

Supporting Information for

**Dehydrogenation of propane over hydrothermal synthesized Ga₂O₃–
Al₂O₃ catalyst in the presence of carbon dioxide**

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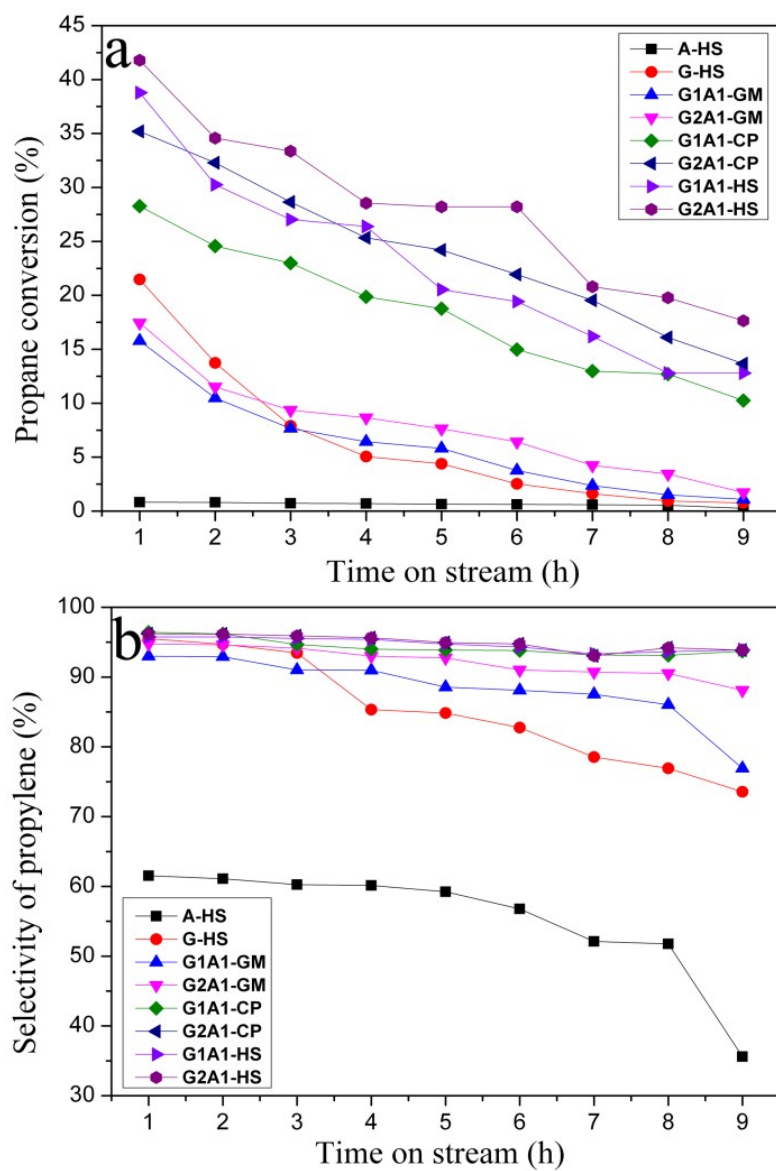


Fig. S1 Propane conversion (a) and selectivity of propylene (b) as a function of time on stream for as-prepared samples. Reaction conditions: $T = 550\text{ }^{\circ}\text{C}$; $P = 100\text{ kPa}$; $m_{\text{cat.}} = 150\text{ mg}$; the feed gas mixture $\text{C}_3\text{H}_8/\text{CO}_2/\text{N}_2$ with the molar ratio of 1:3:27; total flow rate = $15\text{ cm}^3\cdot\text{min}^{-1}$.

