

CATALYTIC FAST PYROLYSIS OF BIOMASS BY ZEOLITES AND MESOPOROUS ALUMINOSILICATES

Kostas S. Triantafyllidis^{1,2}

¹Department of Chemistry, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece

²Chemical Process and Energy Resources Institute, CERTH, 57001 Thessaloniki, Greece

E-mail: ktrianta@chem.auth.gr

ABSTRACT

Lignocellulosic biomass in the form of forestry, agricultural and food wastes and byproducts, is an important renewable source for transportation fuels, energy, platform chemicals and polymeric materials. Fast pyrolysis (BFP) represents one of the most promising and commercially attractive thermochemical conversion processes of biomass. The main product of the BFP process is the pyrolytic oil (bio-oil) which consists of oxygenated compounds, such as phenols, acids, ketones, furans, etc. It can thus be used as a low quality fuel (low calorific value, corrosive, unstable, not miscible with hydrocarbons) and as a source of chemicals (i.e. phenols) or it can be upgraded via down-stream hydrodeoxygenation processes. An effective alternative route is the catalytic fast pyrolysis (CFP) of biomass which enables the *in situ* upgrading of bio-oil during pyrolysis, mainly via deoxygenation and aromatization reactions, and to a lesser extent by ketonization, esterification and condensation reactions. Zeolites and micro/mesoporous aluminosilicates are the most promising catalysts for the CFP process due to their acidic nature and high micro/mesoporous surface area.

The state-of-the-art in CFP will be presented and discussed by comparing the performance of different classical zeolites (ZSM-5, USY, Beta, Mordenite, etc.), hierarchical-mesoporous zeolites (meso- and nano-ZSM-5), high surface area amorphous aluminosilicates and their metal (Ni, Co, Pt) modified analogues^[1-5]. In general, zeolites being more acidic favor deeper deoxygenation and aromatization of bio-oil compared to the mildly acidic mesoporous aluminosilicates which however enhance the production of phenolics. Mesoporous zeolites combine the effects of zeolitic acidity with improved diffusion characteristics but control of mesoporosity is needed so as to limit aromatics polymerization and coke formation. Finally, hydrogenation metals (i.e. Ni, Pt) has a relatively limited effect on (de)hydrogenation reactions due to the low pressure of in situ formed hydrogen, but basic metals (i.e. Mg) may induce different reactions pathways towards increased formation of ketones and phenolics.

REFERENCES

- [1] E. F. Iliopoulou, S. D. Stefanidis, K. G. Kalogiannis, A. Delimitis, A. A. Lappas, K. S. Triantafyllidis, *Appl. Catal. B Environ.* **2012**, *127*, 281–290.
- [2] E. F. Iliopoulou, S. Stefanidis, K. Kalogiannis, A. C. Psarras, A. Delimitis, K. S. Triantafyllidis, A. A. Lappas, *Green Chem.* **2014**, *16*, 662–674.
- [3] E. F. Iliopoulou, E. V. Antonakou, S. A. Karakoulia, I. A. Vasalos, A. A. Lappas, K. S. Triantafyllidis, *Chem. Eng. J.* **2007**, *134*, 51–57.
- [4] K. S. Triantafyllidis, E. F. Iliopoulou, E. V. Antonakou, A. A. Lappas, H. Wang, T. J. Pinnavaia, *Micropor. Mesopor. Mater.* **2007**, *99*, 132–139.
- [5] V. B. F. Custodis, S. A. Karakoulia, K. S. Triantafyllidis, J. A. van Bokhoven, *ChemSusChem* **2016**, *9*, 1134–1145.

This page intentionally left blank

