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# Facile synthesis of amine-functionalized SBA-15-supported bimetallic Au–Pd nanoparticles as an efficient catalyst for hydrogen generation from formic acid

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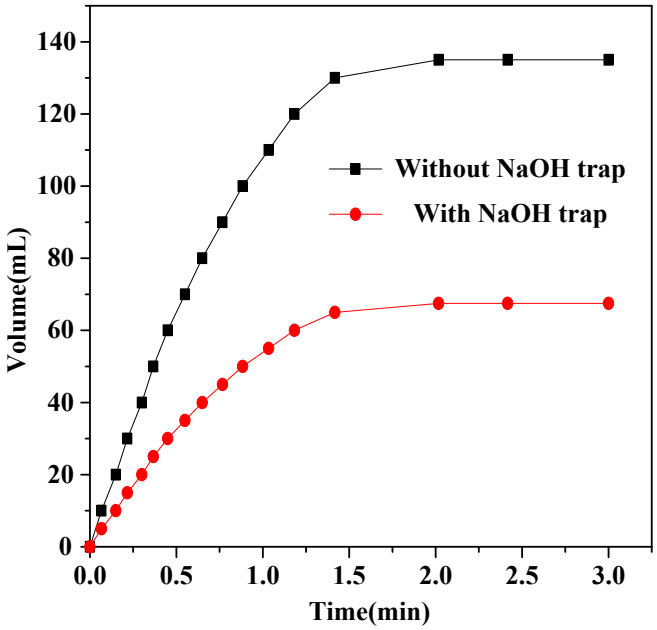


**Fig. S1.** Gas generation by decomposition of FA/SF vs time catalyzed by $Au_2Pd_8$/SBA-15-Amine at 323 K with and without NaOH trap (catalyst= 100 mg, $n_{FA}$ =3 mmol, $n_{SF}$ =1 mmol).

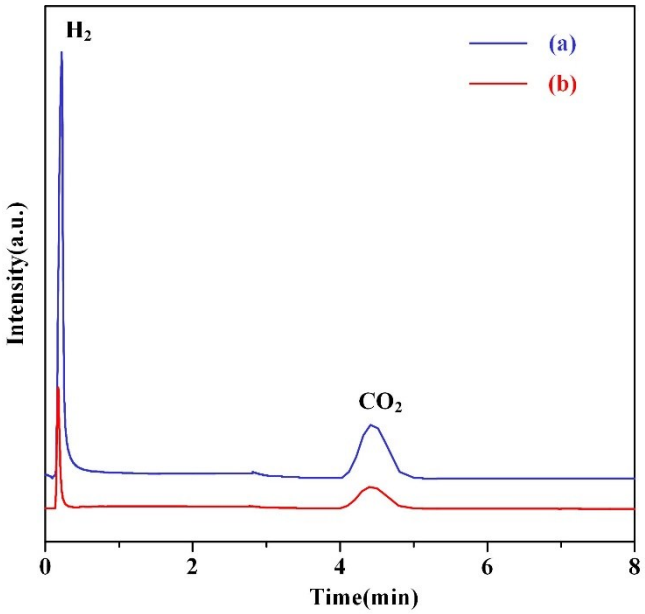


**Fig. S2.** GC spectrum using TCD for a) commercial mixture gas of $H_2$ and $CO_2$, and b) evolved gas from FA/FS aqueous solution ($n_{FA}$ =3 mmol, $n_{SF}$ = 1 mmol) over $Au_2Pd_8$/SBA-15-Amine at 323 K.

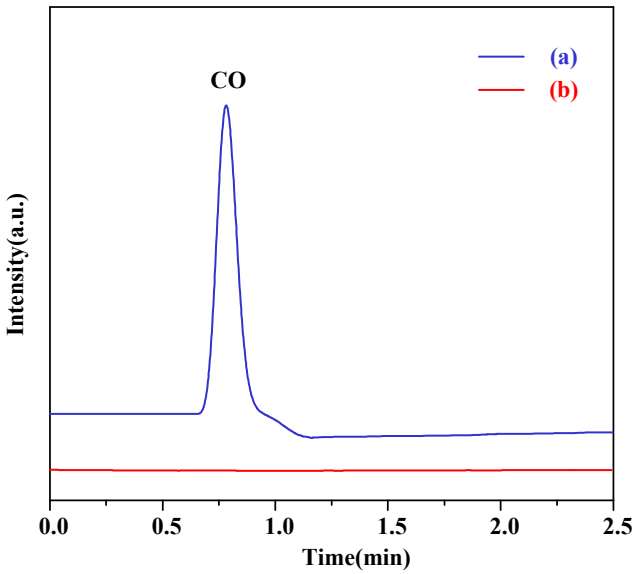


**Fig. S3.** GC spectrum using FID-Methanator for the a) commercial pure CO, and b) evolved gas from FA/FS aqueous solution ($n_{FA}$ =3 mmol, $n_{SF}$ = 1 mmol) over $Au_2Pd_8$/SBA-15-Amine at 323 K.