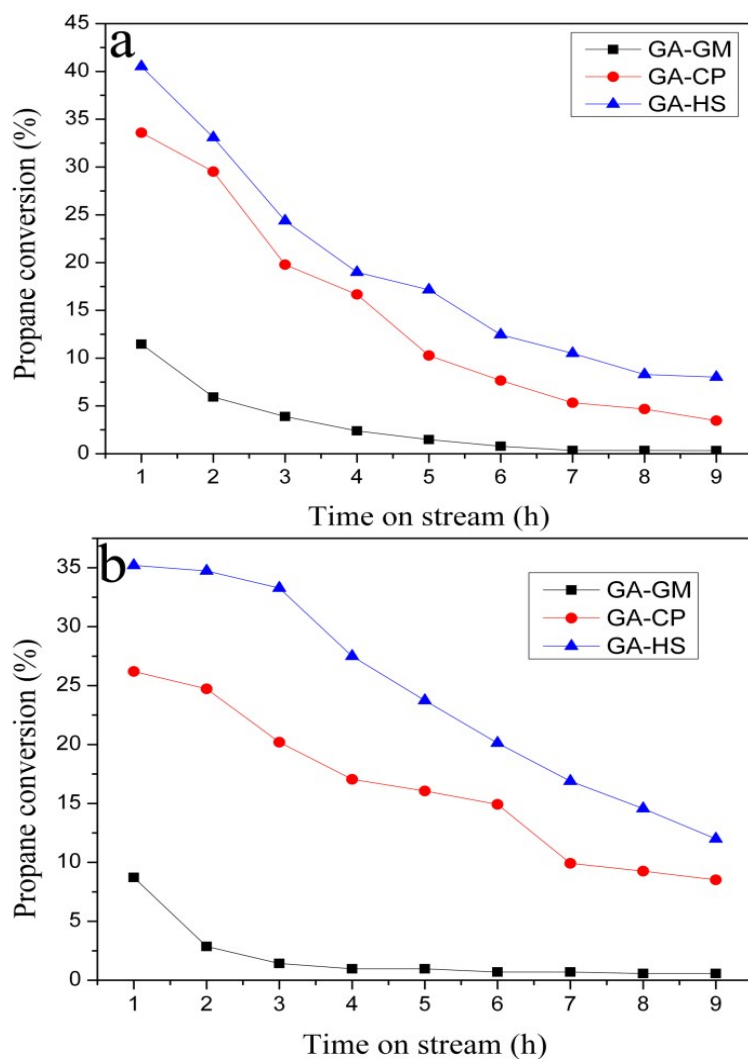


Fig. S2 Propane conversion as a function of time on stream for as-prepared samples in reaction without (a) and with CO₂ (b).

Table S1 Catalytic performance of different Ga₂O₃-Al₂O₃ catalysts in the dehydrogenation of propane in the presence and absence of CO₂.

Sample	Conversion (%)		Selectivity (%)					Yield (%)	
	C ₃ H ₈	CO ₂	C ₃ H ₆	C ₂ H ₆	C ₂ H ₄	CH ₄	C ₃₊	C ₃ H ₆	H ₂ /CO
GA-GM ^a	8.7	1.6	95.8	0.3	1.8	1.6	0.5	8.3	0.7
GA-GM ^b	11.4	/	90.8	0.5	4.9	2.9	0.9	10.4	/
GA-CP ^a	26.2	4.3	95.2	0.2	2.2	1.9	0.5	24.9	0.6
GA-CP ^b	33.6	/	91.2	0.3	3.8	3.5	1.2	30.6	/
GA-HS ^a	35.2	8.4	95.1	0.2	2.1	2.0	0.6	33.4	0.3
GA-HS ^b	40.5	/	92.1	0.4	3.6	2.8	1.1	37.3	/

^a Reaction conditions: T = 550 °C; P = 100 kPa; m_{cat.} = 150 mg; the feed gas mixture C₃H₈/CO₂/N₂ with the molar ratio of 1:3:27; total flow rate = 15 cm³·min⁻¹; reaction time = 1h.

^b Reaction conditions: T = 550 °C; P = 100 kPa; m_{cat.} = 150 mg; the feed gas mixture C₃H₈/N₂ with the molar ratio of 1:30; total flow rate = 15 cm³·min⁻¹; reaction time = 1h.

