In-situ upgrading of Napier grass pyrolysis vapour over microporous and hierarchical mesoporous zeolites

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Figure 1: Pre-processing of Napier grass. (1) Napier grass on the field (2) chopped Napier grass stem (NGS) in the dryer (3) Rotor beater mill (4) Ground Napier grass biomass

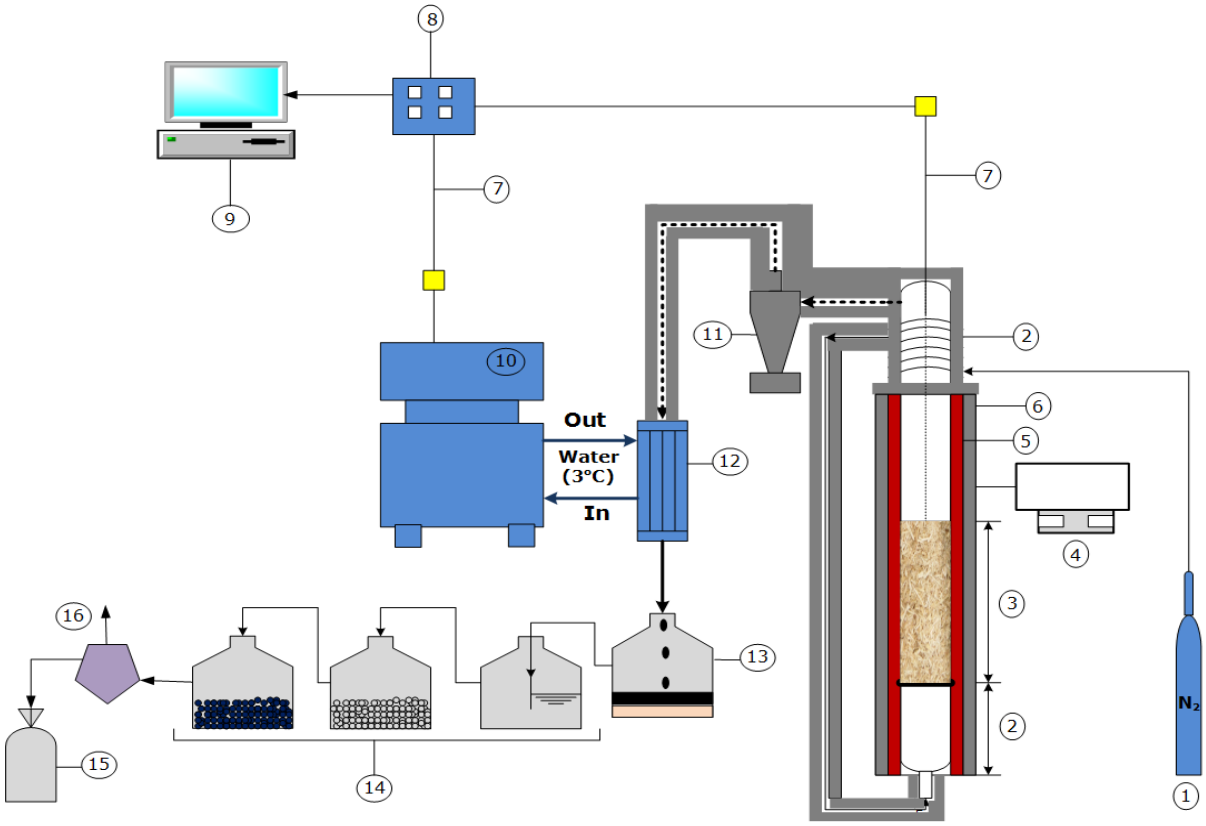


Figure 1~~1~~2: Pyrolysis system. (a) Vertical pyrolysis rig; (b) horizontal pyrolysis set-up. (1) Nitrogen cylinder, (2) nitrogen preheating sections, (3) pyrolysis section, (4) furnace controller, (5) heater, (6) insulator, (7) thermocouples, (8) data logger, (9) computer, (10) water chiller, (11) cyclone, (12) condenser, (13) bio-oil collector, (14) gas scrubber, (15) gas sampling bag, (16) gas venting

