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Electronic Supplementary Information (ESI)

MoS_2 Nanosheets Coated Mesh for pH-induced Multi-pollutant Water Remediation with In-situ Electrocatalysis

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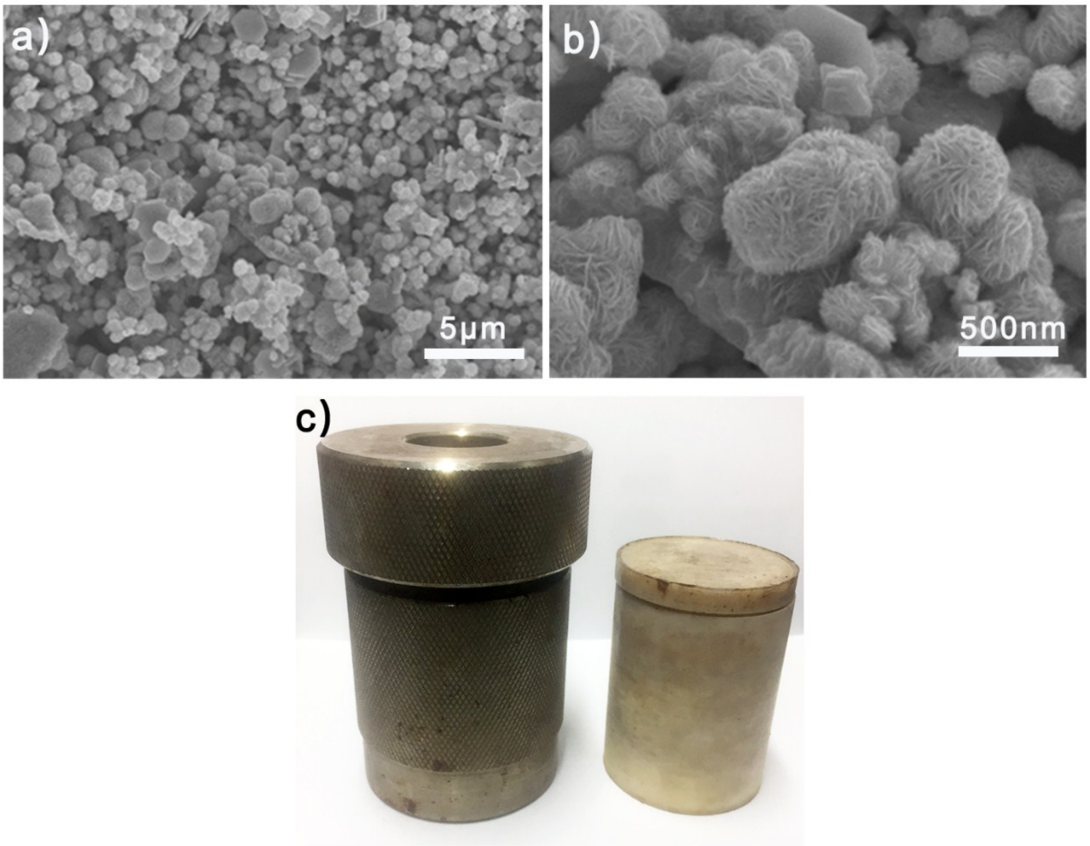


Figure S1. a) b): Different magnification of SEM images of Free MoS_2 crystalline powder without copper substrate; c) The digital photograph of Teflon-lined autoclave used for preparing MoS_2.

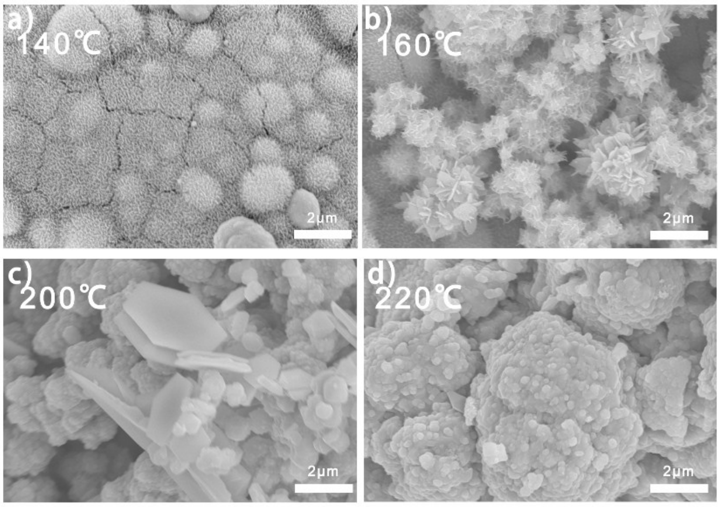


Figure S2. Typical images of MoS_2 anchored meshes at hydrothermal temperatures from 140 °C to 220 °C.