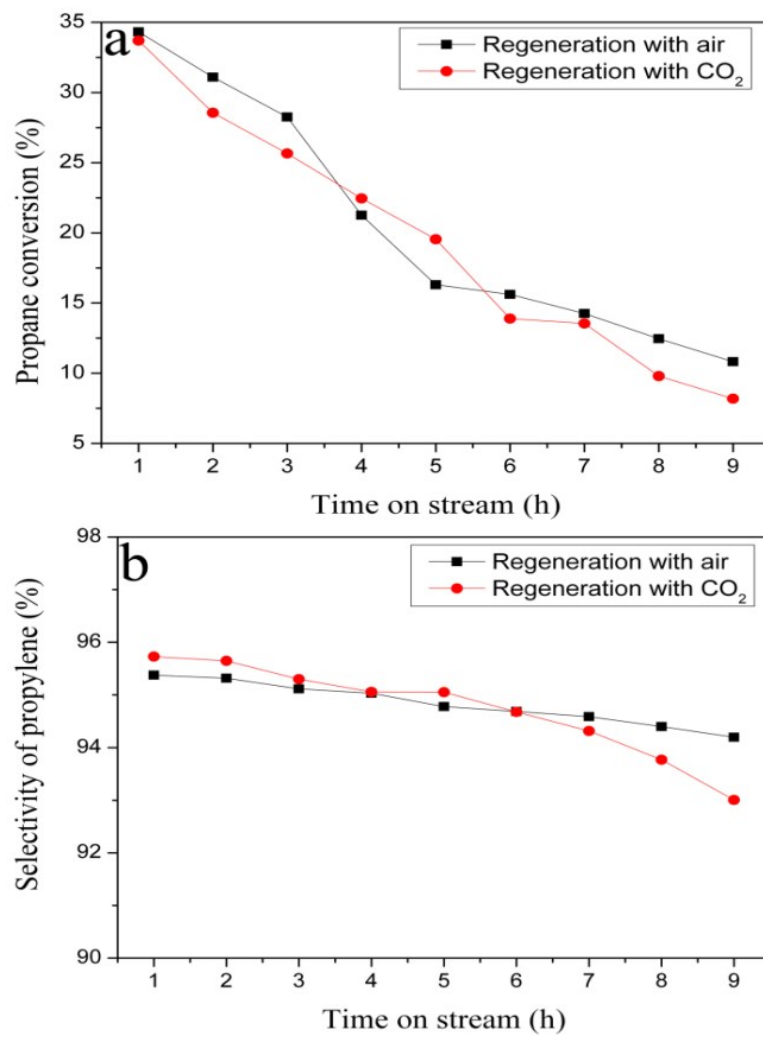


Fig. S3 Propane conversion (a) and selectivity of propylene (b) as a function of time on stream for GA-HS after regeneration with air or CO₂.

