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Heterogeneous Catalysts for Hydrogen Generation Based on Ru-Incorporated Hydroxyapatite

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Hydrolysis of sodium borohydride provides a safe and clean approach to hydrogen generation. Having the proper catalytic support for controlling this reaction is therefore a valuable technology. Here we demonstrate the capability of hydroxyapatite as a novel catalytic support material for hydrogen generation. Aside from being inexpensive and durable, we reveal that Ru ion exchange on the HAP surface provides a highly active support for sodium borohydride hydrolysis, exemplifying a high total turnover number of nearly 24,000 mol H_2/ mol Ru. Moreover, we observe that the RuHAP support exhibits a high catalytic lifetime of approximately one month upon repeated exposure to $NaBH_4$ solutions. In addition to examining surface area effects, we also identified the role of complex surface morphology in enhancing hydrolysis by the catalytic transition metal covered surface. Particularly, we found that a polycrystalline RuHAP catalytic support exhibits shorter induction times for the initial bubble formation as well as increased hydrogen generation rates as compared to a single crystal supports. The independent factor of a complex surface morphology is believed to provide enhanced sites for gas release during the initial stages of the reaction. By demonstrating the ability to shorten induction time and enhance catalytic activity through changes in surface morphology and Ru content, we find it feasible to further explore this catalyst support in the construction of a practical hydrogen generator.

Keywords: hydrogen generation, sodium borohydride, hydroxyapatite, heterogeneous catalyst