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Catalytic methanation reaction over alumina supported cobalt oxide doped noble metal oxides for the purification of simulated natural gas

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摘要 A series of alumina supported cobalt oxide based catalysts doped with noble metals such as ruthenium and platinum were prepared by wet impregnation method. The variables studied were difference ratio and calcination temperatures. Pt/Co(10:90)/Al_2O_3 catalyst calcined at 700℃ was found to be the best catalyst which able to convert 70.10% of CO_2 into methane with 47% of CH_4 formation at maximum temperature studied of 400℃. X-ray diffraction analysis showed that this catalyst possessed the active site Co_3O_4 in face-centered cubic and PtO_2 in the orthorhombic phase with Al_2O_3 existed in the cubic phase. According to the FESEM micrographs, both fresh and spent Pt/Co(10:90)/Al_2O_3 catalysts displayed small particle size with undefined shape. Nitrogen Adsorption analysis showed that 5.50% reduction of the total surface area for the spent Pt/Co(10:90)/Al_2O_3 catalyst. Meanwhile, Energy Dispersive X-ray analysis (EDX) indicated that Co and Pt were reduced by 0.74% and 0.14% respectively on the spent Pt/Co(10:90)/Al_2O_3catalyst. Characterization using FT-IR and TGA-DTA analysis revealed the existence of residual nitrate and hydroxyl compounds on the Pt/Co(10:90)/Al_2O_3 catalyst.

关键词： natural gas cobalt oxide noble metal catalyst methanation reaction

Abstract： A series of alumina supported cobalt oxide based catalysts doped with noble metals such as ruthenium and platinum were prepared by wet impregnation method. The variables studied were difference ratio and calcination temperatures. Pt/Co(10:90)/Al_2O_3 catalyst calcined at 700℃ was found to be the best catalyst which able to convert 70.10% of CO_2 into methane with 47% of CH_4 formation at maximum temperature studied of 400℃. X-ray diffraction analysis showed that this catalyst possessed the active site Co_3O_4 in face-centered cubic and PtO_2 in the orthorhombic phase with Al_2O_3 existed in the cubic phase. According to the FESEM micrographs, both fresh and spent Pt/Co(10:90)/Al_2O_3 catalysts displayed small particle size with undefined shape. Nitrogen Adsorption analysis showed that 5.50% reduction of the total surface area for the spent Pt/Co(10:90)/Al_2O_3 catalyst. Meanwhile, Energy Dispersive X-ray analysis (EDX) indicated that Co and Pt were reduced by 0.74% and 0.14% respectively on the spent Pt/Co(10:90)/Al_2O_3catalyst. Characterization using FT-IR and TGA-DTA analysis revealed the existence of residual nitrate and hydroxyl compounds on the Pt/Co(10:90)/Al_2O_3 catalyst.

Key words： natural gas cobalt oxide noble metal catalyst methanation reaction

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