Layered Double Hydroxide Derived Intermetallic Ni_3GaC_x Catalysts for Dry Reforming of Methane

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NiMgGa-layered double hydroxide (NMG-LDH) was synthesized as an efficient catalyst precursor for dry reforming of methane which shows high stability at low temperature (~600°C). NMG-LDH was transformed to Ni_3Ga intermetallic structure after the reduction pre-treatment, which exhibited high CH_4 (~48%) and CO_2 (~52%) conversion as well as high stability compared to other reported monometallic Ni-based catalysts under similar reaction conditions. The stability of Ni_3Ga intermetallic catalysts was superior to that of monometallic catalysts (Ni/MgO or Ga/MgO) due to high coke resistance property. The formation of unique intermetallic carbide (Ni_3GaC_x) during the reaction was responsible for the outstanding stability compare to the conventional Ni monometallic phase. The formation of Ni_3GaC_x intermetallic carbide structure was confirmed by XRD, HR-TEM, and XAS analysis. *In situ* XRD analysis was investigated to elucidate formation mechanism of Ni_3GaC_x structure and reaction mechanism on the Ni_3GaC_x during the reaction. Carburization of Ni_3Ga by CH_4 and oxidation of Ni_3GaC_x by CO_2 make a redox cycle, resulting in high activity and stability.