A High-Capacity, Reversible Liquid Organic Hydrogen Carrier: Production of Hydrogen and an Application to a Fuel Cell

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Hydrogen storage in the form of liquid chemical is very essential because the supply and demand of hydrogen can happen at different site. In this study, the application of a hydrogen storage material which is a eutectic mixture of biphenyl (35 wt%) and diphenylmethane (65 wt%) has been demonstrated. The proposed material is able to reversibly store and produce molecular hydrogen with 6.9 wt% and 60 g-H_2 L^{-1} of gravimetric and volumetric hydrogen storage capacities. Experimentally, conversion of dehydrogenation was higher than 99%, and hydrogen produced by dehydrogenation reaction had a purity of over 99.9%, with negligible side reactions. Further, this was confirmed via NMR spectroscopy. After a total of 9 cyclic tests of hydrogenation and dehydrogenation, there was a loss of less than 1%. Finally, a dehydrogenation system is designed and operated in conjunction with a PEM fuel cell that can generate higher than 0.5 kW of electrical power continuously, verifying its capability as a promising liquid organic hydrogen carrier.