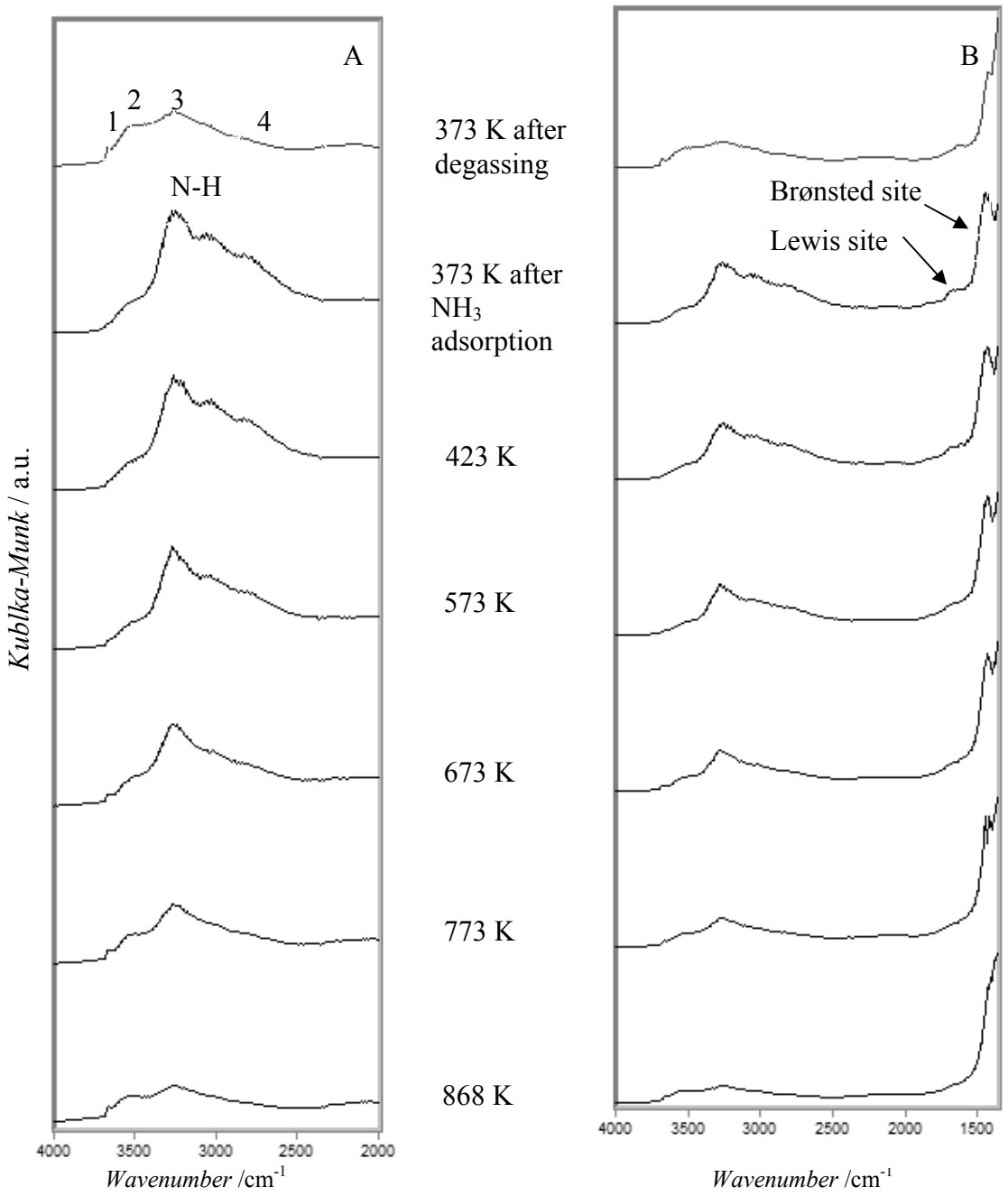

Fig. S1 NH_3–DRIFTS spectra of $ZrPO_x$ after adsorption of ammonia at 373 K followed by degassing under He flow at various temperatures. Shown is (A) the O-H/N-H stretching region (4000- 2000 cm^{-1}) and (B) the region 4000-1350 cm^{-1} including the HNH bending region.

The Research Octane Number (RON) of the gasoline range products were estimated according to method introduced in the Automotive Fuel Reference Book by making a weighted average using measured values for each of the components (listed in Table S1), as shown below for a three-component blend[1].

PB=V1P1+V2P2+V3P3

Where PB is the property (such as RON, MON) of the blend, P1, P2, P3 are the properties of the components and V1, V2, V3 are the volume fractions.

Table S1. Physical properties and research octane number of different gasoline rang products.

