Supporting Information

Niobic acid nanoparticle catalysts for the aqueous phase transformation of glucose and fructose to 5-hydroxymethylfufural

Mariano Tapia Reche,[a] Amin Osatiashtiani,[a] Lee J. Durndell,[a] Mark A. Isaacs,[a] Ângela Silva,[b] Adam F. Lee[a] and Karen Wilson[a*]

[a]European Bioenergy Research Institute, Aston University, Birmingham B4 7ET, UK.
[b]Laboratório de Bioinorgânica e Catálise, Universidade Federal do Paraná (UFPR), Departamento de Química, CP 19081, CEP 81531-990, Curitiba, Paraná, Brasil.
Corresponding author: E-mail: k.wilson@aston.ac.uk

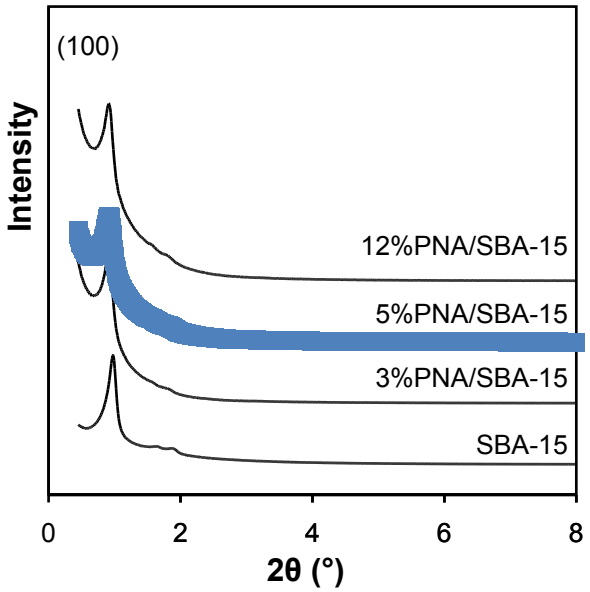

Fig S1. Low angle XRD patterns of PNA/SBA-15 as a function of Nb loading.

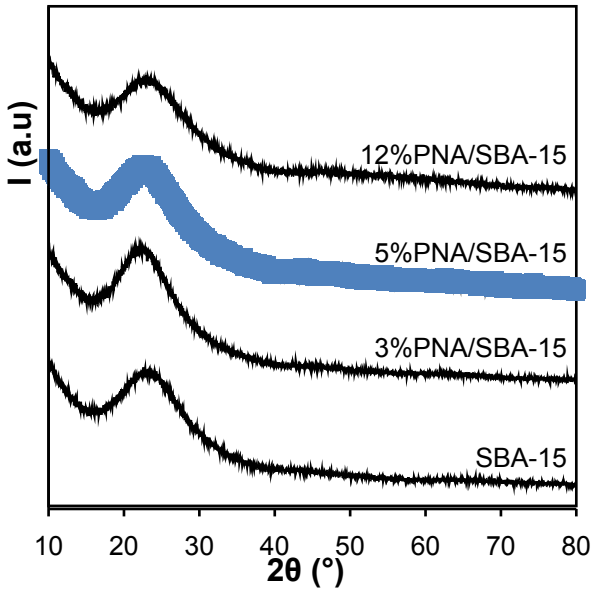

Fig S2. Wide angle XRD patterns of PNA/SBA-15 as a function of Nb loading.