We tried to regulate the size of MoS_2 nanosheets by changing the hydrothermal temperature. And 5 different hydrothermal temperatures (140 ℃, 160 ℃, 180 ℃, 200 ℃, 220 ℃) were conducted to synthesize MoS_2 coated mesh. The result showed that high or low temperature both had negative effect to the generation of crystallographic MoS_2, thus would reduce the catalysis activity.

When the temperature was 140 ℃, the hydrothermal reaction was too slow to preparing complete MoS_2 crystals and burr-shaped drape uniformly coated on the mesh surface. The roughness of the mesh surface was low. When the temperature was 160 ℃, a few sheet structure began to appear while the density of MoS_2 was low, indicating the lack of MoS_2 on the mesh surface. When the temperature was 180 ℃ (Figure 1a), dense MoS_2 with an average side length of 500 nm and an average thickness of about 200 nm covered the mesh surface. And when the temperature was 200 ℃, the morphology of MoS_2 was similar with that synthesized under 180 ℃. When the temperature was 220 ℃, the reaction was too fast to generate intact crystal, and most of the MoS_2 showed ruleless morphology with less active edges. So we could deduce that temperature has important influence to the morphology of MoS_2 and 180 ℃ was the optimal condition.

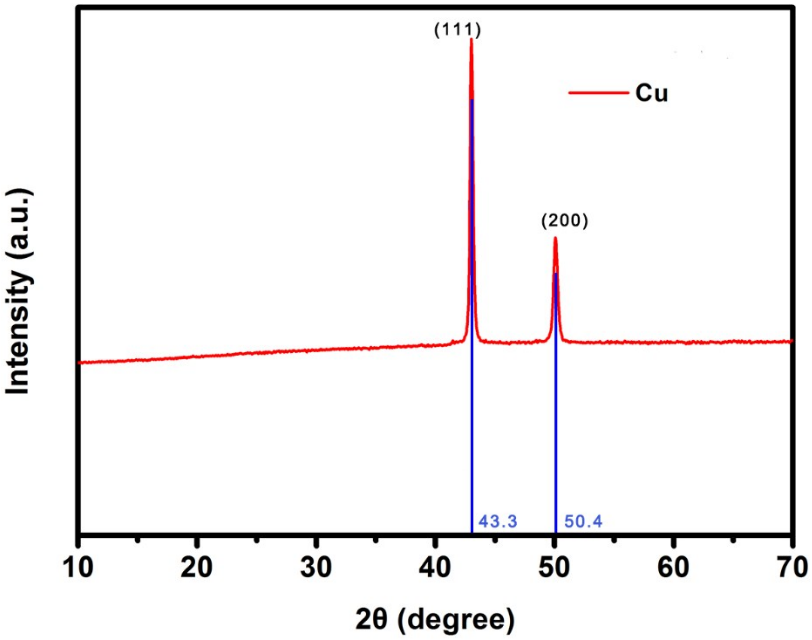


Figure S3. Typical XRD pattern of the copper mesh. The characteristic peak at 2*θ* = 43.29°, 50.04° signify the (111) and (200).

