

Supplementary Information

## **Exfoliated MoS<sub>2</sub> nanosheets immobilized in porous microbeads as recoverable photocatalysts**

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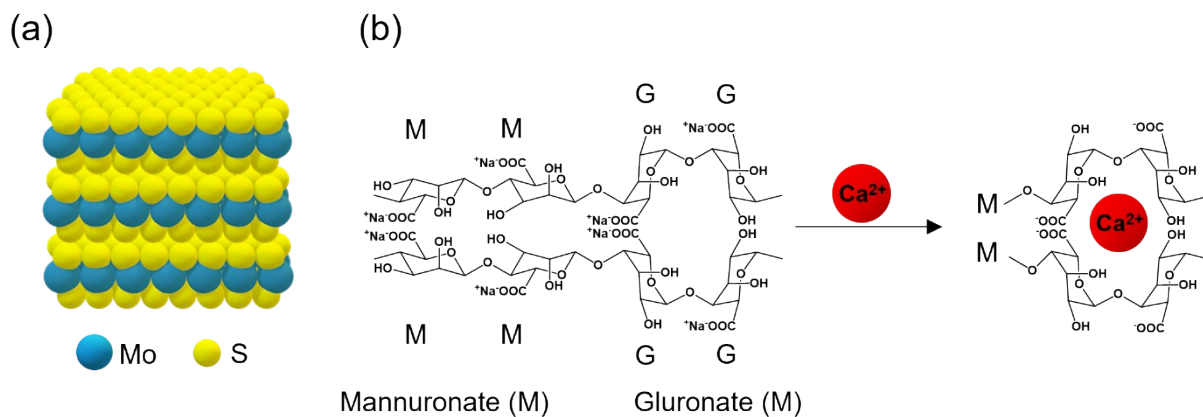
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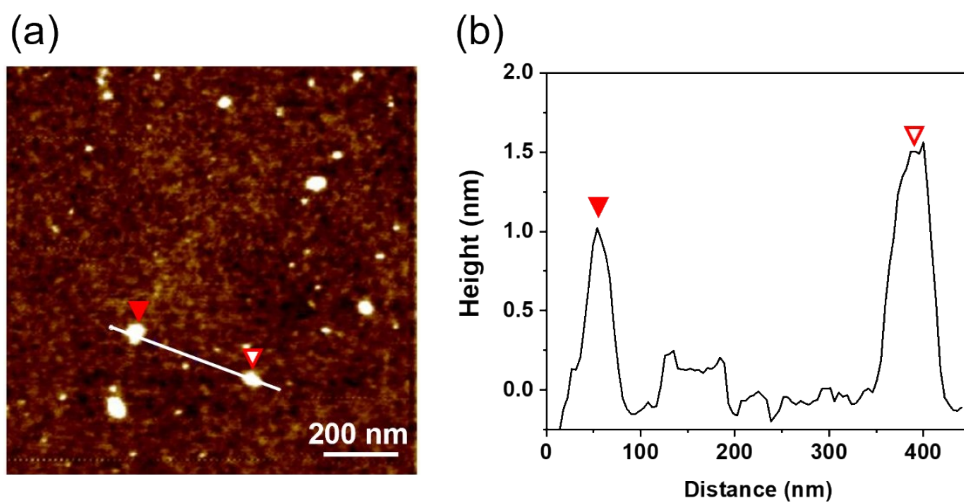
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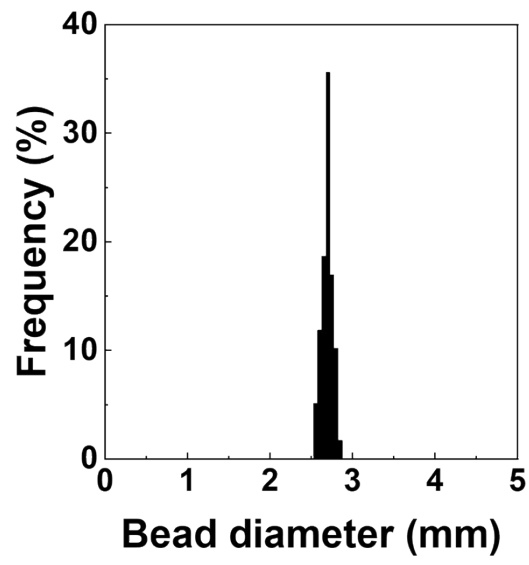
## Supporting Figures