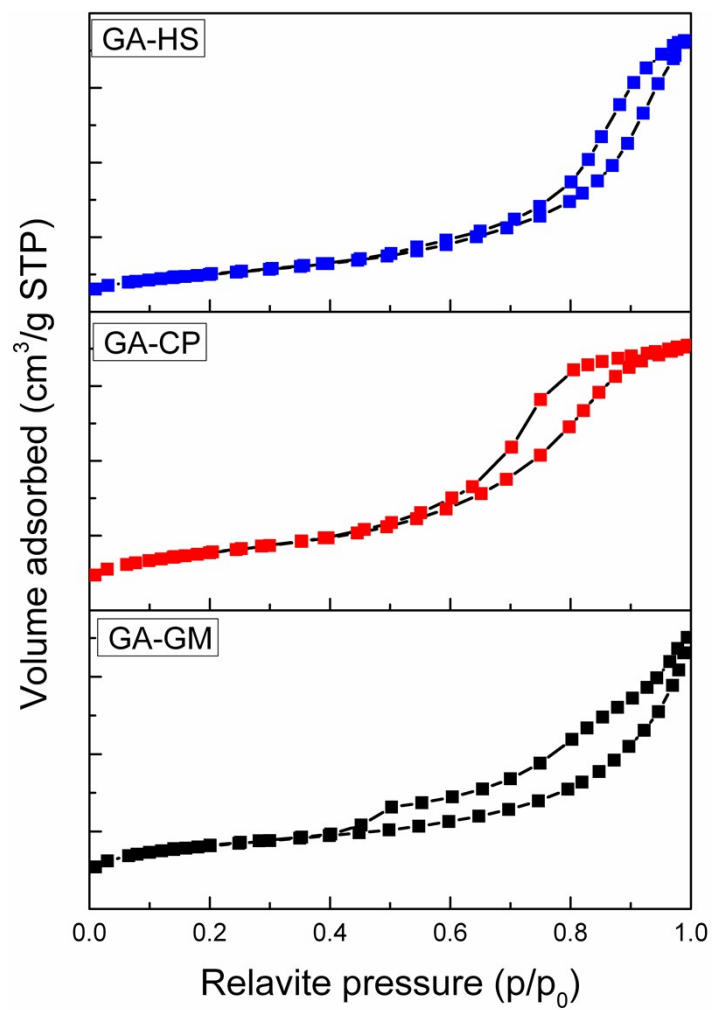


Fig. S4 Nitrogen adsorption–desorption isotherms for different catalysts.

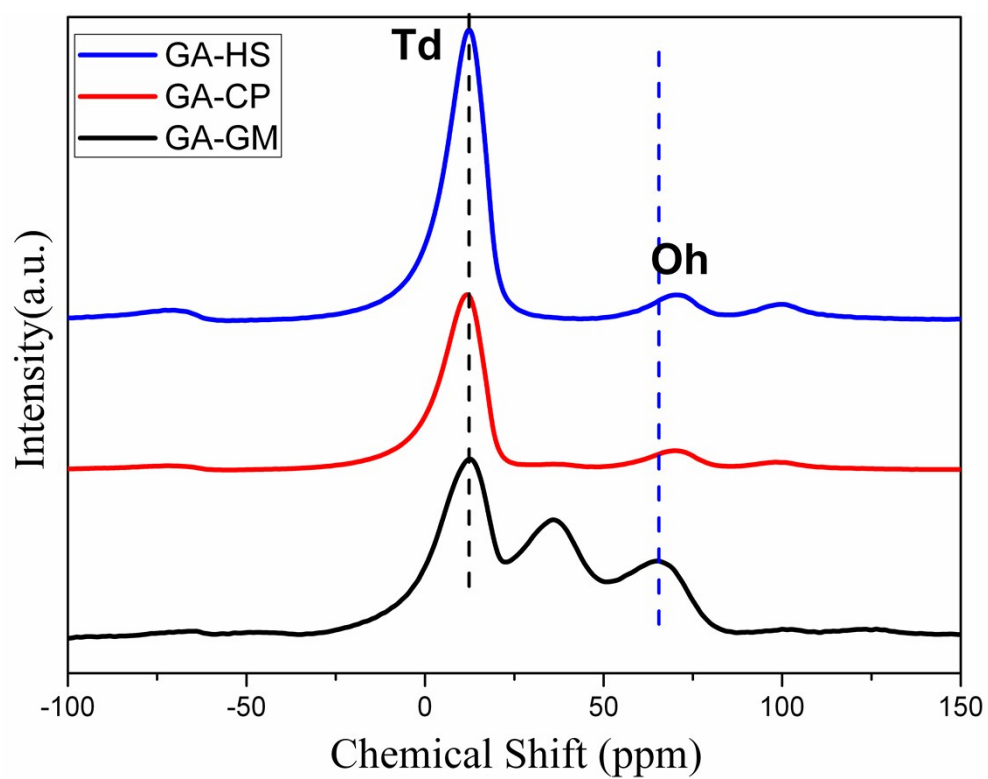


Fig. S5 ^{27}Al MAS NMR profiles for as-prepared catalysts.