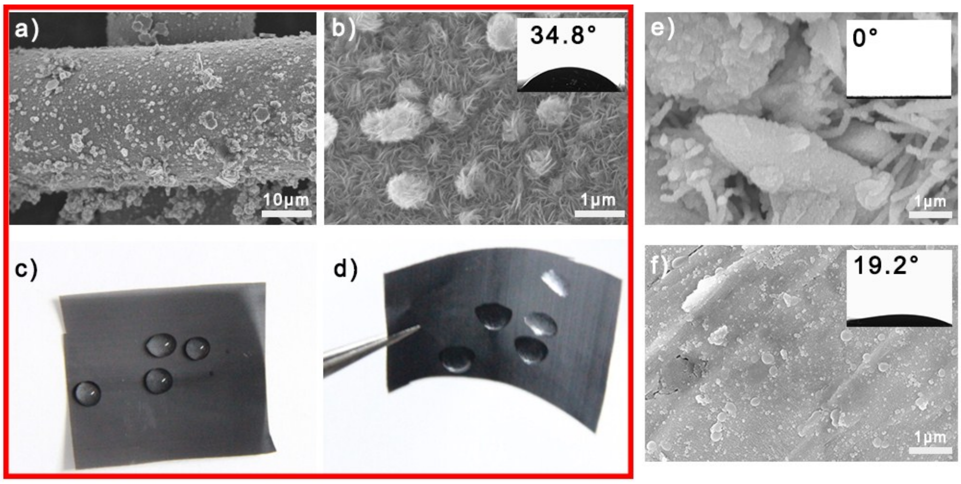


Figure S4. Morphology and wetting behavior of the MoS_2 coated substrates: a)-d) MoS_2 coated stainless steel mesh (1000); e) MoS_2 coated nickel sponge; f) MoS_2 coated stainless steel mesh (400).

We further introduced nickel sponge, stainless steel mesh (with a mesh number of 400) and stainless steel mesh (with a mesh number of 1000) as substrates to show the advantage of copper mesh substrate.

As we could see, figure a)-d) exhibited the MoS_2 coated stainless steel mesh (1000), as the stainless steel mesh surface was relatively stable, the active sulfur could not corrode the mesh surface, and the morphology of MoS_2 was approximate to free MoS_2. The as prepared mesh showed high hydrophobicity (WCA=34.8°) rather than superhydrophobicity due to the low surface roughness. Figure e) and f) were the typical images of MoS_2 coated nickel sponge/stainless steel mesh (400), respectively. As nickel sponge was easier to be corroded than copper mesh, the mesh showed high roughness and the WCA was 0°. However, the physical structure of nickel sponge was severely broken under the corrosion of active sulfur, making it unsuitable for water remediation. Besides, when using stainless steel mesh (400) as substrate, the active sulfur could not corrode the mesh surface either. So the surface roughness was low. And little MoS_2 was embedded on the mesh with the WCA=19.2° (high hydrophobic).

In comparision, copper mesh could be corroded by active sulfur and produce high surface roughness. And the physical structure remained complete after corrosion. So we regard copper mesh as the best substrate.

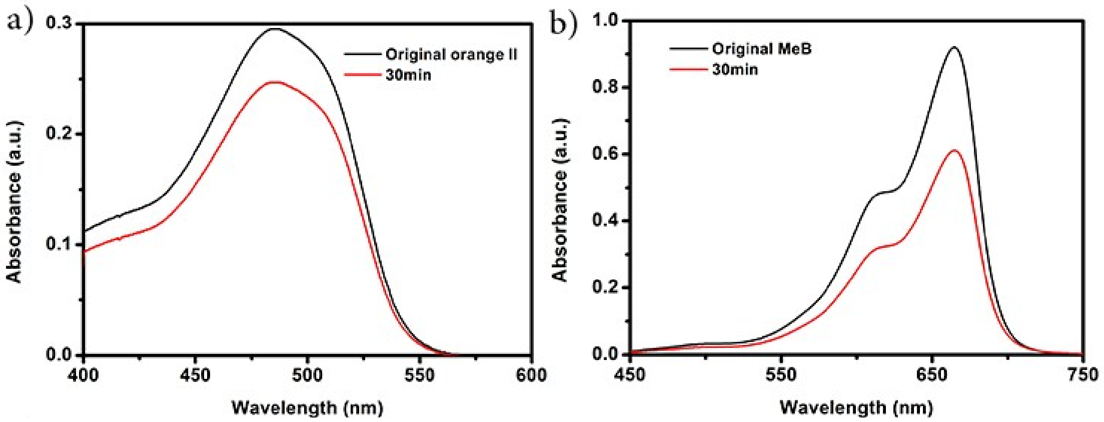


Figure S5. a) Electrocatalysis of orange II (anionic dyes) in acidic condition, showing low reaction efficiency; b) Electrocatalysis of methylene blue (cationic dyes) in alkaline condition, showing low reaction efficiency too.

