Electronic Supplementary Material (ESI) for Inorganic Chemistry Frontiers.

Electronic Supplementary Information

An effective amino acid-assisted growth of ultrafine palladium nanocatalysts toward superior synergistic catalysis for hydrogen generation from formic acid

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Table S1. Catalytic activities for hydrogen generation from formic acid catalyzed by various heterogeneous catalysts

Catalyst	Additive	Temp. (°C)	CO evolution	TOF (h^{-1})	Ref.
Arg-Pd/MSC-30	HCOONa	**60**	**No**	**5723**	**This work**
	None	**50**	**No**	**1365**	**This work**
Pd/MSC-30	HCOONa	50	No	2623	S1
Au/ZrO_2 NCs	NEt_3	50	No	1593[a]	S2
Ag@Pd/C	Aqueous	20	No	192	S3
Pd-S-SiO_2	Aqueous	85	No	719	S4
AuPd@ED-MIL-101	HCOONa	90	Yes	106	S5
PdAu/C-CeO_2	HCOONa	92	145 ppm	113.5	S6
$Ag_{42}Pd_{58}$	Aqueous	50	No	328[a]	S7
Pd-B/C	HCOONa	30	No	1184	S8
PdAu@Au/C	HCOONa	92	30 ppm	21.4	S9
$Co_{0.30}Au_{0.35}Pd_{0.35}$	Aqueous	25	No	80[a]	S10
Pd/APC	HCOONa	55	No	2999	S11
Pd/N-MSC-30-two-175	HCOONa	60	No	8414	S12
$Pd_{0.6}Ag_{0.4}$@ZrO_2/C/rGO	HCOONa	60	No	4500	S13

[a] Initial TOF values calculated at the initial stages of the catalytic reactions.

Table S2. ICP results of Pd content for Pd/MSC-30 and Arg-Pd/MSC-30

Sample	Pd content (wt%)
Pd/MSC-30	7.92
Arg-Pd/MSC-30	3.81
Recycled Arg-Pd/MSC-30	3.75

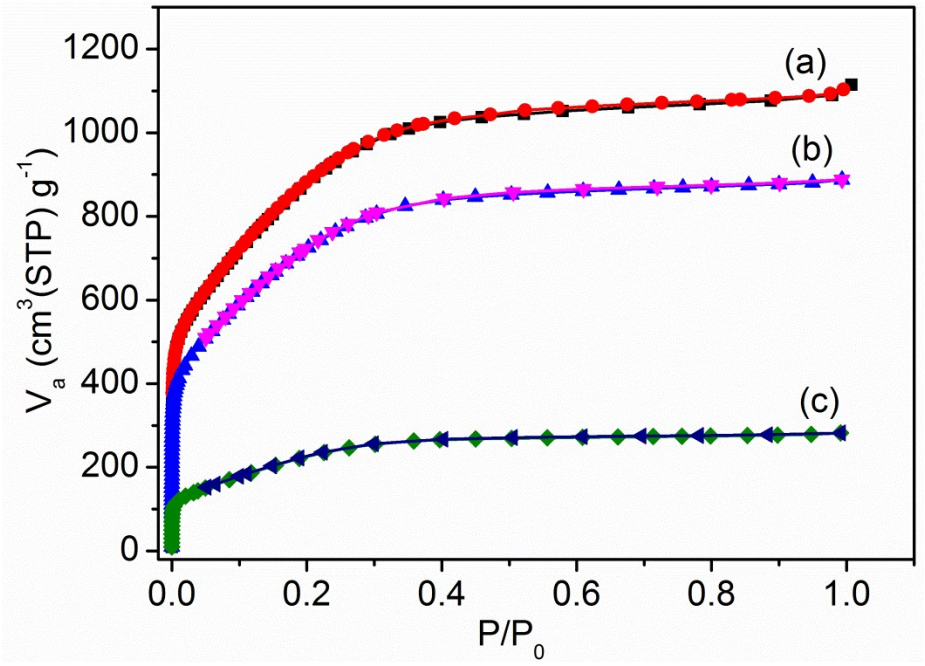

Figure S1. N_2 sorption isotherms of (a) MSC-30, (b) Pd/MSC-30, and (c) Arg-Pd/MSC-30 at 77K.