Table S2 Al^{T} percentage for as-prepared catalysts.

Sample	Al^{T} (%)
GA-GM	0.677
GA-CP	0.913
GA-HS	0.936

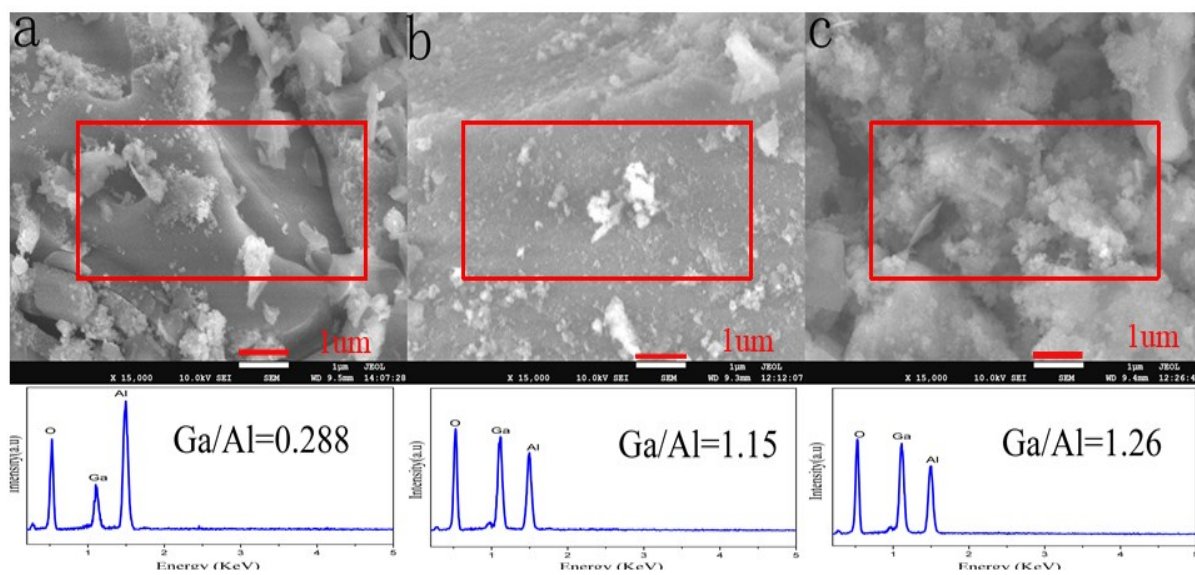


Fig. S6 SEM images of the different as-prepared catalysts: (a) GA-GM; (b) GA-CP; (c) GA-HS.

