Supporting Information

Exfoliated MoS$_2$ supported Au–Pd bimetallic nanoparticles with core-shell structures and superior peroxidase-like activities

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Experimental

MoS$_2$ preparation:

The MoS$_2$ nanosheets were obtained by chemically exfoliated method following the procedures reported before. 1.5 g MoS$_2$ power was immersed in 15 ml of 1.6 M n-butyllithium in hexane at 100 ℃ in a flask filled with argon gas. After 2 days, the suspension was filtered and washed with hexane. Exfoliation in water was achieved immediately with the assist of ultra-sonication. The mixture was then centrifuged several times to remove the un-exfoliated materials and lithium cations. Finally, the as-made chemical exfoliated MoS$_2$ was purified using exhaustive dialysis.
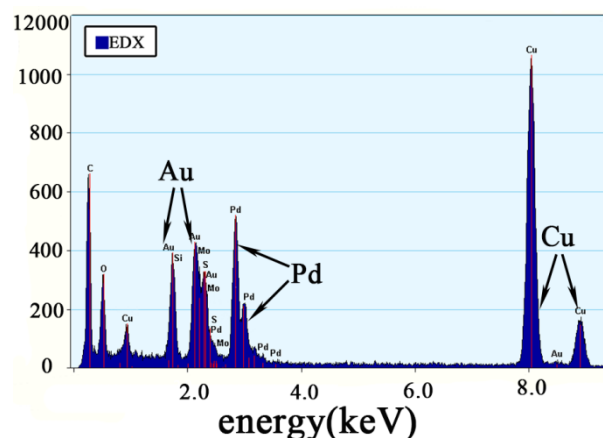
Characterization

Figure S1. Energy dispersive X-ray spectroscopy (EDX) of the prepared Au–Pd/MoS$_2$, the Cu peaks come from the copper grid.
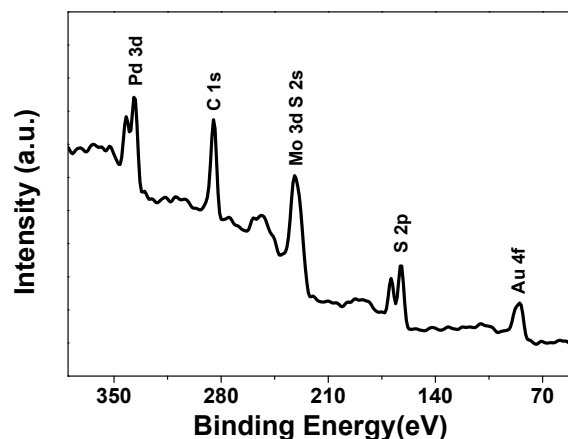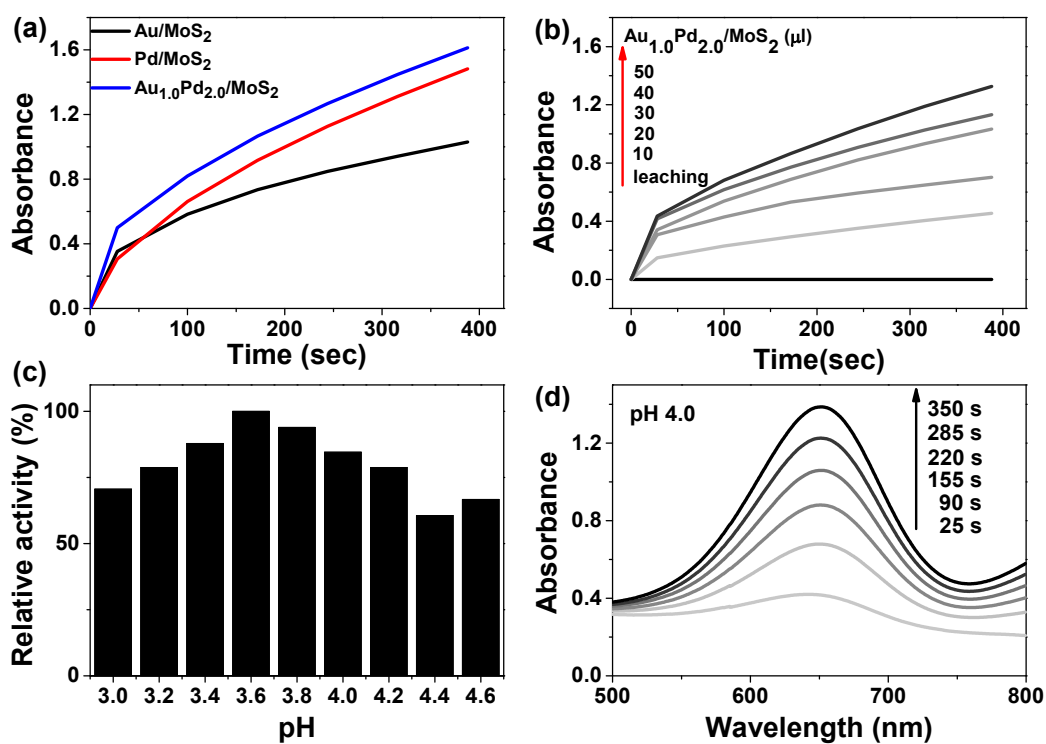
Figure S2. Full range XPS spectra of Au–Pd/MoS$_2$ hybrids. Note the signal of C may come from CO$_2$.