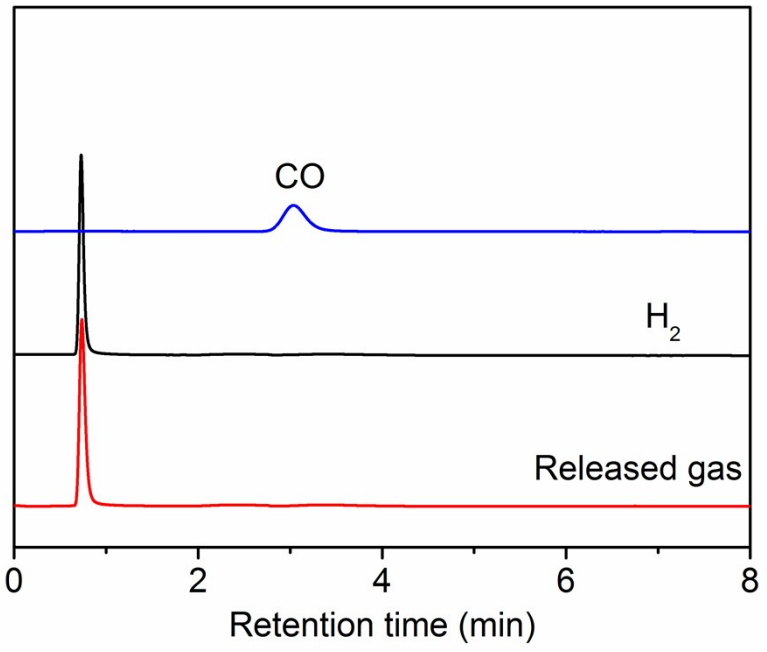

Figure S2. Gas chromatograms of CO and H_2 as reference gases and the released gas from the dehydrogenation of FA over Arg-Pd/MSC-30 (n_{Pd}/n_{FA} = 0.01, FA/SF = 1:1, 323 K).

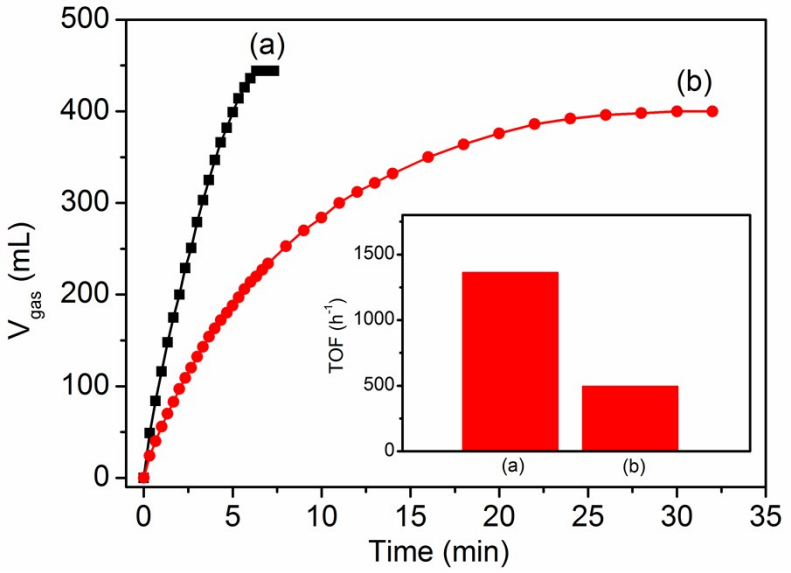

Figure S3. Volume of the generated gas (CO_2 + H_2) versus time for the dehydrogenation of pure FA over the as-prepared (a) Arg-Pd/MSC-30 and (b) Pd/MSC-30 (n_{Pd}/n_{FA} = 0.01, 323 K, n_{FA} = 9.0 mmol). Insert: corresponding TOF values for dehydrogenation of pure FA over the Arg-Pd/MSC-30 and Pd/MSC-30 catalysts.

