

Nanocatalyst for Conversion of Biomass into Fuels using Microchannel-Microreactor and Tubular Reactor

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Abstract: The major focus of our research at NSF-CREST Bioenergy Center is to develop catalysts for conversion of CO₂ enriched syngas into liquid fuels and production of hydrogen for fuel cell applications. One main objective is to develop robust and stable catalysts for Fischer-Tropsch (F-T) synthesis using Si-microchannel microreactor. Recently, we demonstrated a novel, modified closed channel infiltration (mCCI) method, to produce ~10 μm silica sol-gel coatings containing Ru, Fe and Co- catalysts in the Si-microchannels.¹ While Co/SiO₂ at 250°C showed highest CO conversion, 90%, with higher stability, it was followed by Fe/SiO₂ and Ru/SiO₂ in regard to CO-conversion and deactivation of the catalyst. To investigate the role of support, the Si-microchannels were coated with titania sol-gel containing Ru, Co, Fe catalysts. Initial studies exhibited stability and reactivity (150°C to 300°C) in the order of 12%Ru-TiO₂ >> 12%Fe-TiO₂ > 12%Co-TiO₂ and the phase of the support plays a significant role (Manuscript submitted).

The other area of research, to address Green Chemistry challenges, involves catalyst development for H₂ production from bio-derived alcohols. Our previous studies on steam reforming of methanol with different metals and MCM-41 and TiO₂-supports have shown that the interaction between metal and the support plays a profound role on H₂ production and its selectivity.² We have now extended our studies to steam reforming of glycerol (SRG), a byproduct of biodiesel. The SRG studies were carried out with Ni/Co-MCM-41 and Ni/Co-SBA-15 catalysts at 650 °C using a tubular reactor. Both H₂ selectivity (85% vs 78%) and conversion (99% vs 88%) were better at higher glycerol to water feed ratio (1:12) for both catalysts (*manuscripts to be submitted*).

References: 1. Mehta, S.; Deshmane, V.; Zhao, S.; Kuila, D. *Industrial & Engineering Chemistry Research* **2014**, 53, (42), 16245-16253. 2. Abrokwah, R. Y.; Deshmane, V. G.; Kuila, D. *Journal of Molecular Catalysis A: Chemical* **2016**, 425, 10-20.