SYNTHESIS, STRUCTURE, AND HYDROGEN STORAGE PROPERTIES OF H-RICH ALUMINUM-AMIDOBORANE COMPLEXES

Ting Zhang, Michel Devillers*, Yaroslav Filinchuk*

Institute of Condensed Matter and Nanosciences, Université catholique de Louvain.

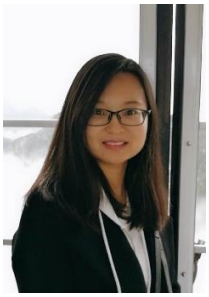
e-mail: ting.zhang@uclouvain.be

Materials based on a boron-nitrogen (B-N) bond, in particular, ammonia borane, metal amidoborane, hydrazine borane, metal hydrazinidoboranes, and metal borohydride ammoniates [1] attracted significant attention as hydrogen storage materials because of their high gravimetric hydrogen densities. We pay more attention to aluminum-amidoborane complexes, given some encouraging properties for the first system studied, involving the unsubstituted amidoborane.[2] Here we studied the synthesis, structure, and hydrogen storage properties of the Al-based terminal substituted amidoborane complexes $Na[AlH(CH_3NHBH_3)_3]$ and $Na[Al(CH_3NHBH_3)_4]$ obtained from $NaAlH_4$ and $CH_3NH_2BH_3$. As compared with unsubstituted Al-based amidoboranes ($Na[Al(NH_2BH_3)_4]$), $Na[Al(CH_3NHBH_3)_4]$ is easier to obtain with lower energy input. However, large mass losses during the thermal decomposition of $Na[Al(CH_3NHBH_3)_4]$, exceeding largely the hydrogen content of this complex hydride, indicates the loss of larger fragments, preventing the reversibility of H-desorption. Fortunately, $Na[Al(CH_3NHBH_3)_4]$ + 12 NaH and $Na[Al(CH_3NHBH_3)_4]$ + 6 $NaNH_2$ reactive hydride composites (RHCs) produce a large amount of high purity hydrogen at moderate temperatures. This gives hopes for the potential hydrogen reversibility in this and related Al-amidoborane systems.

References

[1] J. Alloys Compd. 2019, 794, 303-24

[2] a. J. Mater. Chem. A, 2013, 1, 1810-1820; b. Chem. Eur. J., 2015, 21, 14562-14570; c. Energies 2015, 8, 9107-9116; d. Int. J. Hydrog. Energy, 2018, 43, 311-321.



Ting Zhang a Ph.D. student of Université catholique de Louvain

- Working on the design, synthesis, structure, and hydrogen storage properties of Al-based lightweight materials from 09.2018 to now
- Worked on the synthesis, structure, and application of supramolecular metal-organic macrocycles from 09.2014 to 07.2017