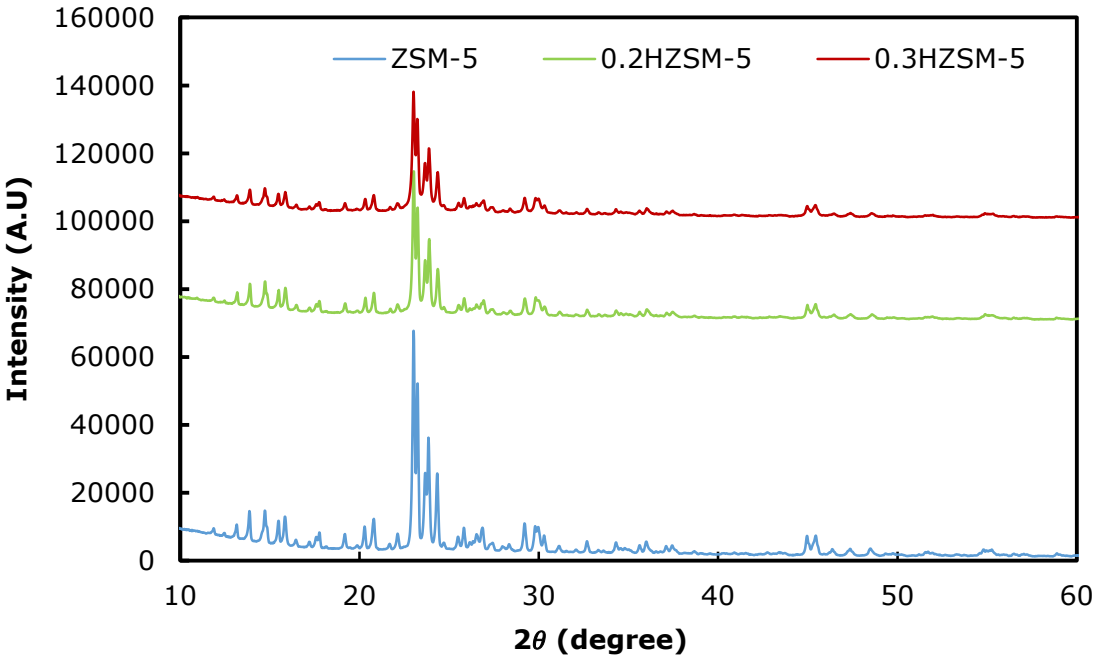


Figure 2~~2~~3: XRD Diffractogram of parent and modified ZSM-5

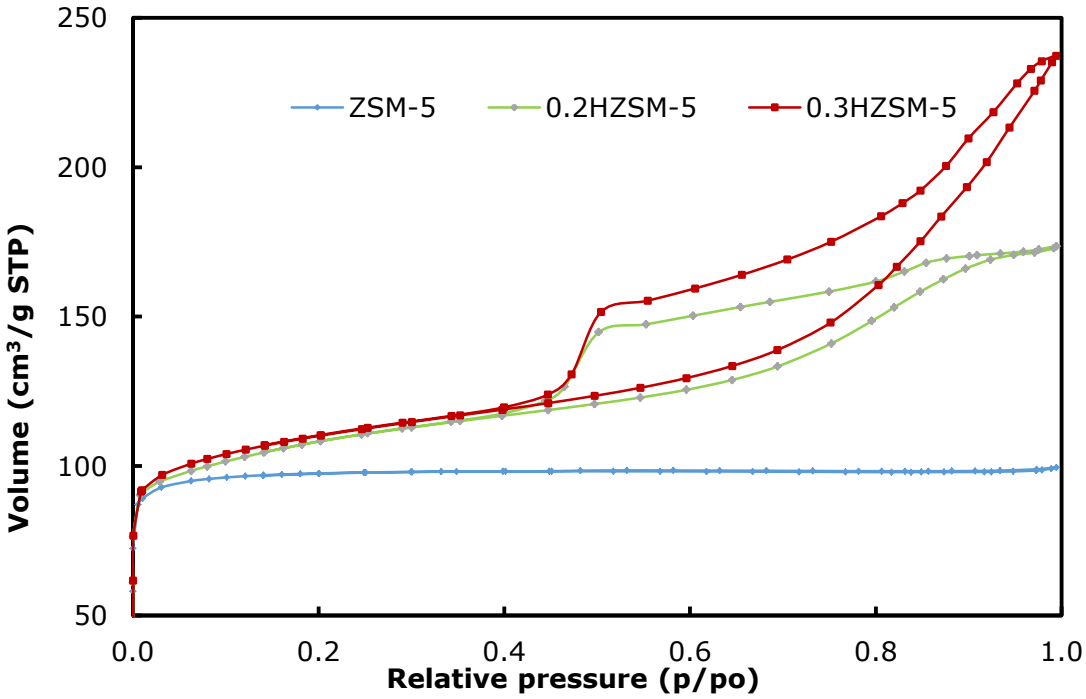


Figure 3~~3~~4: Isotherms of