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Catalytic Production of Hydrogen and Carbon Nanotubes over Metal/SiO2 Core-Shell Catalyst from Plastic Wastes Gasification

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Abstract : Nowadays, plastic product and utilization are extensive and have greatly improved our life. Yet, plastic wastes are stable and non-biodegradable challenging issues to the environment. Waste-to-energy strategies emerge a promising way for waste management. This work investigated the co-production of hydrogen and carbon nanotubes from the syngas which was from the gasification of polypropylene. A nickel-silica core-shell catalyst was applied for syngas reaction from plastic waste gasification in a fixed-bed reactor. SiO2 were prepared through various synthesis solvents by Stöber process. Ni plays a role as modified SiO2 support, which were synthesized by deposition-precipitation method. Core-shell catalysts have strong interaction between active phase and support, in order to avoid catalyst sintering. Moreover, Fe or Co metal acts as promoter to enhance catalytic activity. The effects of calcined atmosphere, second metal addition, and reaction temperature on hydrogen production and carbon yield were examined. In this study, the catalytic activity and carbon yield results revealed that the Ni/SiO2 catalyst calcined under H2 atmosphere exhibited the best performance. Furthermore, Co promoted Ni/SiO2 catalyst produced 3 times more than Ni/SiO2 on carbon yield at long-term operation. The structure and morphological nature of the calcined and spent catalysts were examined using different characterization techniques including scanning electron microscopy, transmission electron microscopy, X-ray diffraction. In addition, the quality and thermal stability of the nano-carbon materials were also evaluated by Raman spectroscopy and thermogravimetric analysis.

Keywords : plastic wastes, hydrogen, carbon nanotube, core-shell catalysts
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