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Impact of the reactor bottom shape on the solid sodium borohydride hydrolysis for hydrogen generation

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Abstract

Sodium borohydride ($NaBH_4$) is a chemical hydride that produces hydrogen (H_2) 'on-demand' through the reaction with water, and exhibits high gravimetric hydrogen storage capacity (10.8 wt.%). $NaBH_4$ has been appointed as an efficient energy/hydrogen carrier for use with fuel cells [1-6]. Unfortunately, problems also exist with $NaBH_4$ hydrolysis: H_2 production rates are not sufficiently fast, reaction completion is not always reachable and effective gravimetric (and volumetric) H_2 storage capacity is far from the theoretical value.

The present study reports original experimental work on generation of hydrogen, by hydrolysis of solid sodium borohydride with stoichiometric amount of distilled water ($H_2O/NaBH_4$: 2, 3 and 4 mol/mol), in the presence of a powder unsupported Ni-Ru based catalyst, reused about 320 times. The experiments, performed in two batch reactors with equal internal volume but with different bottom shapes (flat and conical), reveal - for the conical bottom shape with any excess of water - 8.1 H_2 wt% and 92 kg H_2/m^3 (materials-only basis), and a H_2 rate of 87.4 $L(H_2)\ min^{-1}g^{-1}$ catalyst. The role of reactor bottom geometry on the solid $NaBH_4$ hydrolysis - with any excess of water - is, as the authors are aware, for the first time here referred.

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