



Short Communication

Aqueous-phase reforming of the low-boiling fraction of rice husk pyrolyzed bio-oil in the presence of platinum catalyst for hydrogen production

Chunyan Pan, Aiping Chen, Zhen Liu, Ping Chen, Hui Lou ^{*}, Xiaoming Zheng

*Institute of Catalysis, Department of Chemistry, Zhejiang University, Tianmushan Road 148, Hangzhou 310028, PR China
Key Laboratory of Zhejiang Province, Hangzhou 310028, PR China*

HIGHLIGHTS

- ▶ The low-boiling fraction of rice husk pyrolytic bio-oil was used for hydrogen production.
- ▶ Hydrogen content of the gas products can be as high as 65 vol.%.
- ▶ Reaction temperature is about 400 K lower than that applied in steam Reforming.
- ▶ Aqueous-phase reforming is a promising method to utilize organics in low-boiling fraction of the bio-oil to produce hydrogen.

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ABSTRACT

Aqueous-phase reforming (APR) of the low-boiling fraction (LBF) of bio-oil from rice husk pyrolysis was investigated over Pt/Al₂O₃ for hydrogen production. The influence of reaction temperature (503–563 K), reaction time (1–4 h), different load of organics in water (3–12 wt.%) and catalyst amounts (0.25–1 g) were studied. The hydrogen content of the gas products reached 65 vol.% at 533 K for 4 h with a feedstock of 9.6 g LBF and 30 mL water in the presence of 0.5 g of 2 wt.% Pt/Al₂O₃. APR is a promising method to make use of the organics in LBF of bio-oil to produce hydrogen.

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1. Introduction

Crude bio-oil obtained by pyrolysis of biomass is a complex mixture of acids, phenols, aldehydes, alcohols, esters, ketones, carbohydrates, and other compounds (Gayubo et al., 2004a,b; Iordanidis et al., 2006; Li et al., 2011a; Peng et al., 2009). The water content of crude bio-oil can be as high as 30 wt.% and negatively influences on combustion performance of the bio-oil. It is difficult to remove the water completely from crude bio-oil through distillation because of the formation of azeotropes and the presence of compounds that have boiling points lower than that of water. Vacuum distillation of crude bio-oil at 328 K produces about 40 wt.% distillate (low-boiling fraction, LBF) and about 60 wt.% high-boiling residuals. The latter can be catalytically upgraded to a liquid vehicle fuel (Li et al., 2011b). The distillate (LBF) contains about 75 wt.% water and 25 wt.% low boiling point oxygenated organics. Consid-

ering the large amount of water in LBF, aqueous-phase reforming (APR) (Huber and Dumesic, 2006), may be a better choice than steam reforming to utilize the organics in LBF because the reaction temperature in APR is about 400 K lower than that employed in steam reforming (Tanksale et al., 2010). APR does not require high temperatures, reduces vaporization steps, and produces less CO and light hydrocarbons compared to steam reforming (SR) (Czernik et al., 2002; Garcia et al., 2000; Hou et al., 2009; Huber et al., 2006; Kan et al., 2010; Medrano et al., 2011; Rioche et al., 2005; Tokarev et al., 2010; Yuan et al., 2008). APR reactions have been carried out with glycol (Wen et al., 2008), glucose (Irmak and Ozturk, 2010), glycerol (King et al., 2010; Meryemoglu et al., 2010), oxygenated hydrocarbons (Davda et al., 2005; Huber et al., 2004), sorbose (Tokarev et al., 2010), and some pyrolytic bio-oils such as biomass hydrolysates (Valenzuela et al., 2006; Meryemoglu et al., 2010, 2012) and the aqueous fraction of wood-derived pyrolysis oils (Vispute and Huber, 2009). These studies indicate that bio-oil is a feasible feedstock for the production of hydrogen. Pt is considered the best monometallic catalyst in terms of activity and selectivity for the production of hydrogen by APR, and the activity of this catalyst can be improved by supporting the metal on alumina

^{*} Corresponding author at: Institute of Catalysis, Department of Chemistry, Zhejiang University, Tianmushan Road 148, Hangzhou 310028, PR China. Tel./fax: +86 571 88273283.

E-mail address: hx215@zju.edu.cn (H. Lou).