Researchers demonstrate reversible generation of a high capacity hydrogen storage material

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Researchers at the U.S. Department of Energy's Savannah River National Laboratory have created a reversible route to generate aluminum hydride, a high capacity hydrogen storage material. This achievement is not only expected to accelerate the development of a whole class of storage materials, but also has far reaching applications in areas spanning energy technology and synthetic chemistry.

"We believe our research has provided a feasible route to regenerate aluminum hydride, a high capacity hydrogen storage material," says Dr. Ragaiy Zidan of SRNL, lead researcher on the project. The SRNL team, supported by the DOE Office of Energy Efficiency and Renewable Energy, has developed a novel closed cycle for producing aluminum hydride (AlH_3), also known as alane, that potentially offers a cost-effective method of regenerating the hydrogen storing material in a way that allows it to repeatedly release and recharge its hydrogen. In this process, the hydride is made via an electrochemical method, and the starting material is regenerated directly with hydrogen. Although many attempts have been made in the past to make alane electrochemically, none of these previous attempts were totally successful.

For years, one of the major obstacles to the realization of the hydrogen economy is hydrogen storage. Solid-state storage, using solid materials such as metals that absorb hydrogen and release it as needed, has many safety and practicality advantages over storing hydrogen as a liquid or gas, and many storage materials have been examined trying to meet DOE's goals. Several materials have been discovered that have met or exceeded the DOE gravimetric and/or volumetric performance targets. Of those, however, the majority do not have the required thermodynamic and kinetic properties that allow them to release their hydrogen when needed, and be efficiently and economically reloaded with hydrogen when spent.

Alane possesses the desired qualities, but had been considered impractical because of the high pressures required to combine hydrogen and aluminum to reform the hydride material. Alternate methods of production using chemical synthesis have typically produced stable metal chloride byproducts that make it practically impossible to regenerate the alane. The electrochemical cycle demonstrated by Dr. Zidan and the SRNL team for production of alane avoids both of these issues.

In conjunction with this research, the SRNL team discovered novel ways to facilitate separation and formation of aluminum hydride that also apply to the formation of other complex metal hydrides and have the potential to cost-effectively regenerate other high capacity hydrogen storage materials. The SRNL results are expected to accelerate the development of a whole class of similar materials needed for hydrogen, batteries and other energy storage applications.

In addition, this work will significantly impact other fields including those of thin films, adduct based syntheses, and the recycling and regeneration of other materials.

More information: The research is reported in an article published in *Chem. Commun.*, 2009, 3717, a publication of the Royal Society of Chemistry. The work was supported by a grant from the U.S. Department of Energy.

Source: Savannah River National Laboratory

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