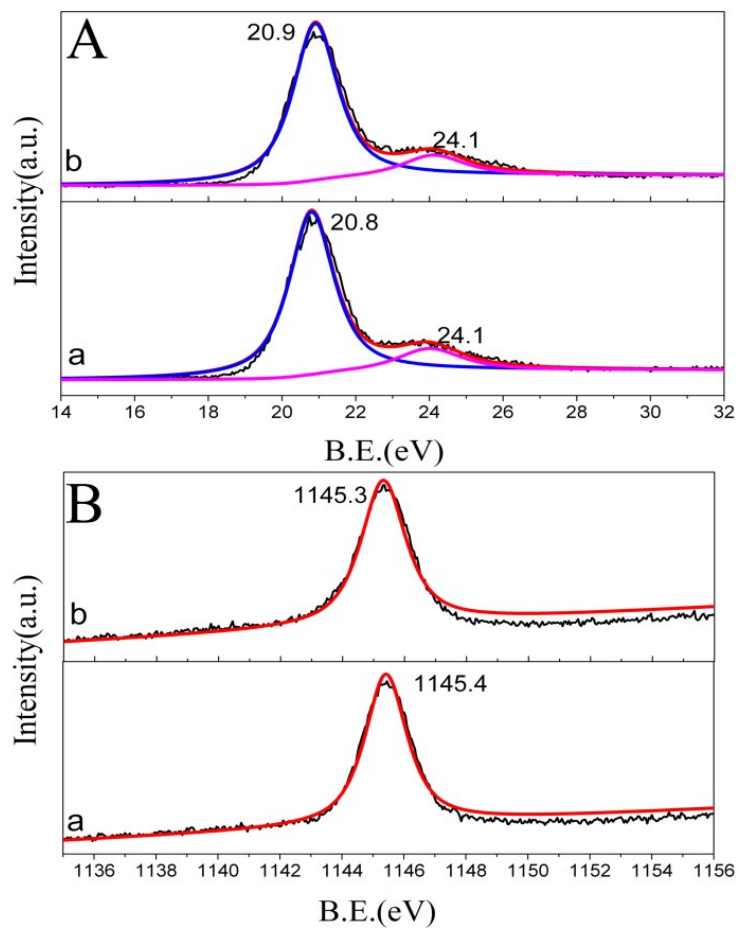


Fig. S7 Ga 3d XPS (A) and Ga 2p_{1/2} XPS (B) profiles of spent GA-HS after reactions with (a) and without CO₂ (b).

