Effect of Co/Ni ratios in cobalt nickel mixed oxide catalysts on methane combustion

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A series of cobalt nickel mixed oxide catalysts with the varying ratios of Co to Ni, prepared by co-precipitation method, were applied to methane combustion. Among the various ratios, cobalt nickel mixed oxides having the ratios of Co to Ni of (50:50) and (67:33) demonstrate the highest activity for methane combustion. Structural analysis obtained from XRD and EXAFS evidently demonstrates that CoNi (50:50) and (67:33) samples consist of NiCo2O4 and NiO phase and, more importantly, NiCo2O4 spinel structure is largely distorted, which is attributed to the insertion of Ni2+ ions into octahedral sites in Co3O4 spinel structure. Such structural disorder results in the enhanced portion of surface oxygen species, thus leading to the improved reducibility of the catalysts in the low temperature region as evidenced by H2 TPR and XPS O 1s results. They prove that structural disorder in cobalt nickel mixed oxides enhances the catalytic performance for methane combustion. Thus, it is concluded that a strong relationship between structural property and activity in cobalt nickel mixed oxide for methane combustion exists and, more importantly, distorted NiCo2O4 spinel structure is found to be an active site for methane combustion.