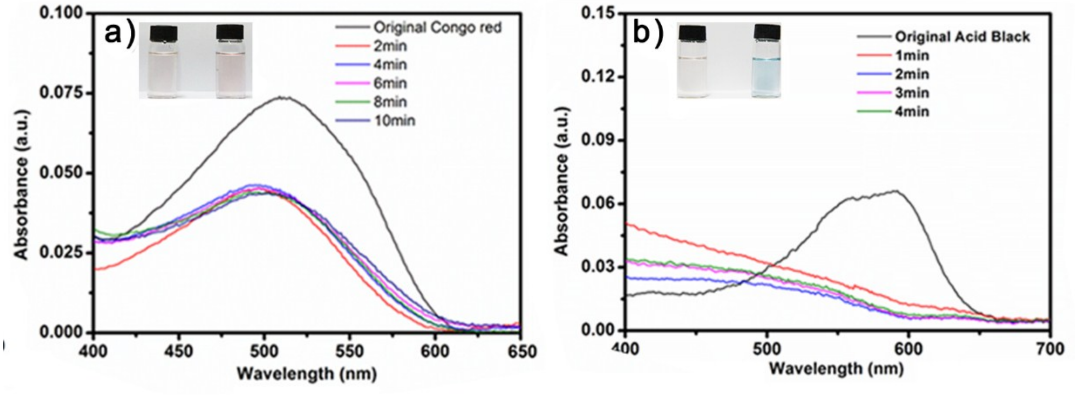
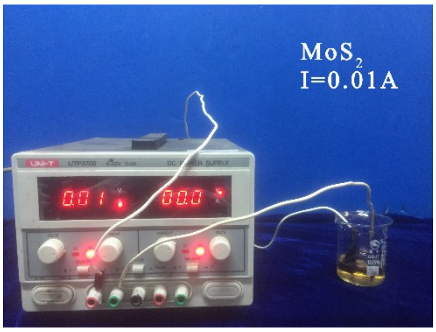
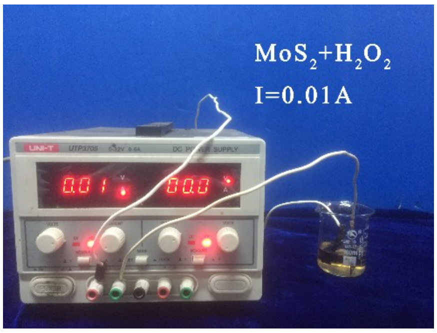


Figure S6. Degradation process of: a) Congo red; b) acid black with participation of both MoS_2 and H_2O_2

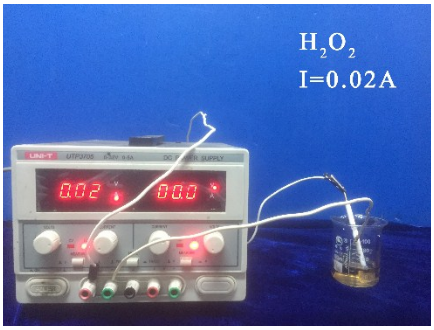
To make the experimental result more accurate, we further investigated the corresponding currents in the three control experiments in Figure 2 (the voltage was kept at 12 V). And the results were listed as below:

When the MoS_2 coated mesh acted as anode, the currents of the circuit was 0.01 A, and adding H_2O_2 did not change the circuit.





When the electrocatalysis process was conducted with the participation of H_2O_2 alone, a platinum gauze electrode was used as anode to take the place of MoS_2 coated mesh, and the circuit became 0.02 A. However, no degradation happens in 10min even though the current was higher (Figure 2b).



In conclusion, H_2O_2 itself had little catalytic activity; MoS_2 coated mesh showed far better catalytic property than H_2O_2 even though the current was lower; and adding 9.8mM H_2O_2 could promote the degradation while did not change the current.

