A High-Capacity, Reversible Liquid Organic Hydrogen Carrier: H_2-Release Properties and an Application to a Fuel Cell

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Hydrogen storage in the form of a liquid chemical is an important technology to bridge the gap between sustainable hydrogen production and utilization with a fuel cell. In the presentation, a novel liquid organic hydrogen carrier (LOHC), a mixture of biphenyl and diphenylmethane, is demonstrated. The presented material is capable of storing and releasing molecular hydrogen with 6.9 wt% and 60 g-H_2 L^{-1} of gravimetric and volumetric hydrogen storage capacities, respectively. The as-presented LOHC stores molecular hydrogen with Ru/Al_2O_3, producing LOHC-H_2. The formed LOHC-H_2 then releases molecular hydrogen with a dehydrogenation conversion of >99% in the presence of Pd/C. In addition, molecular hydrogen released is found to be >99.9% purity. Less than 1% of the material is lost after consecutive and nine times cyclic tests of hydrogenation and dehydrogenation. Finally, a dehydrogenation system is designed and operated in conjunction with a polymer electrolyte membrane fuel cell, generating ca. 0.5 kW of electrical power in a continuous manner.