

Complementary effect of plasma-catalysis hybrid system on methane complete oxidation over non-PGM catalysts

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The complete oxidation of methane was carried out in a non-thermal plasma (dielectric barrier discharge) quartz tube reactor where both plasma and catalyst were combined into one in-plasma catalysis system. Non-platinum group metal (PGM) catalysts such as CoCr_2O_4 and $\text{Co}_1\text{Ni}_1\text{O}_x$ were applied. In plasma only condition, methane was oxidized even at room temperature to CO or CO_2 . On the other hand, the CO selectivity was maintained at high value (~50%) until the temperature reached about 200 degrees Celsius. In the presence of both plasma and catalyst, however, methane was oxidized even at room temperature mostly to CO_2 with low CO selectivity over certain non-PGM catalyst like $\text{Co}_1\text{Ni}_1\text{O}_x$. In this case, the major role of plasma was to convert CH_4 into CO, which was consequently oxidized to CO_2 over catalyst. Hence, methane complete oxidation reaction proceeded at much lower temperature similar to PGM catalyst such as Pd/ Al_2O_3 , while maintaining low CO selectivity.