

## Catalytic upgrading of biomass-derived pyrolysis vapour over metal-modified HZSM-5 into BTX: a comprehensive review

*Veke Balasundram<sup>a</sup>, Norazana Ibrahim<sup>b</sup>, Rafiziana Md. Kasmani<sup>b</sup>, Ruzinah Isha<sup>c</sup>, Mohd. Kamaruddin Abd. Hamid<sup>d</sup> & Hasrinah Hasbullah<sup>d</sup>*

<sup>a</sup> Chemical Energy Conversions and Applications (ChECA) Research Group, Malaysia-Japan International Institute of Technology (MJIT), Universiti Teknologi Malaysia, Jalan Sultan Yahya Petra, Kuala Lumpur, 54100, Malaysia

<sup>b</sup> Energy Management Research Group, School of Chemical and Energy Engineering, Faculty of Engineering, Universiti Teknologi Malaysia (UTM), Johor Bahru, Johor 81310, Malaysia

<sup>c</sup> Faculty of Chemical & Process Engineering Technology, Universiti Malaysia Pahang, Lebuhraya Tun Razak, Gambang, Kuantan, Pahang 26300, Malaysia

<sup>d</sup> School of Chemical and Energy Engineering, Faculty of Engineering, Universiti Teknologi Malaysia (UTM), Johor Bahru, Johor 81310, Malaysia

### ABSTRACT

This paper provides an updated and comprehensive review on the catalytic upgrading of biomass-derived pyrolysis vapours over metal-modified HZSM-5 catalyst into bio-aromatic hydrocarbons. The catalytic upgrading of biomass pyrolysis vapours seems to be a promising technology in generating gasoline-type bio-aromatic hydrocarbons, i.e. benzene, toluene and xylene (BTX). Biomass-derived raw pyrolysis oil has high oxygenated compounds that deteriorate pyrolysis oil properties and limits its applications. Metal modification of hydrogen exchanged Zeolite Socony Mobil Five (HZSM-5) catalyst has gained attention in a biomass pyrolysis research area due to the beneficial effects on upgrading the oxygenated pyrolysis vapours into BTX-enriched pyrolysis oils. The influence of metals (alkali and alkaline earth metals, transition metals and rare earth metals) as bi-functional or multifunctional activity on HZSM-5 catalyst during pyrolysis has been addressed. The effect of reaction temperature, the type of metals, metal contents, the silica-to-alumina ratio of catalyst and the catalyst-to-biomass ratio are critically discussed for maximum production of monocyclic aromatic hydrocarbons during the upgrading of pyrolysis vapours. Finally, concluding remarks on metal-modified zeolite catalyst and future recommendation in upgrading biomass pyrolysis vapours are presented.

### KEYWORDS

Biomass pyrolysis; BTX; Catalytic upgrading; HZSM-5; Metal modification

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