# The Partial Oxidation of Methane to Syngas over Rh, Ru, and Ni Impregnated on $CeO_2$, $Al_2O_3$, $SiO_2$ Catalysts

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The partial oxidation of methane(POM) to syngas over Rh(5wt%), Ru(5wt%), and Ni(5wt%) impregnated on $CeO_2$, $Al_2O_3$, $SiO_2$ catalysts was investigated based on the product distribution in a fixed bed flow reactor under atmospheric condition and also on analysis results by SEM, XPS, BET, and XRD. The activity of the catalysts based on the syngas yield increased in the sequence Rh(5wt%)/$CeO_2$≈ Ni(5wt%)/$CeO_2$ > Ru(5wt%)/$Al_2O_3$>Rh(5wt%)/$SiO_2$>Rh(5wt%)/$Al_2O_3$ > Ru (5wt%)/$CeO_2$. Compared to the noble metals catalysts, the syngas yield and stability of Ni (5wt%)/$CeO_2$ catalyst were almost similar and superior to them of any other noble metal catalysts except rhodium. BET surface area before reaction for Rh(5wt%)/$CeO_2$, Ni(5wt%)/$CeO_2$, and Ru (5wt%)/$Al_2O_3$ were 101.46 ±0.29, 34.53±0.22, 86.69±0.23 $m^2$/g, respectively. XPS core lectrons spectra of O 1s and Ce 3d showed that $O^{2-}$,$Ce^{3+}$, and Ce $^{4+}$ ions were in existence on catalyst surface. It could be suggested that the redox reaction between $Ce^{3+}$ and $Ce^{4+}$ played more important role to enhance activity and stability of catalyst than the surface area of catalyst.