Anodic Aluminum Oxide Supported Cu-Zn Catalyst for Steam Reforming of Methanol

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Recently, hydrogen production from steam reforming of methanol (SRM) has been proposed for supplying hydrogen to fuel cells. [1]. For this purpose, metal monolith reactors have been studied since such reactors have high thermal conductivity, good mechanical strength and low pressure drop[2]. However, the reactors suffered from peeling of the catalyst layer due to the weak bonding between the metal substrate and the catalyst layer. As a solution, the catalyst support layer grown on the metal surface and then coating the support to make the catalyst layer was proposed [3].

In this study, an anodic aluminum oxide (AAO) support was prepared on an Al plate by anodizing in oxalic acid electrolyte solution. Fig. 1 shows the AAO support after anodic oxidation (a), the support after the treatment of pore widening (b) and after hot water treatment (c) to increase the specific surface area. The support was then immersed into a solution of Cu nitrate (1M) and Zn nitrate (1M). The impregnated support was dried and calcined. To increase the loading of the active components in the catalyst layer the impregnation procedure was repeated up to five times. The activity of prepared catalysts were examined for steam reforming of methanol.

Fig. 2 shows the change in the methanol conversion with repeating the impregnation procedure and the change in the Cu metal surface area measured by the method of N_2O dissociation. It is found that the immersion time has no effect on the performance of the catalyst and the repeated impregnation procedure has increased the activity up to 4 times. Also a direct relation between the Cu metal area and the catalytic activity is observed.

Fig. 3 shows the high temperature stability of the catalyst. As Cu-based catalysts are limited to use below 300 C, to induce the high temperature deactivation, the catalysts were subjected to a thermal cycle between 350 C (3h) and 250 C (1h). The catalyst impregnated only once deactivated quickly (green circles) with the cycles while the catalysts impregnated twice or five times show gradual decline in the activity.

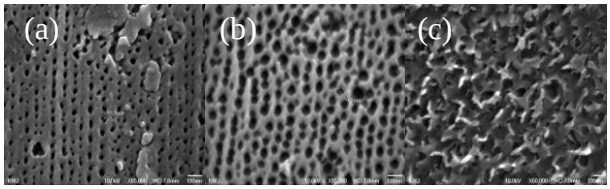

Fig. 1. SEM images of AAO(a), PWT-AAO(b) and HWT-AAO (c).

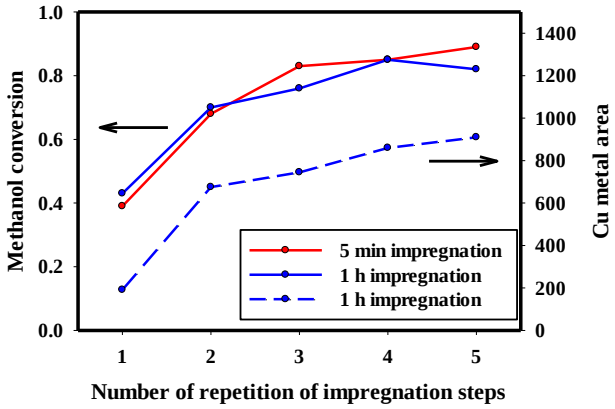

Fig. 2. Effect of repetition of impregnation steps on the performance of catalysts.

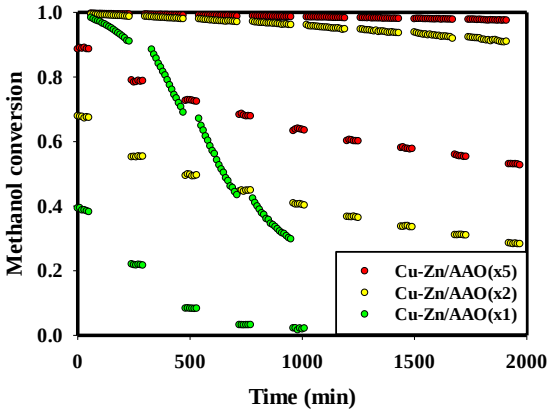

Fig. 3. High temperature stability of catalysts.

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