N_2 adsorption/desorption of the catalysts

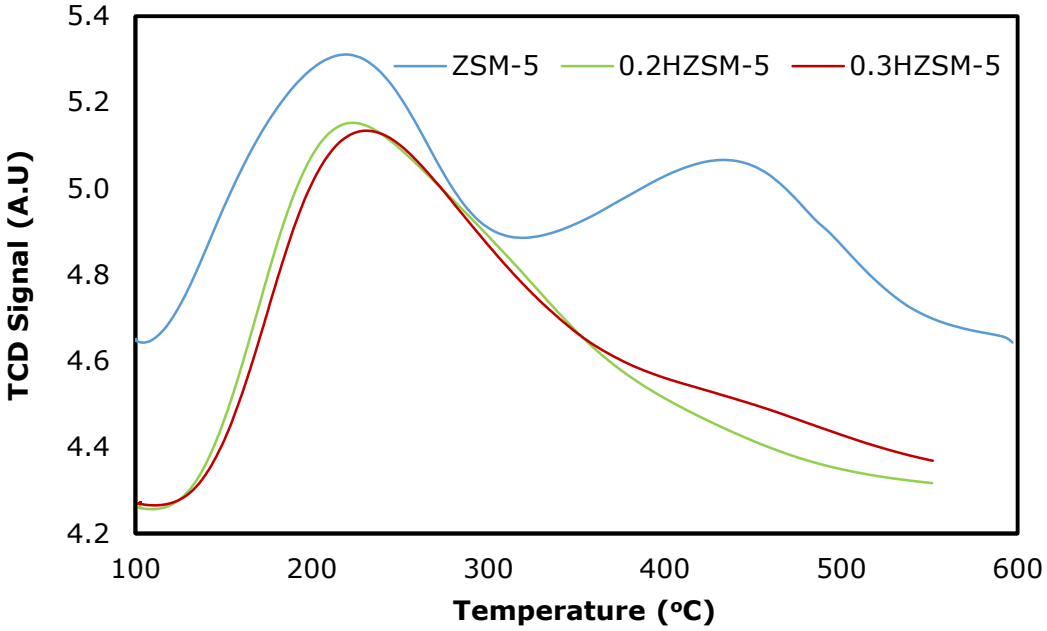


Figure ~~4~~45: NH_3-TPD temperature-programmed desorption curves

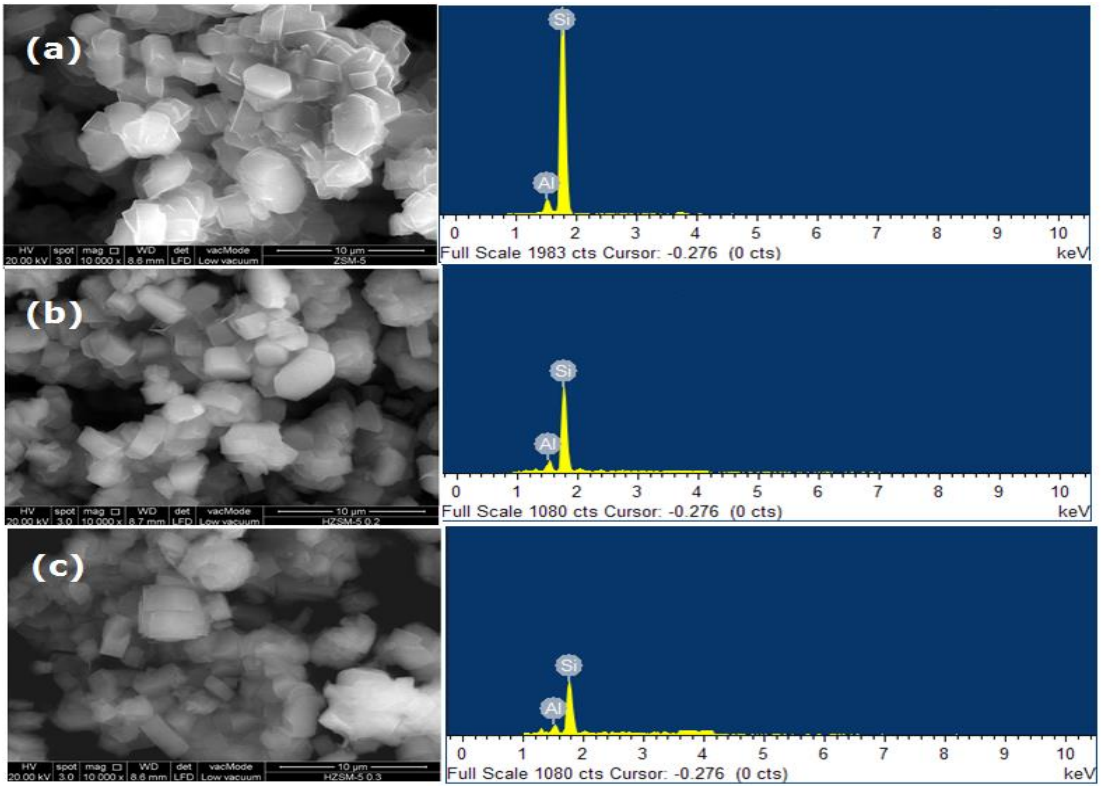


