Abstract

This research is focused on the hydrogen production for the use with proton exchange membrane fuel cells. There are 3 projects under this research. The first project aims to synthesize and characterize Pt-ZnO over mixed oxide containing CeO_2, ZrO_2 and Al_2O_3 catalysts. The catalytic activities to methanol stem reforming reaction were investigated. The ratio of methanol to water was kept constant at 5:1. The Brunauer Emmett-Teller (BET) results showed that the sample containing zinc oxides and aluminum oxides of 10:90 gave the highest specific surface area of 192.8 m^2/g and also showed the best performance to methanol steam reforming. The methanol conversion reached maximum of 42% at 340 °C. The H_2 production rate under the studied conditions was 0.34 L/h.

The second project aims to produce activated carbons from mangosteen shells in order to use it as a catalyst supporter. It was found that the pretreatment process induced the pore sizes to be wider. The post treatment yields oxygen functional groups on pore surface. The activated carbons prepared by using physical activation have higher specific surface area than those prepared by chemical activation because the severe condition of chemical activation resulted in an increase in numbers of large pores. Consequently, the surface area of activated carbon decreased. Therefore, both pretreatment with steam and post treatment with nitric acid were required to obtain activated carbons with high specific surface area.

The third project is about the immobilization of microalgae in order to enhance the algae to grow and to effectively produce hydrogen. The microalgae species “spirulina” was selected because it produces highest rate of hydrogen production and has faster growth rate. Then, the suitable condition to immobilize microalgae with sodium alginate and chitosan was studied. The result showed that the suitable concentration of the immobilized algae were 4% alginate with dimension 1.5 millimeter in 4% strontium chloride with incubation time of 2 h. The cell concentration was 1.5 g (dry weight)/ 100 ml alginate. Moreover, the chitosan that made the beads stable and enhanced algae to grow in alginate beads was 0.4% and light intensity was 6000 lux. The hydrogen gas production was 31.6 µL/h.

Keywords: Hydrogen production, Methanol steam reforming, Mangosteen shell, Physical activation, Chemical activation, Microalgae, Immobilized beads