Development hydride materials as compact form for hydrogen storage and hydrogen generation

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During the last two decades it became obviously, that intensive evolution of industry and transport would lead to energy crisis. Fast decrease of fossil fuel promotes a search of alternative energy sources. The development of fuel cells and their wide application are impossible without highly efficient and safe technologies for obtaining pure hydrogen and its storage, safety transportation and distribution. The requirement to H_2 storage systems are determined by character of commercial applications. So, the large volumetric and gravimetric hydrogen density of H_2 fuel is very important for mobile devises.

According to many researchers, hydrogen generators based on hydrolysis of hydrides are offered as promising portable devices that were employed with proton-exchange fuel cells. Among the hydrides, sodium borohydride (10.5 wt% H) and ammonia-borane (19.4 wt% H) are desirable due to high hydrogen content and the excellent stability. The presence of catalysts not only accelerates the hydrides hydrolysis but also prevents the formation of side products. Obtained hydrogen is saturated only with water vapor. Therefore, it can be fed to the anode space of a fuel cell without additional purification or wetting. Also, hydrogen generators could potentially be used not only for power generation but for many other stationary and mobile industry applications.

In this work investigation of hydrogen generation from $NaBH_4$ and NH_3BH_3 over catalysts has been carried out. The systematic study of nanosized Pt, Ru, Rh, Co, Ni-supported catalysts was performed. It was shown, that the interaction between active component and support affects the rate of hydrides hydrolysis. Variation of catalysts preparation conditions allows us to control activity of nanosize metal particles. However, high cost of catalysts containing platinum group metals initiated our studies on the development of catalytic systems without precious metals. It was shown that catalysts containing cobalt borides are the most active.

Carried out studies have permitted to develop the optimized design of portable hydrogen generators. The type and quantity of catalyst, its packing in the reactor, the feed rate and the feed solution concentration are all key parameters in the reactor operation. Hydrogen "on demand" technology has been successfully demonstrated over a wide range of hydrogen delivery flow rates using different catalysts. The realization of reversibility of hydride decomposition products is very important for practical use.