Figure ~~5~~56 : SEM-EDX images of (a) ZSM-5, (b) 0.2HZSM-5 and (c) 0.3HZSM-5

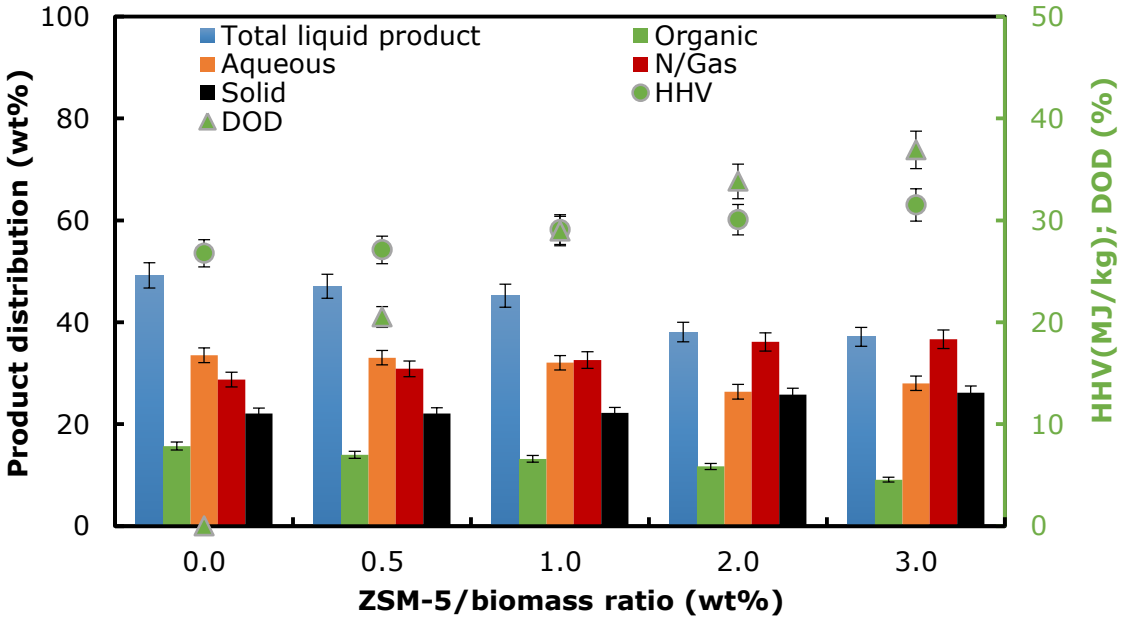
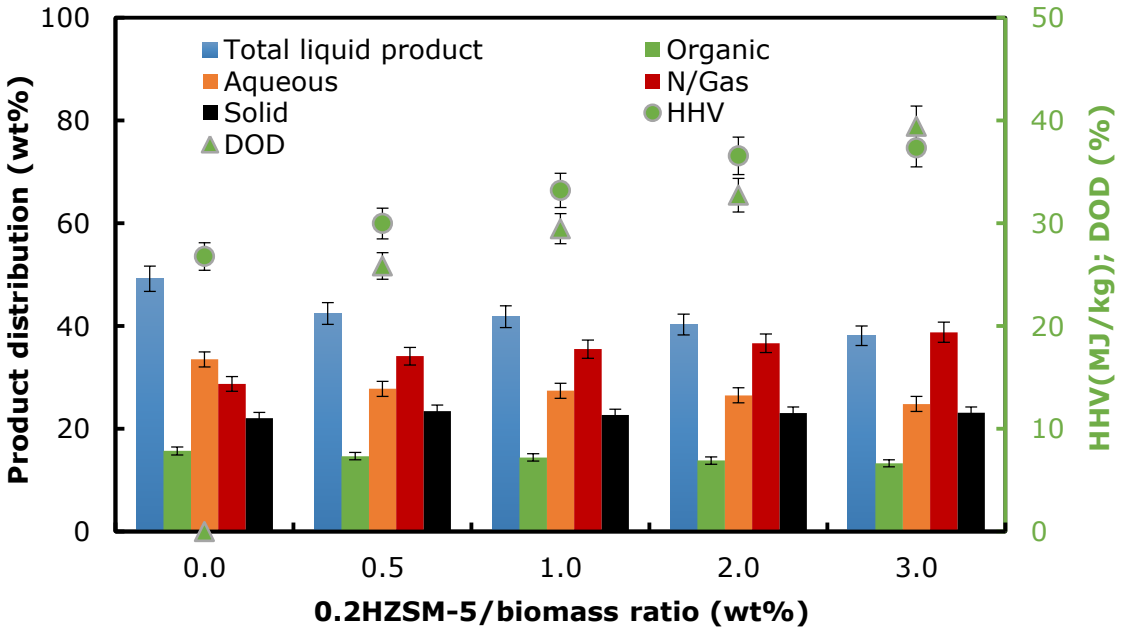


