Nanoparticle Complex Hydrides for Ionic Conductor

Tsuoma Narika

Department of Chemical Engineering, Kyushu Institute of Technology, Kita Kyushu, Japan

[Abstract] Complex hydrides show energy-related functions such as hydrogen storage, neutron shielding. Recently, another novel energy-related function, lithium fast-ionic conduction was recently reported. This finding suggests that complex hydrides are potential candidates for solid-state electrolytes in lithium-ion batteries. This chapter presents the recent progress in the development of lithium fast-ionic conductors of complex hydrides. First, the fast-ionic conduction in LiBH4 as a result of clarifying the mechanism of microwave absorption is presented, and then the conceptual development of complex hydrides as a new type of solid-state lithium fast-ionic conductors in LiBH4, LiNH2, and LiAlH4-based complex hydrides is discussed. Last, the potential prospects of this study from both practical and fundamental standing points are described: utilization of complex hydrides as solid electrolytes for batteries, formation of ionic liquids by complex hydrides, and similarity between complex hydrides.

Reference:

1. Motoaki Matsuo, Yuko Nakamori, Shin-ichi Orimo, Hideki Maekawa, and Hitoshi Takamura. "Lithium superionic conduction in lithium borohydride accompanied by structural transition." Applied Physics Letters 91, no. 22 (2007): 4103.
2. Motoaki Matsuo, Yuko Nakamori, Keitaro Yamada, and Shin-ichi Orimo. "Effects of microwave irradiation on the dehydriding reaction of the composites of lithium borohydride and microwave absorber." Applied physics letters 90, no. 23 (2007): 2907.
3. Hideki Maekawa, Motoaki Matsuo, Hitoshi Takamura, Mariko Ando, Yasuto Noda, Taiki Karahashi, and Shin-ichi Orimo. "Halide-stabilized LiBH4, a room-temperature lithium fast-ion conductor." Journal of the American Chemical Society 131, no. 3 (2009): 894-895.
4. Motoaki Matsuo, Hitoshi Takamura, Hideki Maekawa, Hai-Wen Li, and Shin-ichi Orimo. "Stabilization of lithium superionic conduction phase and enhancement of conductivity of LiBH4 by LiCl addition." Applied Physics Letters 94, no. 8 (2009): 84103.
5. Motoaki Matsuo, Arndt Remhof, Pascal Martelli, Riccarda Caputo, Matthias Ernst, Yohei Miura, Toyoto Sato et al. "Complex hydrides with (BH4)− and (NH2)− anions as new lithium fast-ion conductors." Journal of the American Chemical Society 131, no. 45 (2009): 16389-16391.
6. Motoaki Matsuo, Toyoto Sato, Yohei Miura, Hiroyuki Oguchi, Yu Zhou, Hideki Maekawa, Hitoshi Takamura, and Shin-ichi Orimo. "Synthesis and lithium fast-ion conductivity of a new complex hydride Li3(NH2)2I with double-layered structure." Chemistry of Materials 22, no. 9 (2010): 2702-2704.
7. Yu Zhou, Motoaki Matsuo, Yohei Miura, Hitoshi Takamura, Hideki Maekawa, Arndt Remhof, Andreas Borgschulte, Andreas Züttel, Toshiya Otomo, and Shin-ichi Orimo. "Enhanced Electrical Conductivities of Complex Hydrides Li2(BH4)(NH2) and Li4(BH4)(NH2)3 by Melting." Materials transactions 52, no. 4 (2011): 654-657.