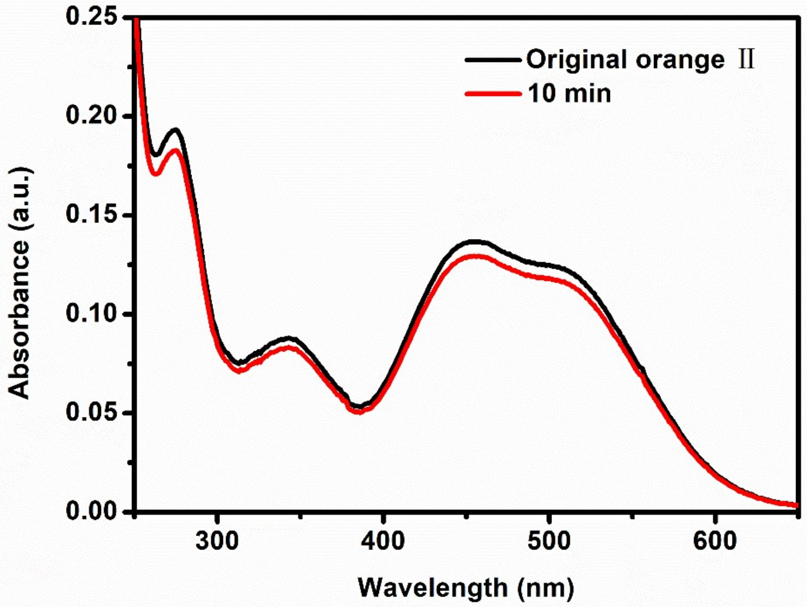


Figure S7. Electrocatalysis process with the participation of only substrate shown almost no spertrum deduction in 10 minutes, indicating the poor catalytic property of the copper substrate.

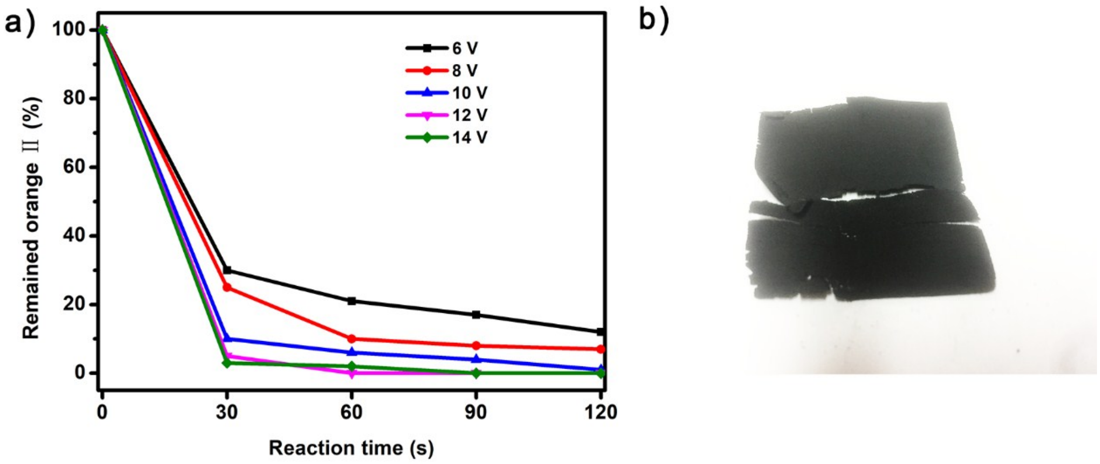


Figure S8. a) Electrocatalysis process under different voltage; b) the mesh would broken under 14 V voltage.