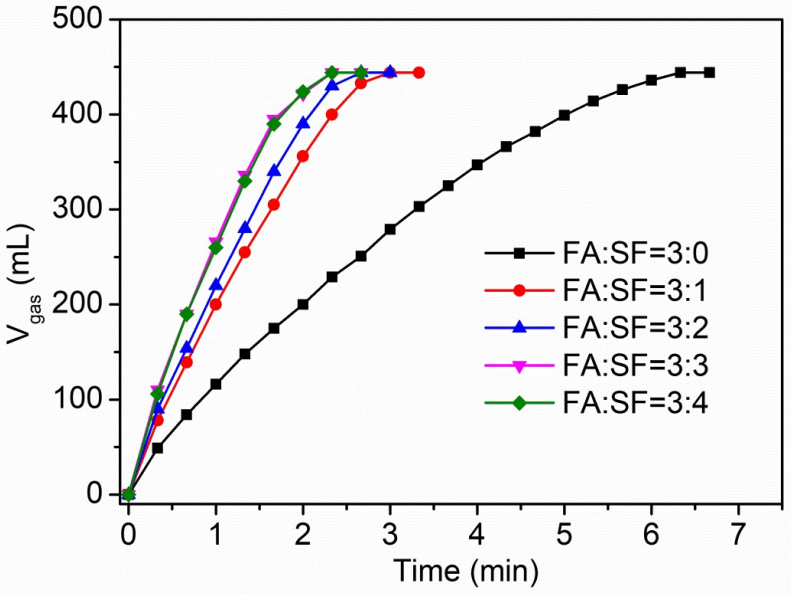

Figure S4. Volume of the generated gas (CO_2 + H_2) versus time for the dehydrogenation of FA with different FA/SF molar ratios over the as-prepared Arg-Pd/MSC-30 catalyst (n_{Pd}/n_{FA} = 0.01, 323 K).

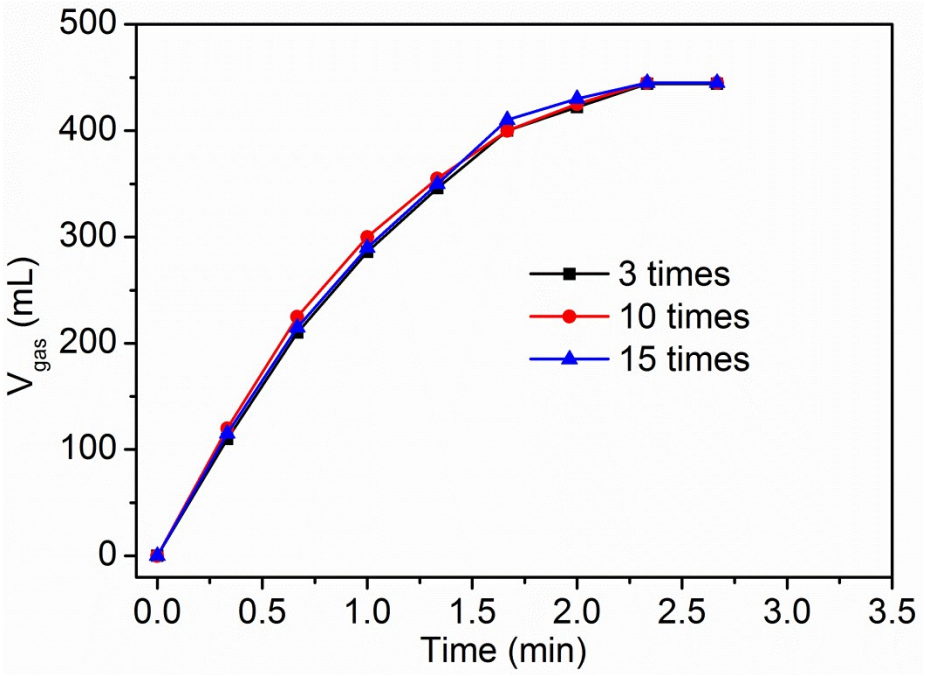

Figure S5. Volume of the generated gas (CO_2 + H_2) versus time for the dehydrogenation of FA with over the as-prepared Arg-Pd/MSC-30 catalyst washed with different times after reduction (n_{Pd}/n_{FA} = 0.01, 323 K).