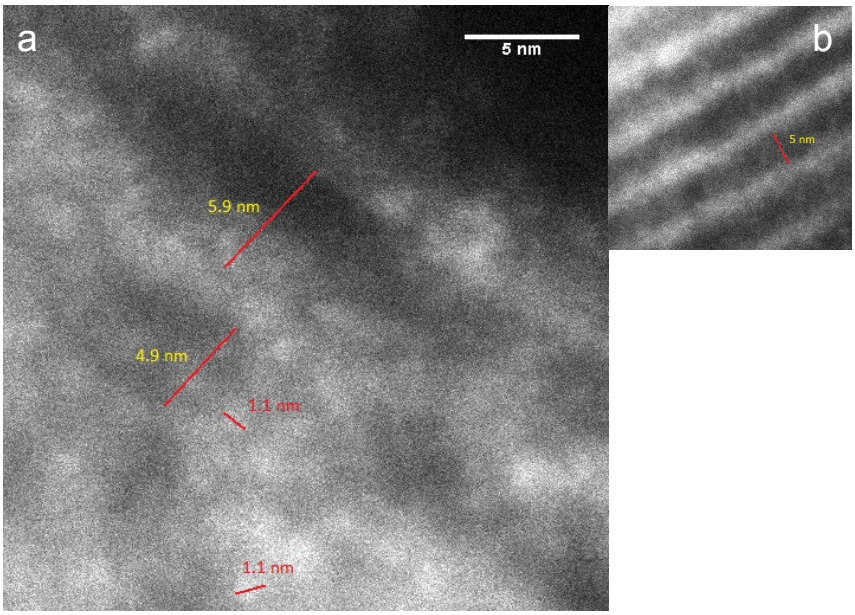

Fig. S3. HRTEM of 10%PNA/SBA-15 showing (a) highly dispersed Nb-containing nanoparticles decorating (b) hexagonal close-packed silica mesopore channels.

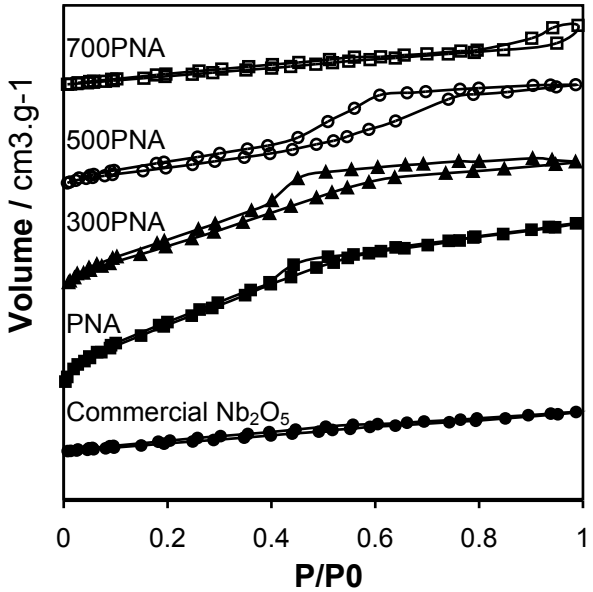

Fig. S4. N_2 adsorption-desorption isotherms of PNA as a function of calcination temperature.

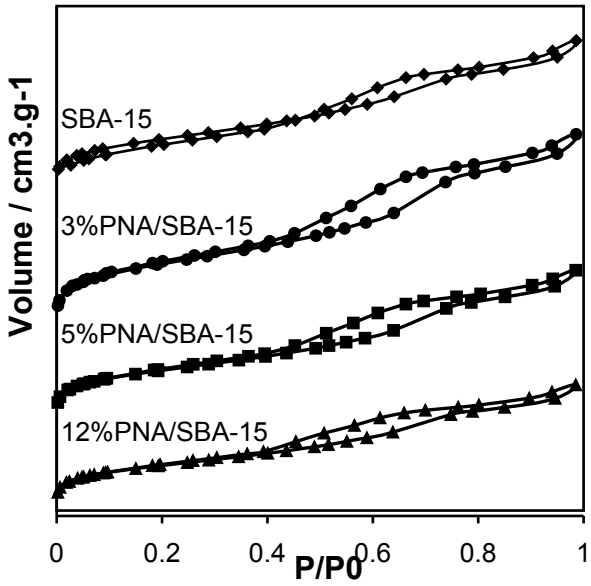

Fig S5. N_2 adsorption-desorption isotherms of PNA/SBA-15 as a function of Nb loading.

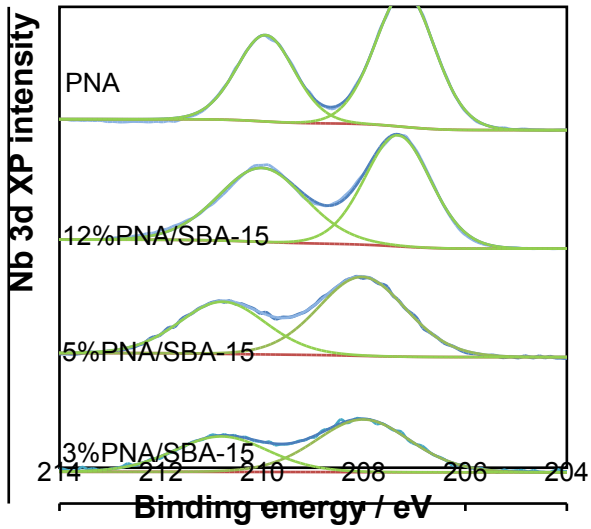

Fig S6. Nb 3d XP spectra of pure PNA and PNA/SBA-15 as a function of Nb loading.

