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A PEMFC operating at up to 200°C as a possible link to the complex metal hydrides like $NaAlH_4$

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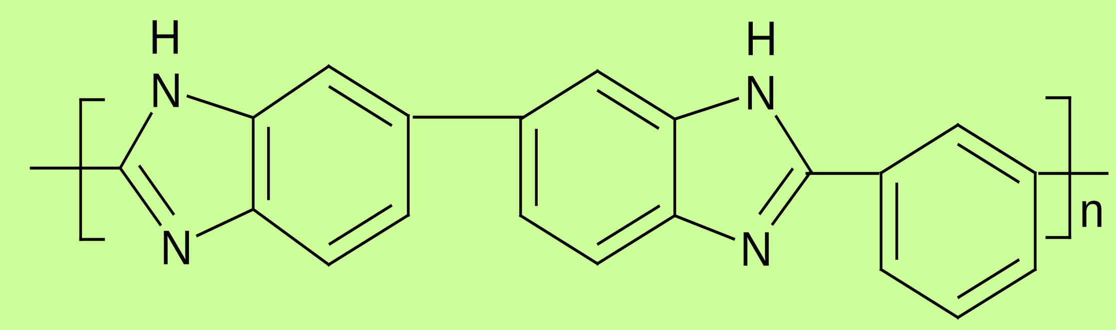
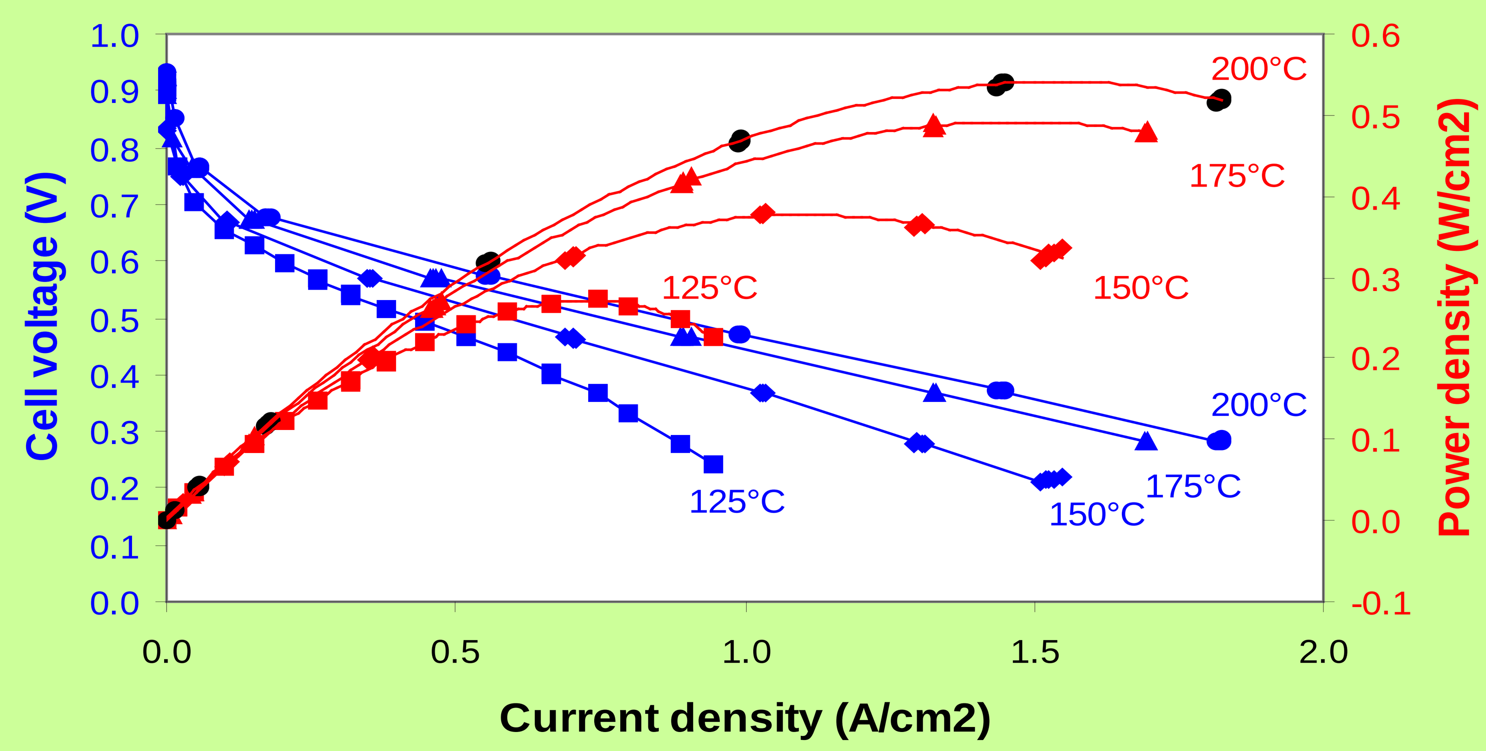
High temperature polymer fuel cells (HT-PEMFC) applying new membrane materials are devoted much attention due to a higher CO tolerance [1], reduced problems with water management and a higher temperature difference allowing for more compact cooling systems. The higher temperature also opens new opportunities for utilization of the heat produced by the fuel cell - typically at least half of the fuel energy.

