Flame-made amorphous solid acids with tunable acidity for the aqueous conversion of glucose to levulinic acid

Supporting Information

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Table S1. XPS-determined surface elemental composition of different flame-made catalysts as well as that of commercial ZSM-5.

Catalyst	Surface elemental composition (%)				
	Al	Si	P	O	C
a-SA0	-	33.0	-	65.8	1.3
a-SA20	2.7	30.0	-	63.9	3.5
a-SA40	7.7	24.8	-	62.3	5.3
a-SA60	16.2	17.8	-	61.8	4.2
a-SA80	23.7	11.2	-	60.6	4.6
a-SA100	36.8	-	-	58.8	4.4
a-SAPO0	10.5	-	19.3	66.4	3.8
a-SAPO25	11.0	7.2	14.0	66.6	1.2
a-SAPO40	11.1	9.3	11.4	64.8	3.3
a-SAPO67	9.2	16.0	7.3	64.6	3.0
a-SAPO80	10.4	17.8	4.6	63.1	4.1
a-SAPO100	9.1	24.1	-	62.4	4.4
ZSM-5	2.5	29.4	-	61.3	6.8

The level of surface carbon content detected by XPS (in Table S1) is typical of any clean samples, which C–C bond is taken as the reference binding energy (284.9 eV). They originated from the trace volatile organic carbons in the ambient that ubiquitously adsorbed on the samples surface. The amount of surface carbon as shown in Table S1 are considered minimal and typical of clean samples.