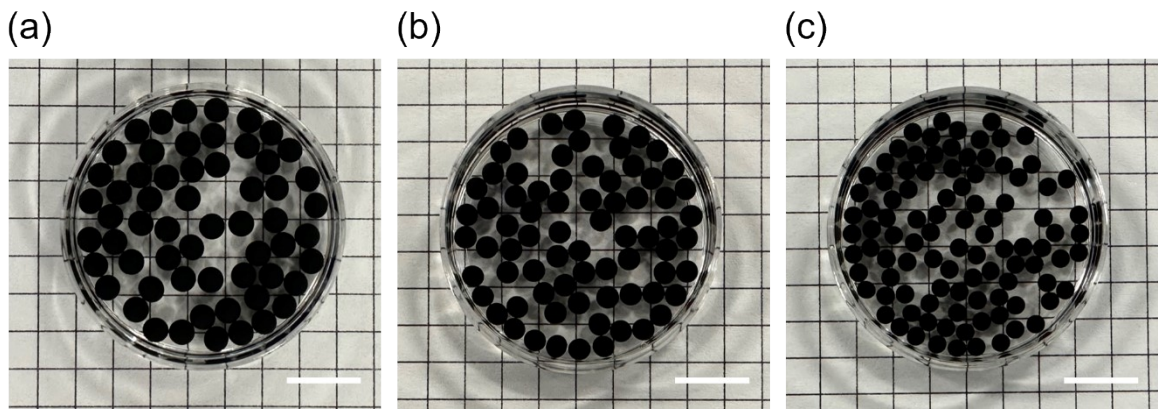
**Fig S1.** (a) Schematic illustration of layered structure of MoS<sub>2</sub>. (b) Chemical structures of sodium alginate and Ca<sup>2+</sup> ion-crosslinked alginate.



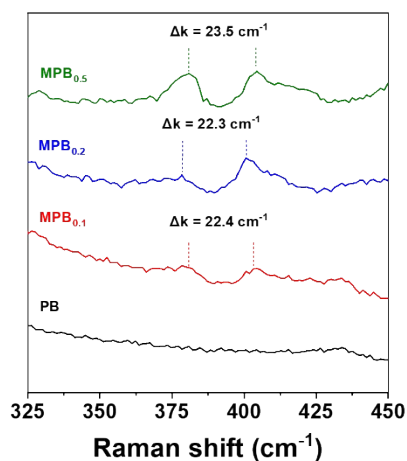
**Fig S2.** (a) AFM image and (b) height profile of chemically exfoliated MoS<sub>2</sub> nanosheets.



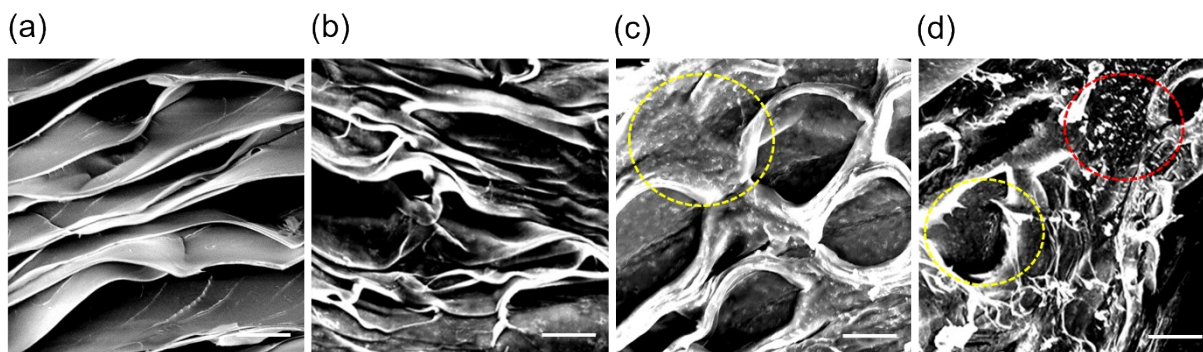
**Fig S3.** Size distribution of MPBs.



