Effective hydrogen by propane steam reforming over M/ 30 wt% NiO/YSZ catalyst (M = Ru, Rh, Pd, Ag)

Yonghwan Im, Misook Kang*
Department of chemistry, Yeungnam university, Gyeongsan-si, Gyeongbuk-do, Republic of Korea

*E-mail: mskang@ynu.ac.kr

Hydrogen is an important energy carrier because it is eco-friendly and high energy density. The main production of hydrogen is a steam reforming from hydrocarbons [1-2]. Especially, propane is one of prospective feed gases of steam reforming because the propane is main component gas of liquefied petroleum gas (LPG) used widely in household, transport, and other uses. Moreover, propane can generate so much hydrogen per unit volume of feed gas that is used commercially.

Catalysts based on Ni/Al_2O_3 are widely used for steam reforming process but these catalysts can be easily aggregated and deactivated due to carbon deposition. But, using yttrium stabilized zirconium (YSZ) as catalytic supporter can solve these problems because YSZ is thermally stable and expected influence of oxygen vacancies of YSZ [3].

In this study, YSZ was used as catalytic supporter in 1 wt% M/30 wt% NiO/YSZ (M= Ru, Rh, Pd, Ag) that was used for propane steam reforming (PSR) to study how YSZ affects performance of PSR. In addition, this study also tried to find out which noble metal is more appropriate to PSR to inhibit carbon deposition.

As a result, in Fig. 1 (a) and (b), the performance of PSR was conducted using 1 g of 30 wt% NiO/YSZ and 1 wt% Pd/30 wt% NiO/YSZ. The reaction was done from 450 ^oC to 900 ^oC at 12000 GHSV (9 % propane in total flux) after reduction of catalyst and steam to carbon ratio (SCR) was 3. The output gases were analyzed as H_2, CH_4, CO, CO_2 and extra feed gas, C_3H_8. In comparison with Fig. 1 (a) and (b), both the catalysts have H_2 selectivity of about 73 % however, the 1 wt% Pd/30 wt% NiO/YSZ was more activated in lower temperature than 30 wt% NiO/YSZ according to C_3H_8 conversion. Likewise, the CH_4 generated in 1 wt% Pd/30 wt% NiO/YSZ was as much as the CH_4 generated in 30 wt% NiO/YSZ, and it indicates 1 wt% Pd/30 wt% NiO/YSZ was easily cracking C_3H_8 more than 30 wt% NiO/YSZ. Whereas, the extent of water gas shift reaction of 30 wt% NiO/YSZ was more active than 1 wt% Pd/30 wt% NiO/YSZ as C_3H_8 conversion was nearly close to 100 % above 700 ^oC. Because CO/CO_2 ratio was higher in 1 wt% Pd/30 wt% NiO/YSZ. Consequently, loaded Pd could enhance H_2 production at low temperature but it could not help water shift reaction at high temperature. In addition, I will discuss the effect of other noble metals, Ru, Rh, and Ag, which I have investigated.

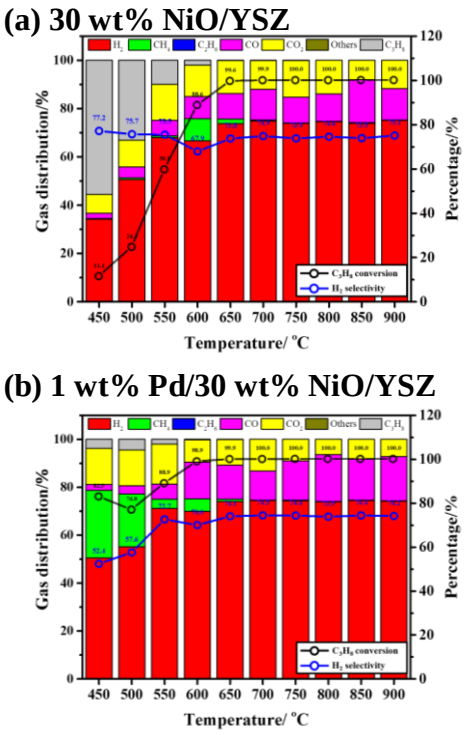

Fig. 1 PSR performance of (a) 30 wt% NiO/YSZ, and (b) 1 wt% Pd/30 wt% NiO/YSZ according to reaction temperature

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