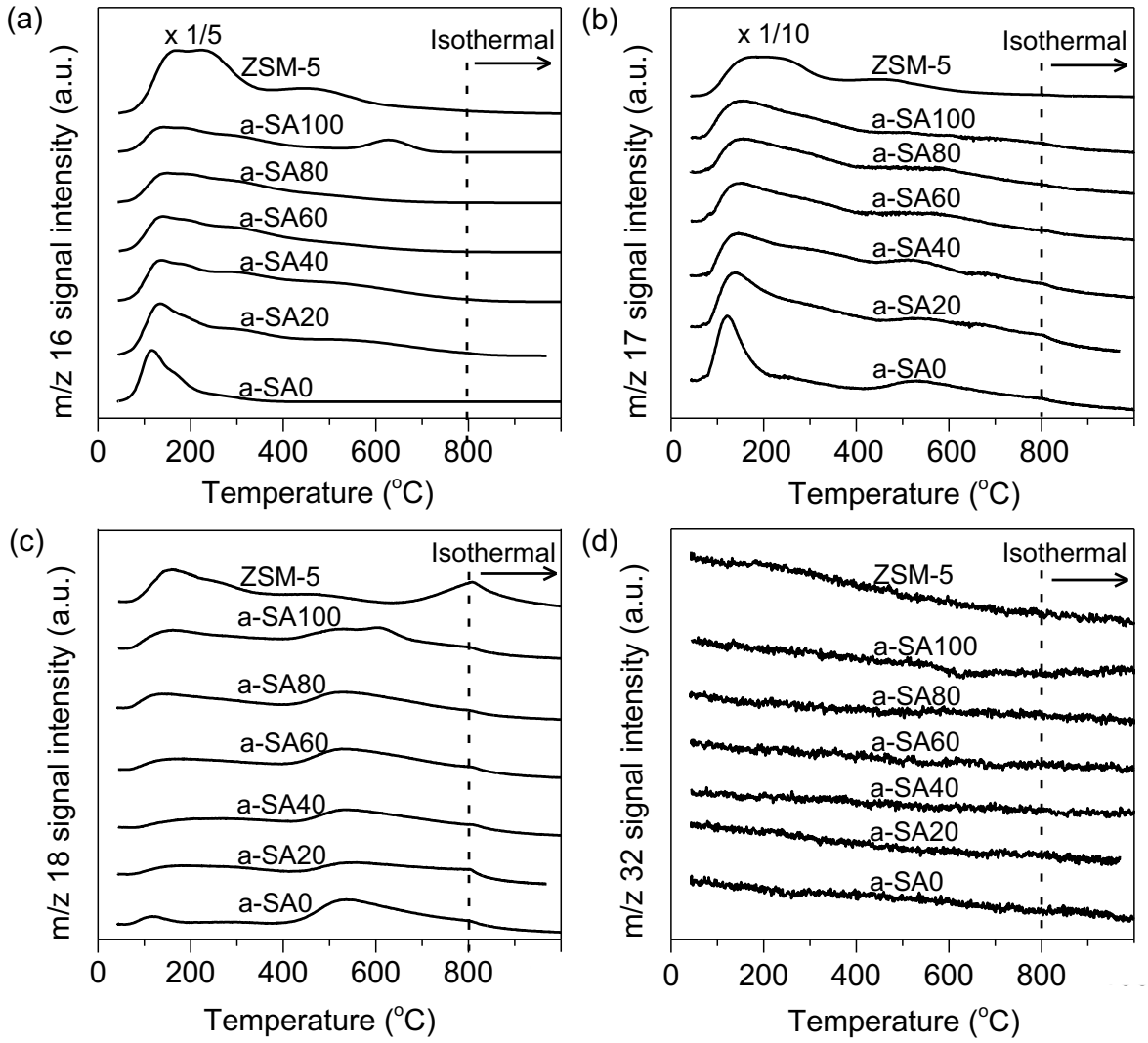

Fig. S1. Mass spectra of NH_3 monitored at (a) m/*z* = 16, and (b) m/*z* = 17, as well as that of (c) H_2O (m/*z* 18) and (d) O_2 (m/*z* 32) during the NH_3-TPD analysis of a-SA samples.

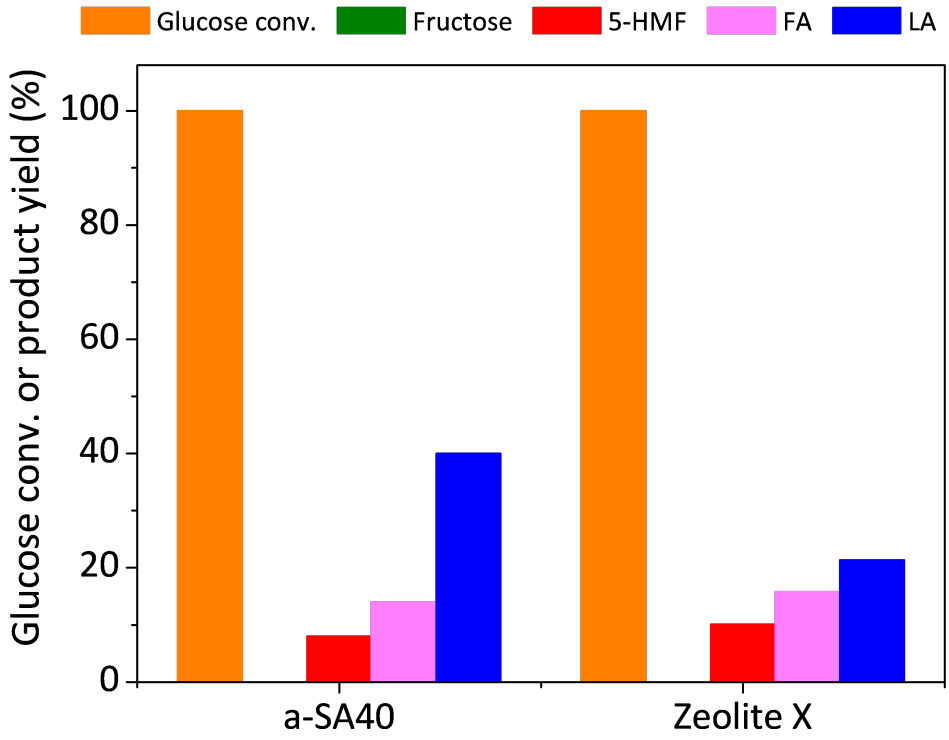

Fig. S2. Comparison of glucose conversion and products yields between the flame-made a-SA40 and protonated Zeolite X, where both catalysts have the same composition of Al/(Si+Al) = 0.40. Reaction temperature: 180 °C.

Table S2. Elemental composition of a-SA40 and a-SAPO25 before (fresh) and after (spent) glucose conversion reaction, as well as the calcined (450 ºC, 1 h) spent catalysts.

Catalyst	**Surface elemental composition (%)**				
	Al	Si	P	O	C
a-SA40 (Fresh)	7.7	24.8	-	62.3	5.3
a-SA40 (Spent)	15.2	10.3	-	44.2	30.2
a-SA40 (450 ºC)	15.8	19.6	-	55.4	9.2
a-SAPO25 (Fresh)	11.0	7.2	14.0	66.6	1.2
a-SAPO25 (Spent)	10.1	1.3	7.8	46.2	34.6
a-SAPO25 (450 ºC)	15.8	1.6	13.9	55.1	13.7