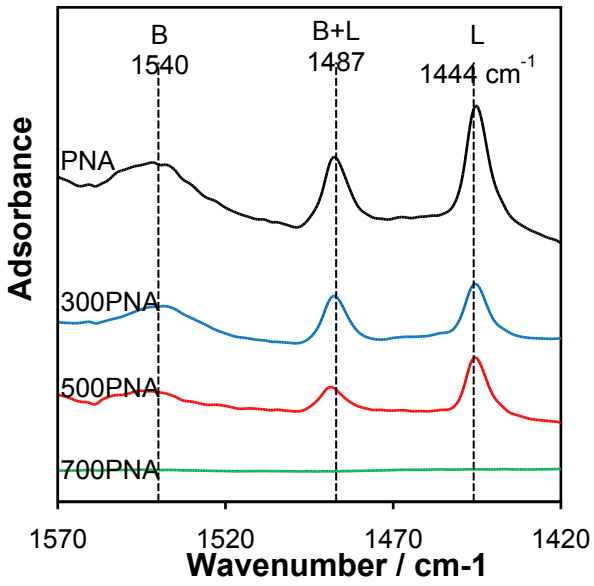

Fig S7. In-vacuo DRIFT spectra of pyridine treated PNA as a function of calcination temperature.

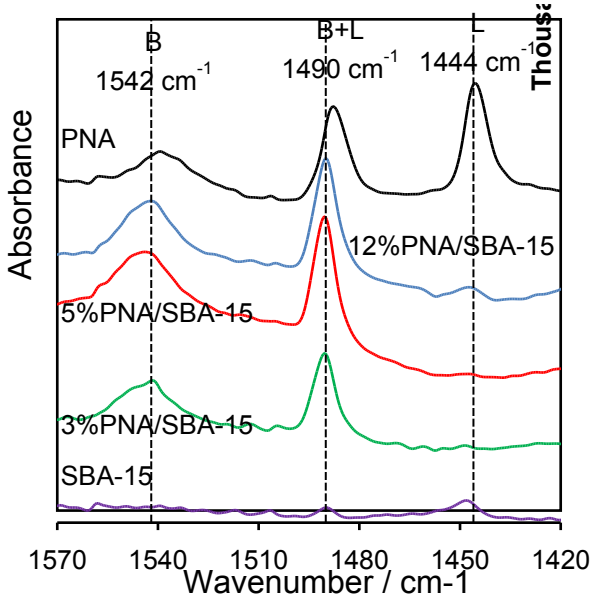

Fig S8. In-vacuo DRIFT spectra of pyridine treated PNA as a function of Nb loading.

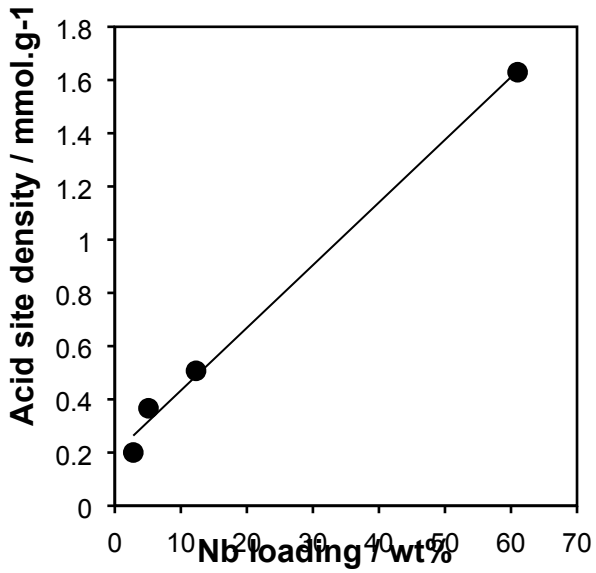

Fig S9. Total acid site density of PNA/SBA-15 as a function of Nb loading.

