World Academy of Science, Engineering and Technology
International Journal of Energy and Power Engineering
Vol:12, No:01, 2018

Water Gas Shift Activity of PtBi/CeO_2 Catalysts for Hydrogen Production

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Abstract : The influence of bismuth on the water gas shift activities of Pt on ceria was studied. The flow reactor was used to study the activity of the catalysts in temperature range 100-400°C. The feed gas composition contains 5%CO, 10% H_2O and balance N_2. The total flow rate was 100 mL/min. The outlet gas was analyzed by on-line gas chromatography with thermal conductivity detector. The catalytic activities of bimetallic 1%Pt1%Bi/CeO_2 catalyst were greatly enhanced when compared with the activities of monometallic 2%Pt/CeO_2 catalyst. The catalysts were characterized by X-ray diffraction (XRD), Temperature-Programmed Reduction (TPR) and surface area analysis. X-ray diffraction pattern of Pt/CeO_2 and PtBi/CeO_2 indicated slightly shift of diffraction angle when compared with pure ceria. This result was due to strong metal-support interaction between platinum and ceria solid solution, causing conversion of Ce^{4+} to larger Ce^{3+}. The distortions inside ceria lattice structure generated strain into the oxide lattice and facilitated the formation of oxygen vacancies which help to increase water gas shift performance. The H_2-Temperature Programmed Reduction indicated that the reduction peak of surface oxygen of 1%Pt1%Bi/CeO_2 shifts to lower temperature than that of 2%Pt/CeO_2 causing the enhancement of the water gas shift activity of this catalyst. Pt played an important role in catalyzing the surface reduction of ceria and addition of Bi alter the reduction temperature of surface ceria resulting in the improvement of the water gas shift activity of Pt catalyst.

Keywords : bismuth, platinum, water gas shift, ceria
Conference Title : ICHEFCT 2018 : International Conference on Hydrogen Energy and Fuel Cell Technology
Conference Location : Sydney, Australia
Conference Dates : January 29-30, 2018