Figure 6~~67~~: Effect of ZSM-5/biomass ratio on pyrolysis product distribution, degree of deoxygenation (DOD) and higher heating value (HHV). N/gas: non-condensable gas. Solid: coke and char. Values are the means (n =3)

Figure



2HZSM-5/biomass ratio on pyrolysis product distribution, degree of deoxygenation (DOD) and higher heating value (HHV). N/gas: non-condensable gas. Solid: coke and char. Values are the means (n =3)

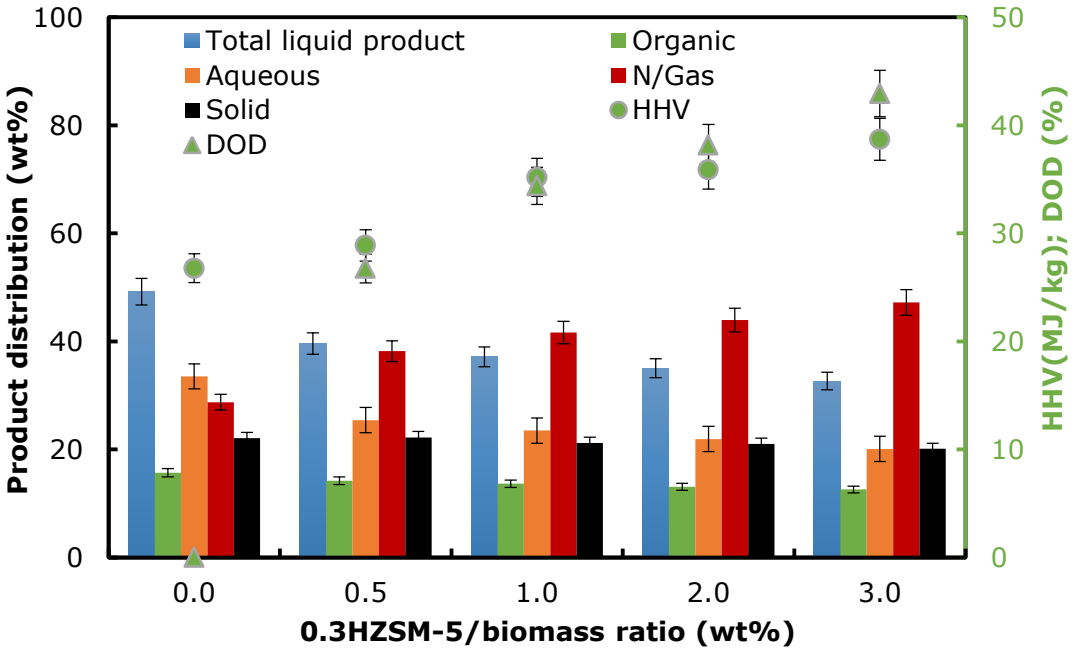


Figure ~~8~~9: Effect of 0.3HZSM-5/biomass ratio on pyrolysis product distribution, degree of deoxygenation (DOD) and higher heating value (HHV). Solid: coke and char. Values are the means (n =3)