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Improvement of catalytic stability in Carbon Dioxide Reforming of Methane over Ni-carbon Composite Catalyst: Effect of Carbon Structure

Carbon dioxide and methane have been utilized as reactant gases to produce hydrogen and carbon monoxide through dry reforming reaction. However, the main problem is catalyst deactivation by coke formation. In order to solve this problem, nickel-carbon nanotubes (Ni-CNTs) composite material with a unique structure of Ni on the tips of CNTs used as catalyst could prolong the catalyst lifetime during the reaction. In this research, the effects of carbon structures of Ni-CNTs composites over mesocellular silica (MS) support on catalytic activity and stability in dry reforming reaction were investigated. Ni-CNTs composite catalysts (Ni-CNTs(x)/MS) were synthesized via the catalytic chemical vapor deposition (CCVD) technique at 650, 700, and 750oC, and were then used in dry reforming reaction at temperatures of 550, 650, and 750oC. With increasing the CCVD temperature, the relative amounts of highly stable CNTs and less stable CNTs significantly increased. Among these composite catalysts, Ni-CNTs(750)/MS catalyst showed better catalytic stability than those of Ni-CNTs(650)/MS and Ni-CNTs(700)/MS catalysts because of its composite structure contained the highest relative amount of highly stable CNTs. . In addition, Ni-CNTs(750)/MS composite catalyst gave the highest turnover frequency (TOF) values of 2.62 and 3.63 times higher than those of the conventional Ni/MS catalysts at the reaction temperatures of 650 and 750oC, respectively. This outstanding performance could be attributed to the existence of highly stable CNTs could significantly enhance the catalytic performance and stability of this Ni-CNTs composite catalyst in dry reforming reaction.

Author: Dr DONPHAI, Waleeporn (Department of Chemical Engineering, Faculty of Engineering,)

Presenter: Dr DONPHAI, Waleeporn (Department of Chemical Engineering, Faculty of Engineering,)

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