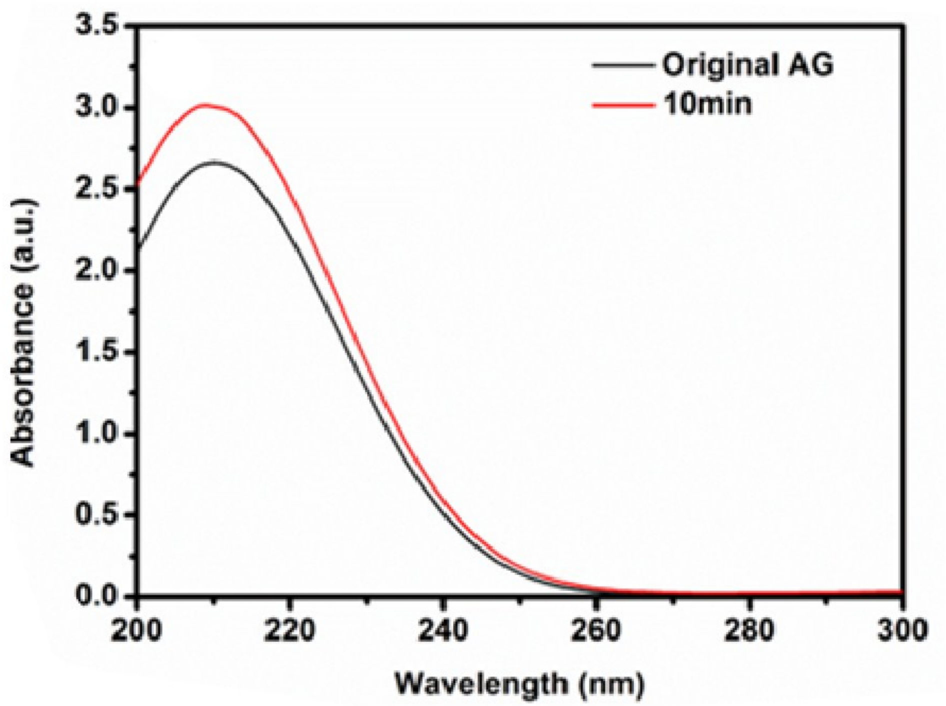


Figure S9. Electrocatalysis process of 100 ppm glyphosate polluted water in alkaline condition (pH=11), there is almost no degradation (10% of the ammonium glyphosate was degraded) occurred.

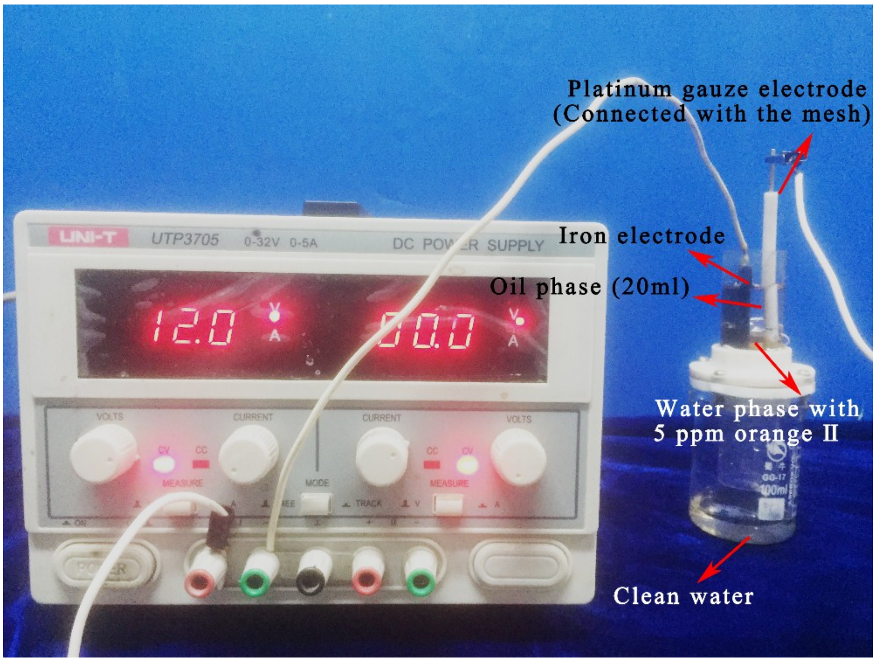


Figure S10. The low-voltage DC power equipment and polytetrafluoroethylene (PTFE) fixtures used in the electrocatalysis experiment and in-situ water remediation.

