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Fluorine-Substituted Metal Hydrides for Thermal Energy Applications

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Metal hydrides have long been explored for their potential application in a variety of technological applications including hydrogen storage materials for energy applications, fast-ion conductors and sensors. For thermal energy storage, such as concentrating solar thermal energy storage, metal hydrides are required to operate at temperatures in excess of 500 °C [1]. This temperature is too high for even the more stable, reversible hydrogen storage materials, and as such, work has been undertaken to synthesise metal hydrides that are stable and reversible at these high temperatures.

One proven strategic method to stabilise these materials is to substitute fluorine atoms for hydrogen [2]. Fluorides are more stable than their hydride equivalents and this can be exploited to increase the stability of metal hydrides by partially substituting hydrogen for fluorine. For example, for the $\text{NaMgH}_{3-x}\text{F}_x$ system, pure NaMgH_3 releases H_2 at ~400 °C, whereas NaMgH_2F decomposes at ~478 °C [2]. This effect has been employed for a number of potential thermal energy storage metal hydrides, such as NaH , Mg_2FeH_6 and $\text{Na}_2\text{Mg}_2\text{FeH}_8$, allowing for greater tuning of their thermal properties by hydrogen/fluorine substitution.

References

1. D. N. Harries et al., Proceedings of the IEEE, 2012, 100, 539.
2. D. A. Sheppard et al., RSC Adv., 2014, 4, 26552.

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