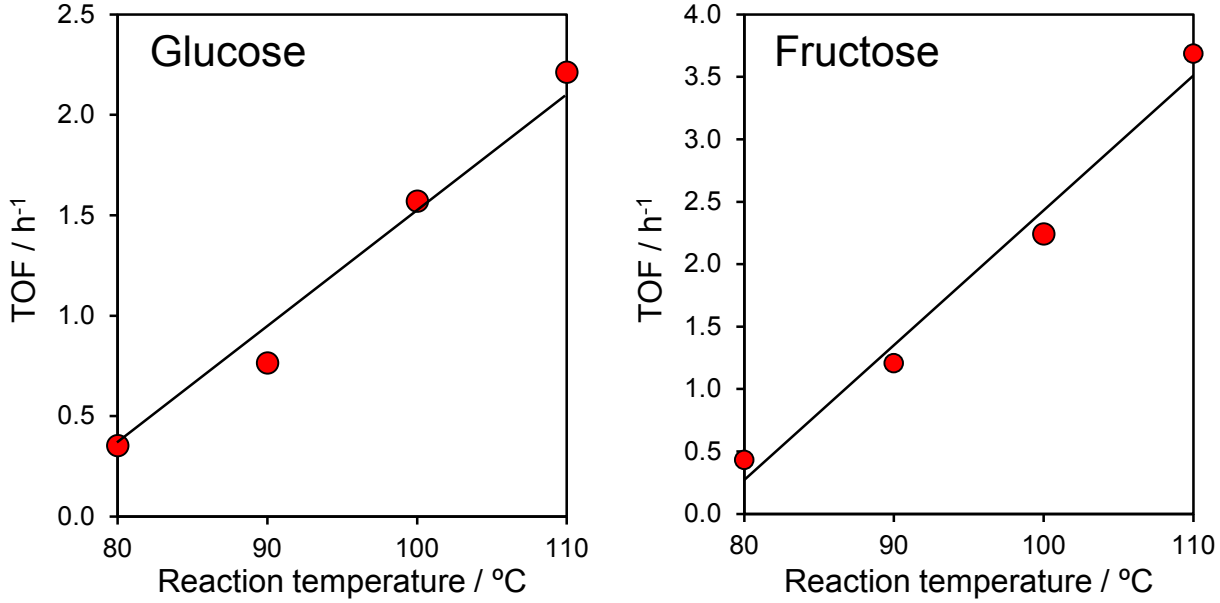

Fig. S10. Turnover frequencies for glucose and fructose normalised to Lewis or Brönsted acid loadings respectively during aqueous phase conversion over parent PNA as a function of reaction temperature. Reaction conditions: 0.1 g glucose or fructose, 0.1 g PNA, 20 cm^3 water.

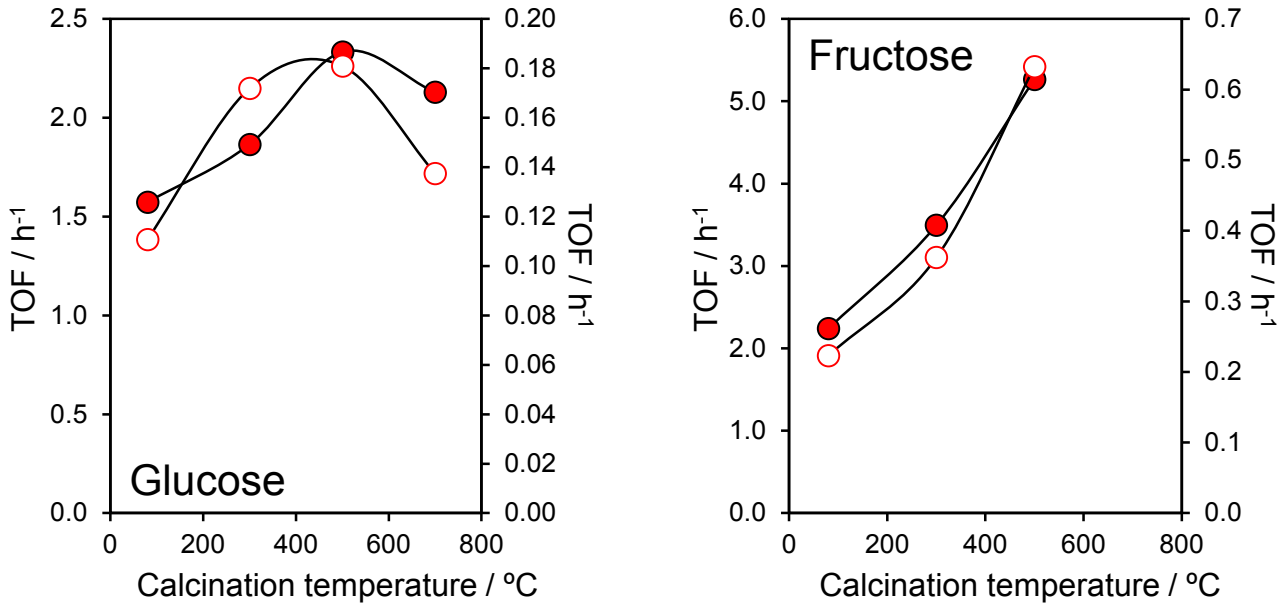

Fig. S11. Turnover frequencies for the aqueous phase conversion of glucose and fructose normalised to Lewis or Brönsted acid loadings respectively (filled symbols), and associated 5-HMF productivity normalised to total acid loading (open symbols), over parent PNA as a function of calcination temperature. Reaction conditions: 0.1 g glucose or fructose, 100 °C, 0.1 g PNA, 20 cm^3 water.