Due to the limited thickness of the Pd shell, both the Au and Pd signals can be clearly observed in XPS analysis.

ure S3. (a) Time-dependent absorbance (abs) changes at 652 nm using Au/MoS$_2$, Pd/MoS$_2$ and Au–Pd/MoS$_2$ hybrids, (b) abs changes at 652 nm in the presence of leaching solution and in the presence of different amounts of Au–Pd/MoS$_2$ hybrids, (c) relative activity upon variations of pH, (d) the evolutions of absorbance spectra at pH 4.0.

Compared with Au/MoS$_2$ and Pd/MoS$_2$ catalysts, the alloy hybrids exhibited relative high activity for the TMB oxidation. In order to exclude the impact of the

leaching metal ions, we incubated the catalyst in an acetate buffer solution (pH 3.6) at room temperature for 20 min, and then used the filtrate for the control experiment. In addition, the catalyst shows good stability over a wide range of pH values, from 3.0 to 4.6, and the optimal pH value is 3.6.
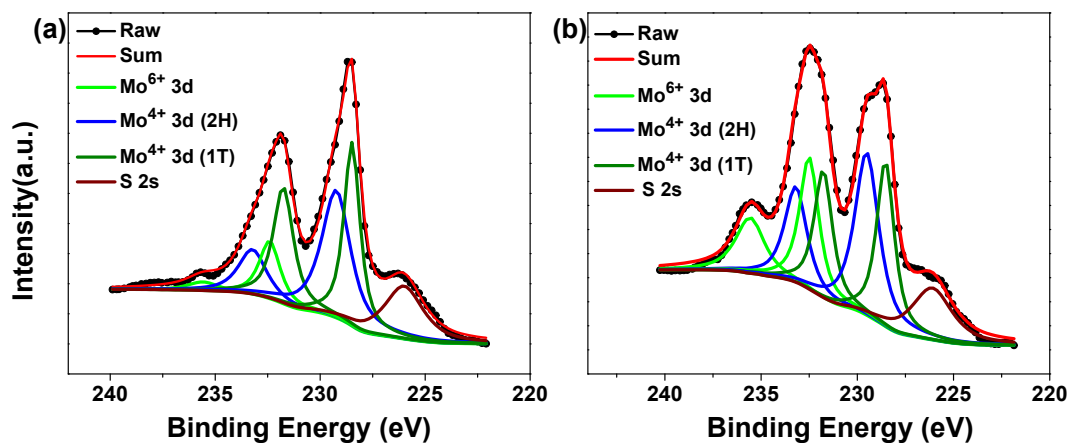

Figure S4. XPS spectra of Mo 3d before (a) and after (b) catalytic reactions

The XPS spectras of Mo 3d before and after catalytic reaction is shown in Figure S4. In Figure S4a, a small peak at 235.5 eV, corresponding to Mo^{6+} $3d_{5/2}$, shows that Mo atoms had slightly oxidized. The relative areas of Mo^{6+} 3d peaks increased from 10.88% to 23.7% after the reaction, indicating MoS_2 is oxidized in the presence of H_2O_2.

Table S1 ICP Results

Pd:Au mass ratio	Pd(mg/L)	Au(mg/L)	Pd/Au	Total loading	Total loading (wt%)
3:1	2.8623	0.9518	3.0071	3.8142	9.5326
2:1	2.5573	1.2698	2.0138	3.8271	9.5650
1:1	1.8653	1.853	1.0066	3.7183	9.2931
0.5:1	1.2177	2.4196	0.5032	3.6373	9.0906
0.33:1	0.9625	2.8675	0.3358	3.8282	9.5677
1:0	3.822	0.03371	113.362	3.8557	9.6364
0:1	0.04416	3.5626	0.01239	3.6067	9.0142

The ICP results confirm the actual loading amounts of Au and Pd. The moral ratios in these catalysts are close to those in the corresponding precursor solutions. The analysis was measured with same amount of samples. Note that the total loading of the nanoparticles is slightly lower than the compositions calculated from corresponding precursors, due to their lose during the repeated washing and

dissolving processes before ICP analysis.