	Molar mass ($g\ mol^{-1}$)	Boiling point (K)	Density ($g\ mL^{-1}$)	Research octane number (RON)	Water solubility ($g\ L^{-1}$)
Pentane	72.15	309	0.626	62[2]	0.1
Hexane	86.18	342	0.655	26[2]	0.01
Ethanol	40.07	351	0.789	130[3]	Miscible
Propanol	60.1	370	0.803	118[3]	Miscible
Acetone	58.08	330	0.793	118[3]	Miscible
Butanol	74.12	390	0.810	96[3]	77
Butanone	72.11	353	0.805	96[3]	290
Tetrahydrofuran	72.11	339	0.889	73[4]	301
Butanoic acid	88.11	435	0.860	96[3]	Miscible
Pentanol	88.15	409	0.814	84[3]	27
Pentanone	86.13	376	0.809	84[3]	0.04
2-Methyl-tetrahydro-furan	86.13	352	0.86	86[5]	140
Tetrahydropyran	86.13	361	0.880	73[4]	80
Pentanoic acid	102.13	459	0.930	97[3]	50
Tetrahydrofurfuryl alcohol	102.13	451	1.054	108[4]	Miscible
Hexanol	102.17	431	0.814	56[6]	6
Hexanone	100.16	400	0.811	56[6]	14
2,5-Dimethyl-tetrahydrofuran	100.16	364	0.833	82[6]	Miscible
2-Methyl-tetrahydropyran	100.16	352	0.863	87[5]	39
Hexanoic acid	116.16	475	0.920	56[6]	11
Tetrahydropyran alcohol	116.16	460	1.027	108[4]	Miscible

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Table S2 Hydrogenation of mono-, di- and polysaccharides.

Saccharide	Catalyst	Conditions	Conversion	Yield	Ref.
glucose	Ru	T=393 K, total pressure = 120 bar, glucose concentration: 40 wt % glucose in aqueous solution (120 mL), reaction time 5 h, stirring at 850 rpm	~100% conversion	~100% selectivity sorbitol	1
glucose	Ru/C	5%Ru/C catalyst was studied in a semi-batch slurry autoclave, 373–403K 4.0–7.5MPa H_2	100% >300min	~100% selective to sorbitol	2
glucose	Ru/MWNT	5wt% Ru 393 K; time 120 min; initial H_2 pressure 4 MPa	62.5%		3
fructose	CuO-ZnO	35–65 bar and between 90 and 130°C	~100% conv. and selectivity after 250min	mannitol	4
Glucose/fructose	Raney Ni	85 to 130°C, 50 to 1000 psi		Fructose not hydrogenated	5
Glucose/fructose	Rh				5
Glucose/fructose	Ru			Most effective	5
xylose	Raney Ni	90-100°C, 40-60bar, 50-60wt% xylose	200min	>90% xylitol	6
maltose	Ru-P	maltose aqueous solution (40 wt%, 50 mL), T = 363 K, PH_2 = 2.0 MPa, reaction time = 2 h, stirring rate = 1200 rpm	98%	100% selectivity maltitol	7
lactose	Ni sponge,	300 mL, Parr Co., operating at 20-70 bar and between 110 and 130 °C	100% 200min	90-99% selectivity lactitol, small amounts of lactobionic acid, lactulose, lactulitol, sorbitol, and galactitol	8
lactose	Ni sponge , Ru/C	120°C, 20-70 Bar H_2	~100% after 150 min Ni 120 min Ru/C	Lactitol ~100%	9
sucrose	Raney Ni	3 h of reaction at 130 °C and 750 psia 1wt% cat, 40 g/L sucrose	~60% 3h		10
sucrose	Ru/Al_2O_3	3 h of reaction at 130°C and 750 psia 1wt% cat, 40 g/L sucrose	~100% 3h	100%, Sorbitol, mannitol	10
sucrose	Ru/NaY, Ru/USY Ru/CaY	135°C~ and 12 atm H_2 2.5h	100% after 3h	Sorbitol, mannitol	11
Inulin	Ru/C(activated)	1% Ru:C, 80 mL aqueous solution of 1 g inulin and 0.100 g 1% Ru:SX1GNS, 100 °C, 100 bar H_2.	100% 300min	inulin to D-mannitol and D-glucitol	12
cellulose	Ru/CNT	cellulose (0.16 g, equivalent to 1 mmol $C_6H_{10}O_5$ unit) and the catalyst (0.050 g) with H_2O (20 mL H_2 of 5 MPa, 185°C, for 24 h with stirring		69 sorbitol 4.0 mannitol 5 Erythritol 5 Glycerol	13
Cellulose	Ru/C	245°C, 4 wt% Ru/C, 6 MPa H_2	85.8% 30min	34.6 sorbitol, 11.4mannitol, 13.4 sorbitan	14
cellobiose	Pd Rh Pt Ru Ru Ru Ru/C	120 °C, 40 bar H_2 12 h cellobiose (7.31 mmol), using H_2O (30 g) HCl to adjust pH	Pd pH 2 100% Rh pH2 100% Pt pH2 100% Ru pH2 100% Ru pH7 87.8% Ru pH10 75. c Ru/C pH7 100%	100% glucose 6.9 sorb 66.9 glu 18.5 sorb 42.6 glu 100% sorbitol 26.4 sorb 1.6 glu 64.8 alc 7.2 other 24.0 sorb 3.2 glu 55.7 alc 17.1 other >99% alc	15
cellulose	Ru/C	170°C, 1wt% H_2SO_4	95% 4h		16,17
biomass	Ru/C	15% load, <190°C for 3-5h, 0.8% H_3PO_4 5wt% Ru/C, 10 wt% cat/biomass	>99%	~100%	16,17

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