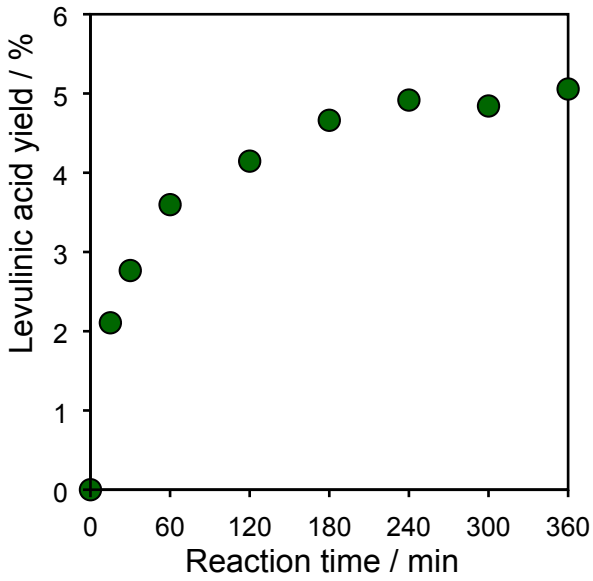

Fig. S12. Aqueous phase conversion of 5-HMF to levulinic acid over PNA. Reaction conditions: 0.1 g 5-HMF, 100 °C, 0.1 g PNA, 20 cm^3 water.

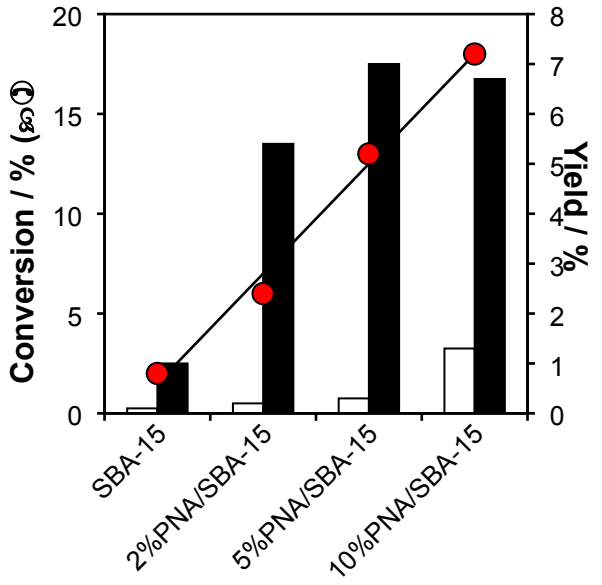

Fig. S13. Aqueous phase conversion of fructose to glucose (black) and 5-HMF (white) over PNA supported on SBA-15 as a function of Nb loading. Reaction conditions: 0.1g fructose, 100 °C, 0.1 g X%PNA/SBA-15, 20 cm^3 water.

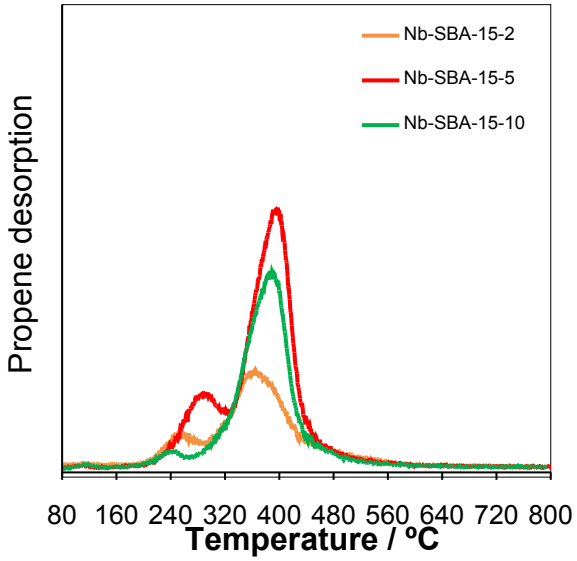

Fig. S14. Reactively-formed propene desorption from propylamine over PNA supported on SBA-15 as a function of Nb loading. Reaction conditions: 0.2 ml propylamine, 6.5 mg X%PNA/SBA-15, ramp-rate 10 °C.min^{-1}.