SYNTHESIS AND CHARACTERIZATION OF NON-NOBLE METAL NANO-CATALYSTS FOR HYDROGEN PRODUCTION

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Abstract

Our objective is to synthesize non-noble metal catalysts for steam reforming of methanol in silicon microreactors to produce hydrogen for portable fuel cell applications. Silica sol-gel supported nano-scale catalysts (Co and Ni) were prepared using the respective metal salts and characterized by X-ray diffraction (XRD), BET surface area analysis, differential thermal analysis (DTA), scanning electron microscopy-energy dispersive x-ray (SEM-EDX), transmission electron microscopy (TEM), vibrating sample magnetometer (VSM), and *in situ* temperature programmed reduction (TPR) techniques. EDX results show 7.85 wt% of Ni, which is lower than the intended loading of 12 wt%. The specific surface area of the Ni-SiO_2 catalyst is 452 m^2/gm and is higher than that of the Co-SiO_2 catalyst. The XRD, DTA and TEM data support increase of sample crystallization and oxide formation with increase of temperature. DTA data yield 400 ºC as the optimum calcination temperature for conversion of metal hydroxides to metal oxides in the sol-gel matrix. TPR results indicate that the reduced metal species are formed at 500 ºC. The ferromagnetic behavior from VSM data shows that the catalyst is still active after 10 hours of steam reforming reaction. Preliminary results show a methanol conversion of 54% with 90% selectivity to hydrogen using Ni metal nanocatalyst at 200 ºC and atmospheric pressure.