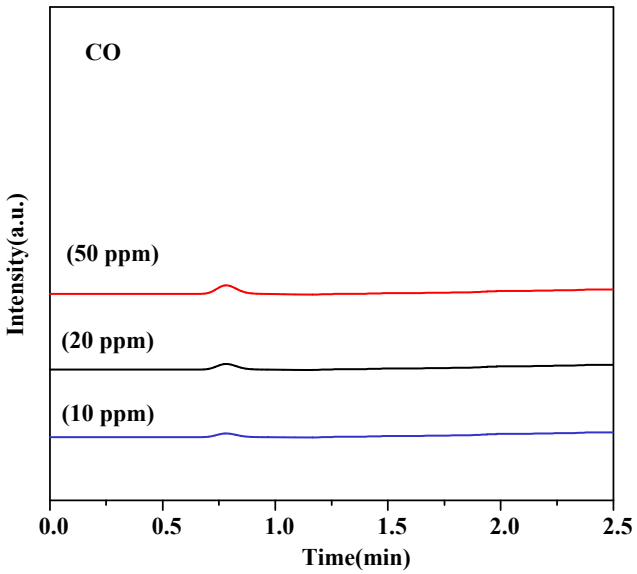


**Fig. S4.** GC spectrum using FID-Methanator for the commercial CO in different concentration, like 10 ppm, 20 ppm, 50 ppm.

**Table S1.** ICP-AES results of AuPd/SBA-15-Amine catalysts

| Catalyst | Au (wt%) | Pd (wt%) | Au-Pd initial composition (molar ratio) | Au-Pd final composition (molar ratio) | Final Metals/Catalyst (mmol/100 mg) |
|---|---|---|---|---|---|
| $Au_8Pd_2$/SBA-15-Amine | 16.29 | 2.47 | 80:20 | 78:22 | 0.106 |
| $Au_6Pd_4$/SBA-15-Amine | 12.38 | 4.26 | 60:40 | 61:39 | 0.103 |
| $Au_4Pd_6$/SBA-15-Amine | 8.11 | 6.03 | 40:60 | 42:58 | 0.098 |
| $Au_2Pd_8$/SBA-15-Amine | 3.69 | 9.04 | 20:80 | 18:82 | 0.104 |

**Table. S2** Comparison of AuPd/SBA-15-Amine catalyzed decomposition of FA/SF solution ($n_{FA}$ =3 mmol, $n_{SF}$ = 1 mmol)

| Catalyst | T/ K | Conversion/ % | $TOF_{initial}$/ $h^{-1}$ | $H_2/CO_2$ ratio |
|---|---|---|---|---|
| $Au_8Pd_2$/SBA-15-Amine | 323 | 22.2 | 255 | 1:1 |
| $Au_6Pd_4$/SBA-15-Amine | 323 | 92.6 | 724 | 1:1 |
| $Au_4Pd_6$/SBA-15-Amine | 323 | 100 | 918 | 1:1 |
| $Au_2Pd_8$/SBA-15-Amine | 323 | 100 | 1786 | 1:1 |
| $Au_2Pd_8$/SBA-15-Amine | 303 | 81.5 | 518 | 1:1 |
| $Au_2Pd_8$/SBA-15-Amine | 313 | 100 | 758 | 1:1 |
| $Au_2Pd_8$/SBA-15-Amine | 333 | 100 | 2922 | 1:1 |

$TOF_{initial}$ is calculated when $x_a$ reaches 20%.

**Table S3** TOF values for the decomposition of FA over various heterogeneous catalysts.[a]

| Catalyst | T(K) | TOF($h^{-1}$) | $E_a$ (kJ/mol) | Reference |
|---|---|---|---|---|
| $Au_2Pd_8$/SBA-15-Amine | 323 | 1786 | 47.6 | This work |
| L-$Au_4Pd_6$ | 298 | 1075 | 21.98 | S1 |
| $Au_6Pd_4$-L-Mg | 298 | 1120 | 18.5 | S2 |
| C–$Au_{41}Pd_{59}$ | 323 | 230 | 28 ±2 | S3 |
| $Ag_{0.2}Au_{0.4}Pd_{0.4}$/rGO | 298 | 73.6 | | S4 |
| $Co_{0.30}Au_{0.35}Pd_{0.35}$/C | 298 | 80 | | S5 |
| Au@Pd/N-mrGO | 298 | 89.1 | | S6 |
| AuPd-$CeO_2$/N-rGO | 298 | 52.9 | | S7 |
| CoAuPd/DNA-rGO | 298 | 85.0 | | S8 |
| PdNi@Pd/GNs–CB | 298 | 577 | | S9 |
| $Ag_{10}Pd_{90}$/0.2CND/SBA-15 | 323 | 893 | | S10 |
| $Co_{1.6}Ag_{62.2}Pd_{36.2}$/graphene | 298 | 110 | 33.9 | S11 |

[a] TOF is calculated when $x_a$ reaches 20%.

**Reference**


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