The optimum fuel for any fuel cell is pure undiluted hydrogen, but the lack of satisfactory hydrogen storage means especially for mobile applications is slowing down the progress of direct hydrogen fuel cells. However, new metal hydrides with higher storage capacities are under development. Among these the $NaAlH_4$ system is very promising with 4-5 percent hydrogen reversible at temperatures around 150°C [2]. A more recent example is the $LiNH_2$-LiH system with desorption temperatures a bit higher [3].

Research groups world wide are aiming at bringing the practical desorption temperature down below 80°C to utilize the excess heat from a conventional PEMFC for hydrogen desorption, but this appears not to be easy. Our approach is to increase the temperature of the fuel cell instead, to make it able to supply the desorption heat at the appropriate temperature [1,4,5].



The polymer applied is polybenzimidazole (PBI). It is thermally stable up to over 400°C. Doped with phosphoric acid it becomes a good proton conductor.

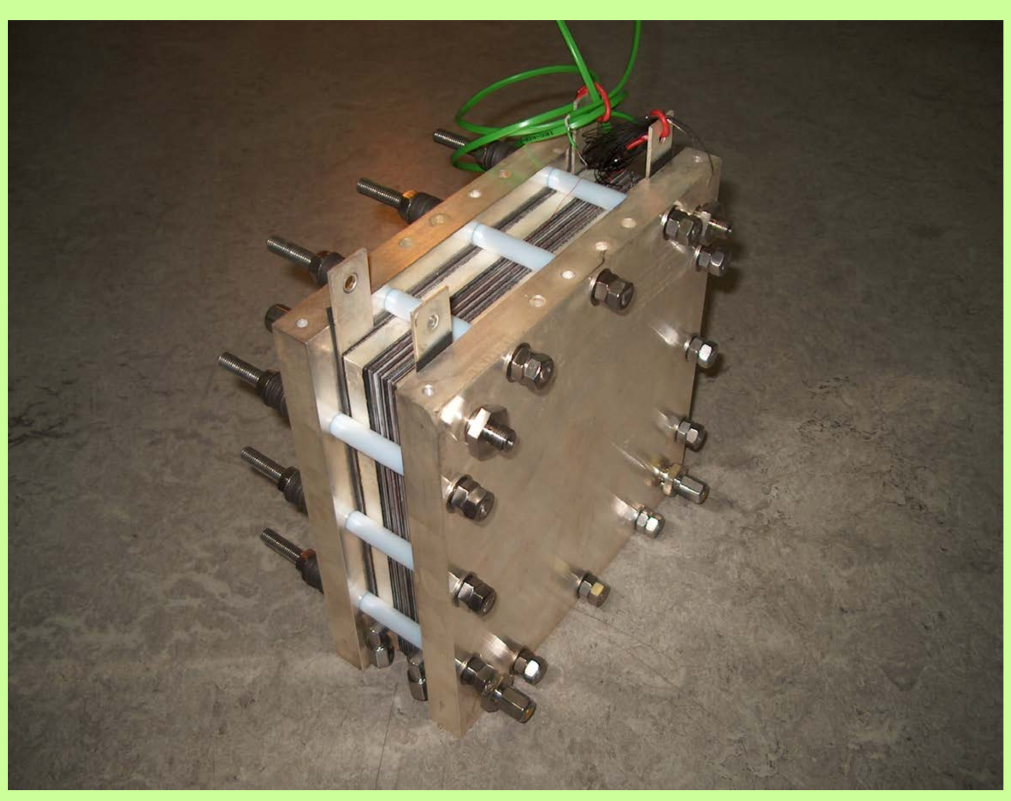


Polarization curves for single cells operated on H_2 and O_2 at ambient pressure. **No humidification applied**. Working temperatures on the figure

The building block for larger stacks:

A 4 cell stack unit with cooling plates.