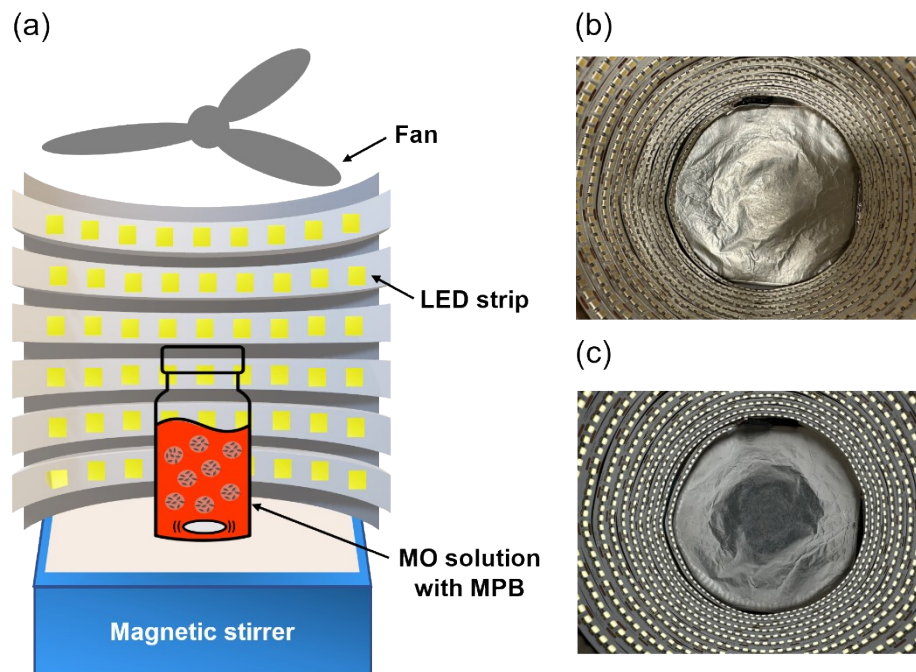
**Fig S4.** Photographs of MPBs depending on syringe diameter: (a) 18 G, (b) 21 G, and (c) 25G (Scale bar = 10 mm).



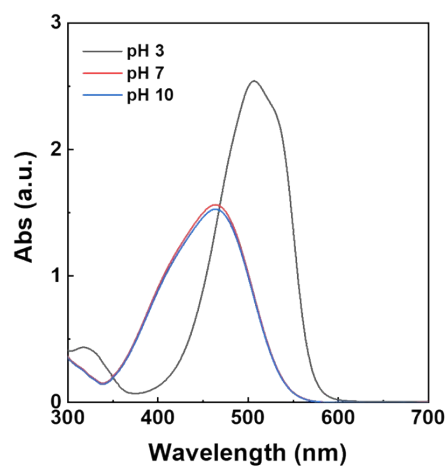
**Fig S5.** Raman spectra of MPB as a function of immobilized MoS<sub>2</sub> concentration.



