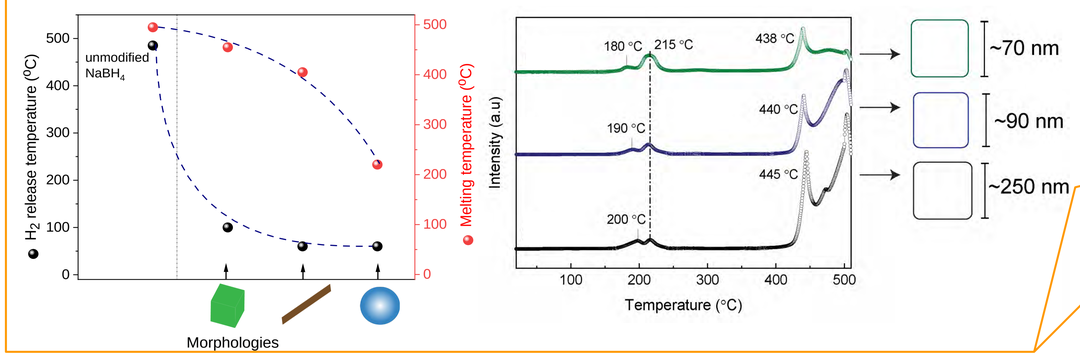
- Synthesis via evaporation induced self-assembly approach – offers higher flexibility and tunability compared to other methods
- TBAB, ODA, and TDA directed $NaBH_4$ spheres, cubes, and bars, respectively.

Key Findings

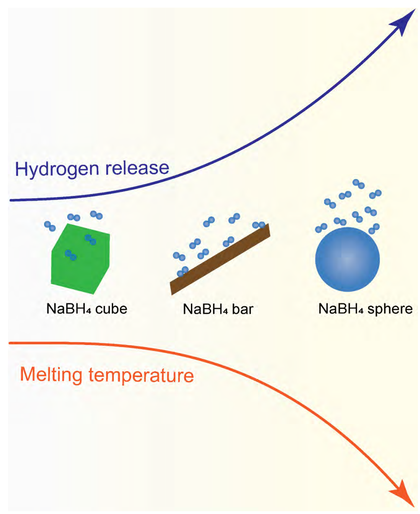




- Cosurfactant directed growth of $NaBH_4$
- Offers better control over size and structure compared to single surfactant
- Shapes could be transformed from one to another
- Size and structure-dependent hydrogen properties were obtained



Conclusion



- For the first time, size and shape-controlled growth of $NaBH_4$ has been achieved
- The size can be controlled by tuning the synthetic parameters; evaporation rate or concentration of surfactant
- The desired assemblies either as spheres, cubes, or bars were further tailored using a cosurfactant
- The structurally controlled $NaBH_4$ showed notable shifts in their melting points and H_2 release temperatures
- Further structure-property correlations are anticipated in the future

References

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