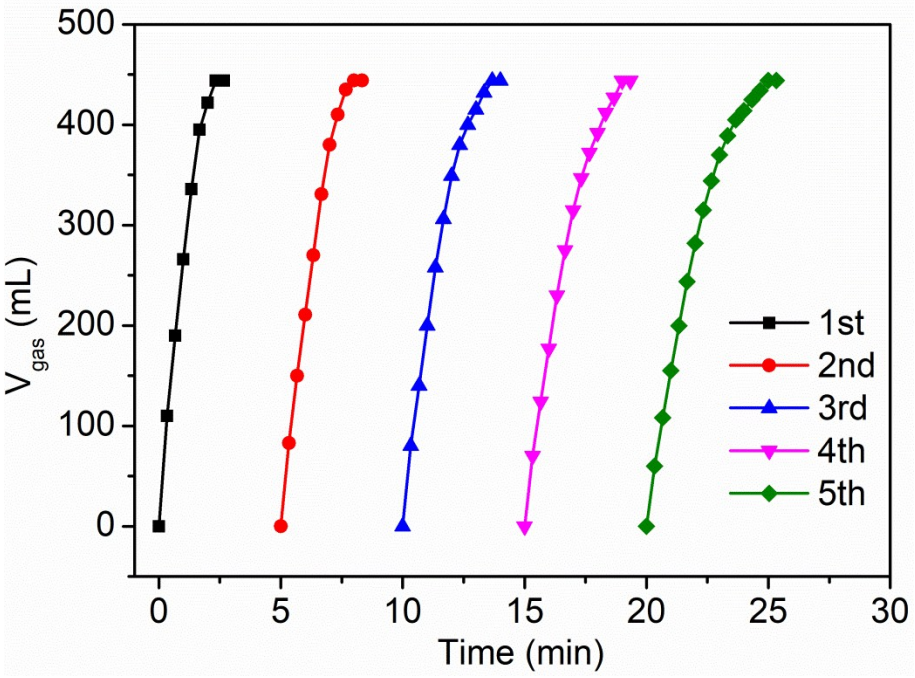

Figure S6. Durability test for the dehydrogenation of FA over Arg-Pd/MSC-30 (n_{Pd}/n_{FA} = 0.01, FA/SF = 1:1, 323 K).

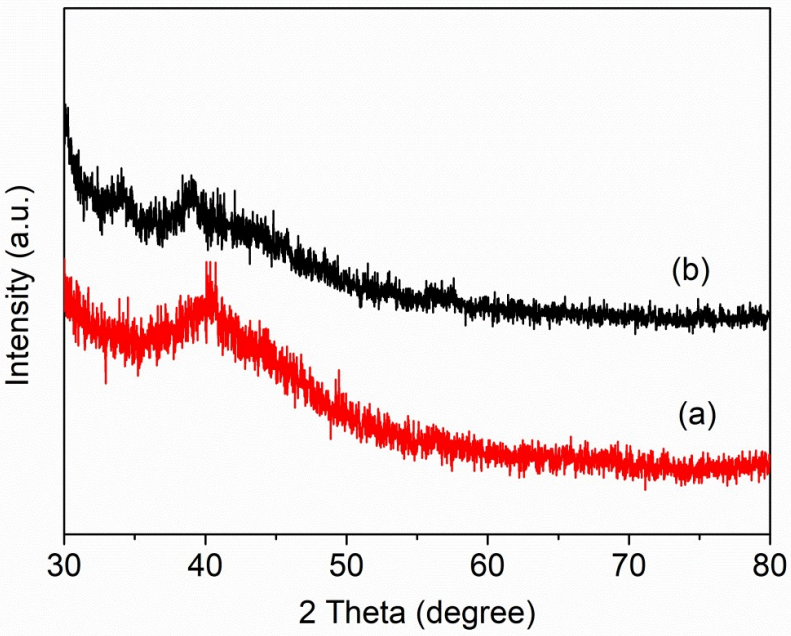

Figure S7. PXRD patterns of Arg-Pd/MSC-30 (a) before and (b) after catalysis.

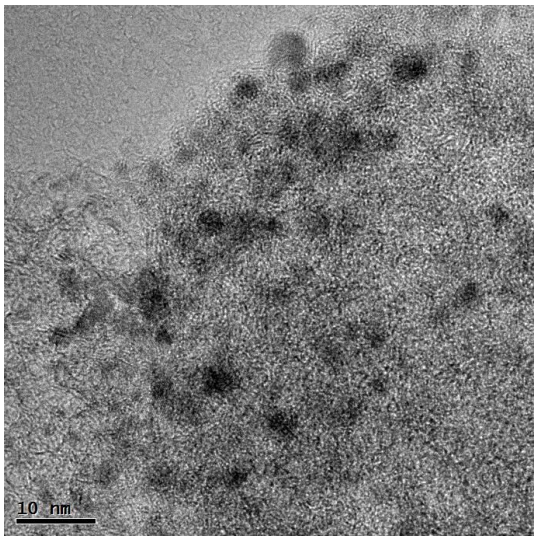

Figure S8. TEM image of Arg-Pd/MSC-30 after catalysis

References

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