Cell size: 16x16 cm



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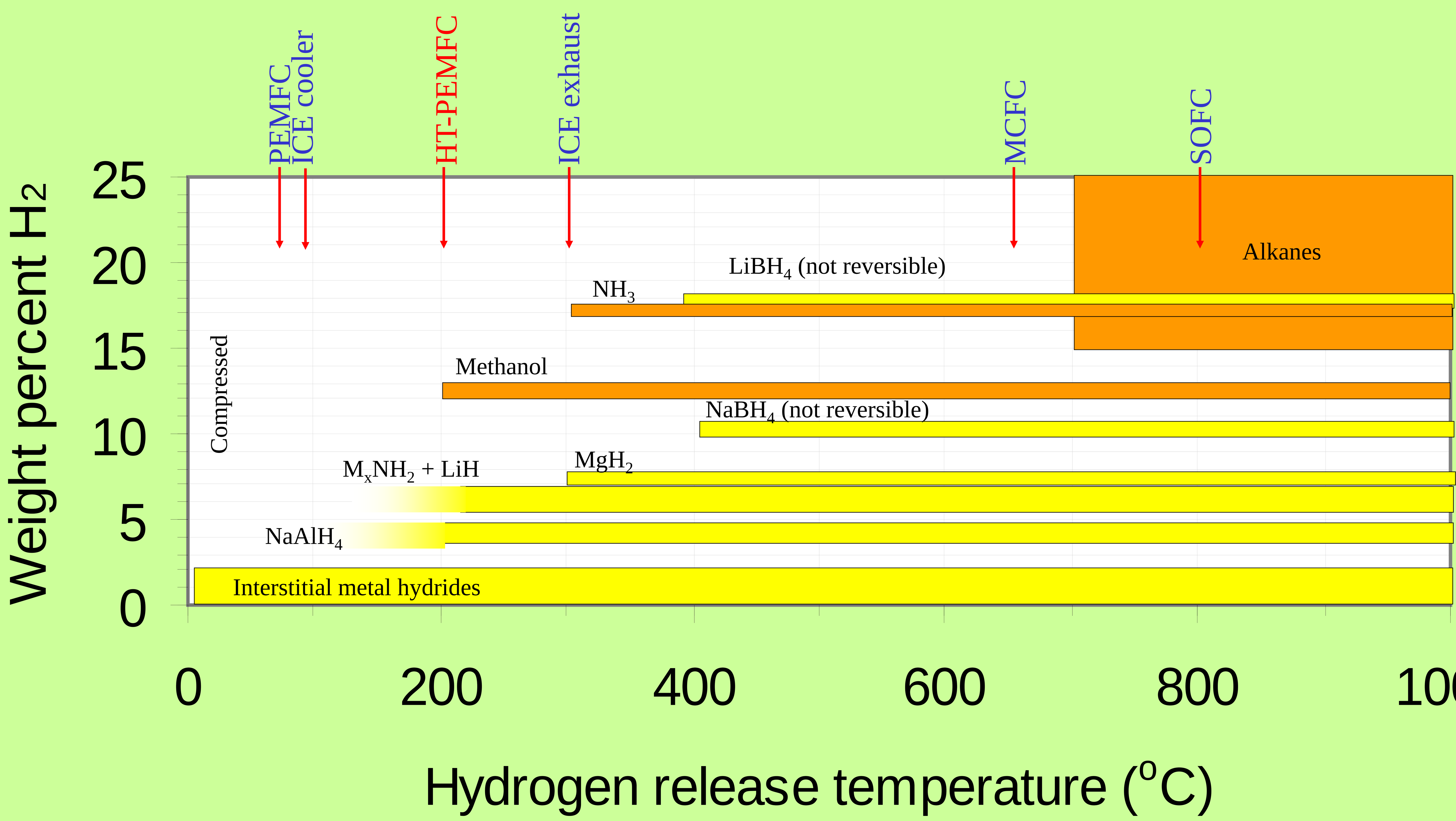

All solid or chemical hydrogen storage materials need heat to desorb hydrogen.

Different materials have different minimum practical hydrogen desorption temperatures at which the desorption heat must be supplied.

The figure compares these temperatures to different fuel cell types and an Internal combustion engine (ICE)

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