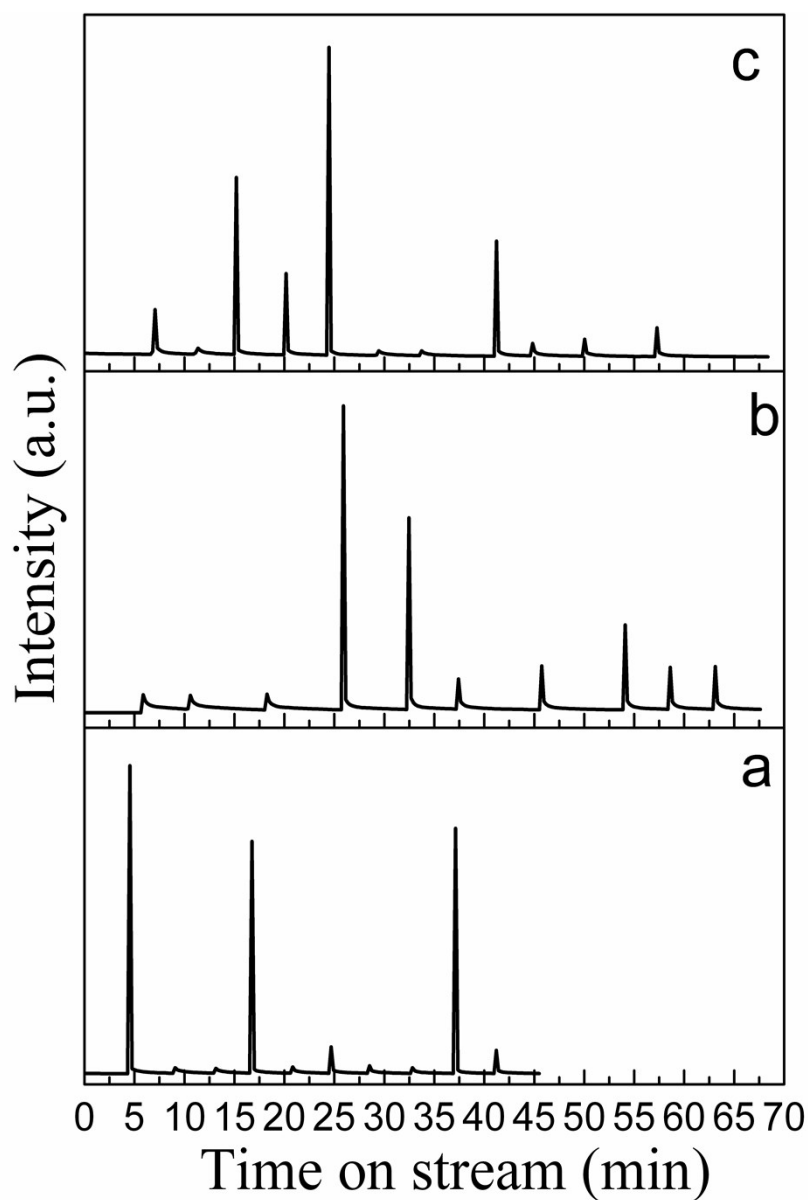


Fig. S8(a-c) Transient responses of $m/z = 44$ (C_3H_8) over as-prepared catalysts against a pulsed introduction of C_3H_8 under steady flow of pure Ar. Reaction conditions: catalyst = 100 mg; Ar carrier = 30 mlmin^{-1} ; $C_3H_8 = 1 \text{ ml}$; furnace temperature = 550°C . (a) GA-GM; (b) GA-SS; (c) GA-HS.

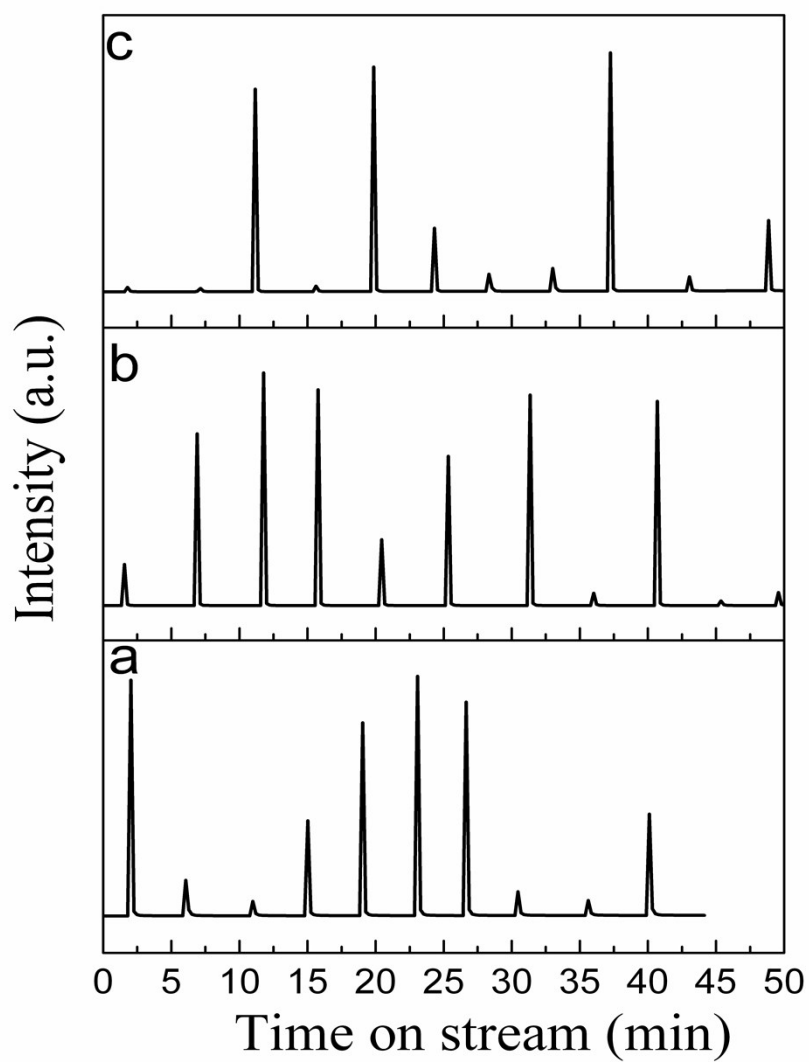


Fig. S9(a-c) Transient responses of $m/z = 43$ (C_3H_8) over as-prepared catalysts against a pulsed introduction of C_3H_8 under steady flow of mixture gas (10% CO_2 and 90%Ar). Reaction conditions: catalyst = 100 mg; CO_2 and Ar carrier = 30 $ml\min^{-1}$; C_3H_8 = 1 ml; furnace temperature = 550°C. (a) GA-GM; (b) GA-SS; (c) GA-HS.