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Catalyst Configuration and Microwave Reactor Applications for Coke Elimination in Hydrogen Production through Reforming Reactions

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Bio-ethanol, with its high hydrogen content, low toxicity and CO_2 neutrality, has been considered as an excellent non-petroleum resource for the production of hydrogen rich synthesis gas (1,2). Conversion of biogas to syngas through dry reforming of methane is another route for the production of synthesis gas with a composition suitable for Fischer-Tropsch synthesis [3]. Coke formation during dry reforming of methane and steam reforming of ethanol is a major problem to be resolved for catalyst and reactor stability. In this study, Ni based mesoporous alumina (MA) catalysts with ordered pore structures were synthesized and tested in both steam reforming of ethanol and dry reforming of methane in the temperature range of 550-600^{o}C. Results obtained for coke elimination during reforming reactions, by the modification of these catalysts with Mg, will be reviewed. Ethanol steam reforming reactions were performed both in a conventionally heated fixed bed reactor and also in a reactor which was heated by a focused microwave source. Complete conversion of ethanol and very high hydrogen yield values (approaching to equilibrium) were obtained at a WHSV of about 5 h^{-1}. Results obtained with Ni impregnated MA catalysts proved the advantages of using a microwave (MW) reactor system to achieve coke minimization. While significant coke formation was observed in the conventional reactor, almost no coke formation was observed in the MW system. Temperature uniformity achieved in the MW system was shown to cause major advantages in terms of product distribution and reactor stability.

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