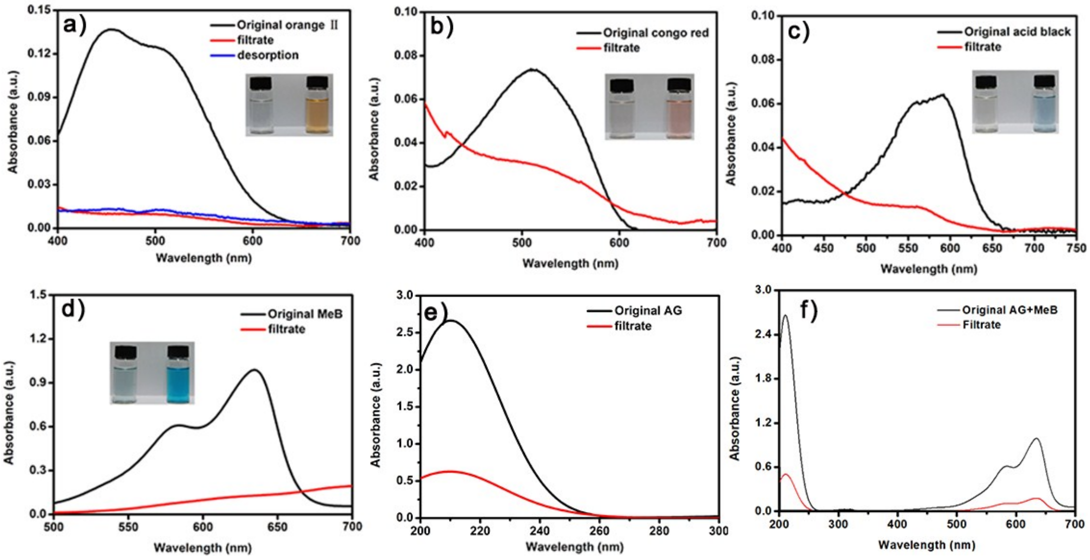


Figure S11. Ultraviolet absorption spectrum of filtrate after in-situ contaminant degradation and oil/water separation: a)-d) The mesh reveals excellent in-situ treatment ability to all of the four dye wastewater, inset are the digital photographs of filtrate and original dye; e) In-situ remediation of 100ppm glyphosate polluted water in acidic condition (pH=3). f)In-situ remediation of mixture solution containing 100 ppm glyphosate and 5 ppm methylene blue.

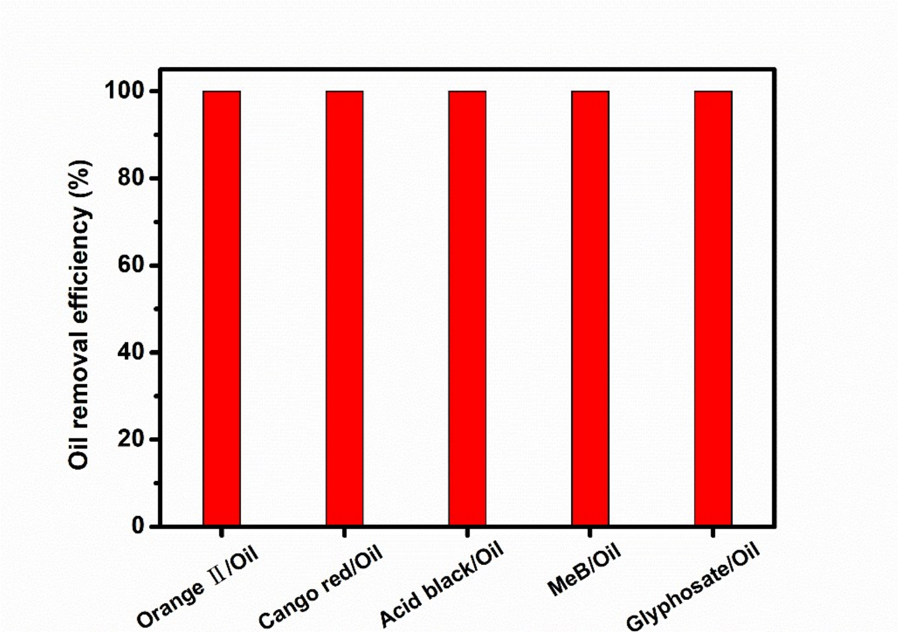


Figure S12. Oil removal efficiency in the in-situ water remediation.