Methanation from syngas on Mo-based catalyst and methanation from CO_2 on Ni-based catalyst

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Abstract:

A series of MoO_3/Al_2O_3 and MoO_3/ZrO_2 catalysts were prepared and studied with respect to sulfur-resistant methanation performance of syngas in synthetic natural gas (SNG) production. The results indicated that the MoO_3/ZrO_2 catalyst achieves much higher activity than the MoO_3/Al_2O_3 catalyst especially at low temperature. The effect of ZrO_2 on the performance were discussed to build structure-activity relationship of Mo-based catalyst based on a serious characterization results including N_2 adsorption-desprption, XRD, TEM and H_2-TPR.

The 15wt% Ni/ZrO_2 catalyst was synthesized using urea as the combustion medium, which shows high catalytic performance for CO_2 methanation due to its high reducibility and Ni dispersion, small Ni particle size and excellent CO_2 adsorption capacity. The CO_2 conversion of Ni/ZrO_2 prepared by the urea combustion method achieves 60% while the conversion of Ni/ZrO_2 using n-propanol as the combustion medium is less than 13%. A series of catalysts were synthesized using different combustion mediums including ethanol, n-propanol, urea, glycol and glycerol. The characterization results illustrated that the combustion medium significantly affects the pore structure, interaction between active metal and support, Ni dispersion, Ni particle size, the crystal structure of ZrO_2 and CO_2 adsorption capacity. In addition, the synergistic effect between nickel and support leads to a phase transformation of zirconia from m-ZrO_2 to t-ZrO_2. The $15Ni/ZrO_2$ catalyst prepared by urea combustion method exhibits not only higher activity but also better stability due to its smaller Ni particle size and better resistance to carbon deposition than the one prepared by impregnation method.

Keywords: Sulfur-resistant methanation; CO_2 conversion; Mo-based catalyst; Ni-based catalyst; ZrO_2.

Biographical Statement of speaker:

I got my BS., MS and Ph.D all from Tianjin University, China. My research is designing heterogeneous catalysts for efficiently converting syngas or CO_2 to valuable chemicals, for example, methanation, clean fuel production by Fischer-Tropsch synthesis, and ethylene glycol production. We focus on catalysis, materials design, chemistry and chemical engineering. Email: zhenhua@tju.edu.cn.