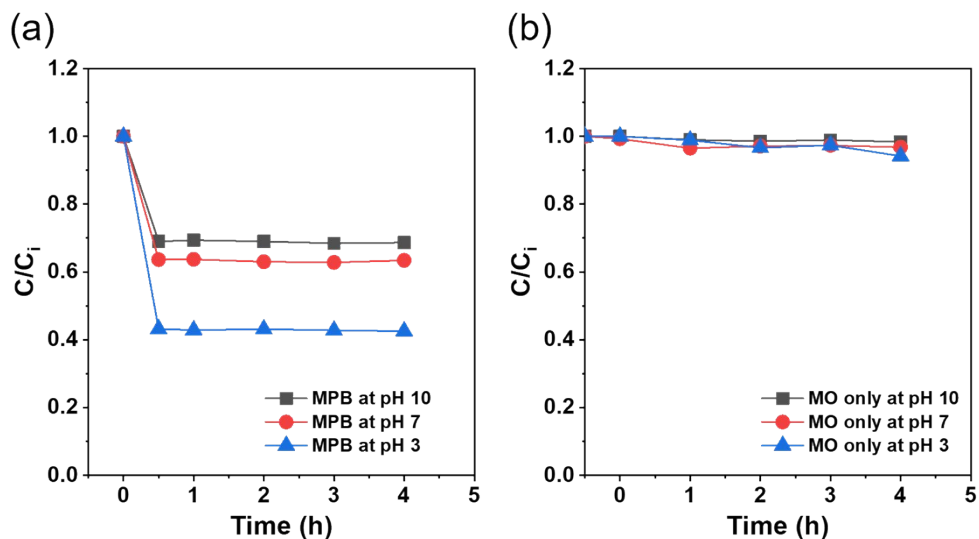
**Fig S6.** Cross-section SEM images of MPB as a function of immobilized MoS<sub>2</sub> concentration: (a) PB (no MoS<sub>2</sub>), (b) MPB<sub>0.1</sub>, (c) MPB<sub>0.2</sub> and (d) MPB<sub>0.5</sub>. (Scale bar = 20 μm). The yellow area represents well-immobilized MoS<sub>2</sub> nanosheets, and the red area represents aggregated MoS<sub>2</sub> nanosheets.



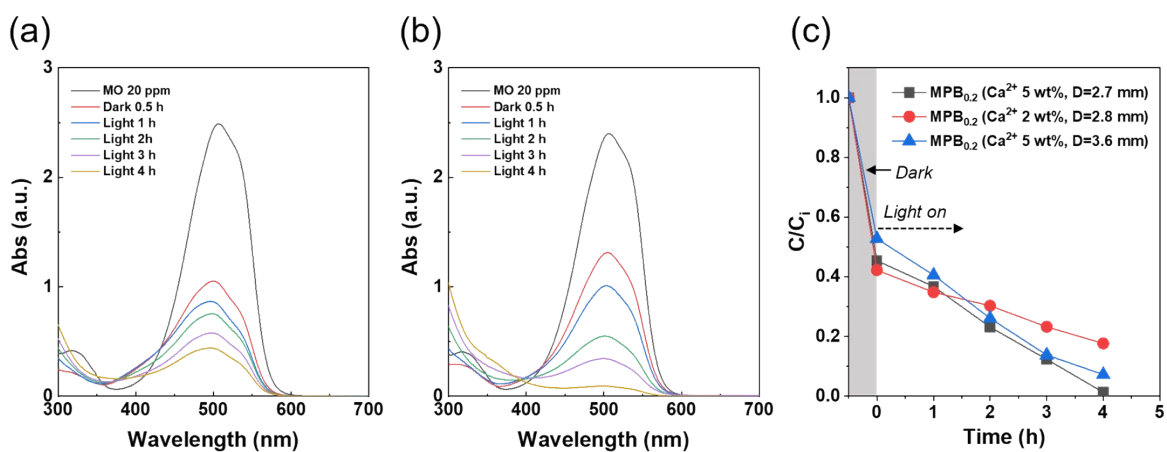
**Fig S7.** Experimental setup for photocatalytic performance test. (a) Schematic illustration of cylindrical photoreactor, real photographs of top view: (b) light off, (c) light on.



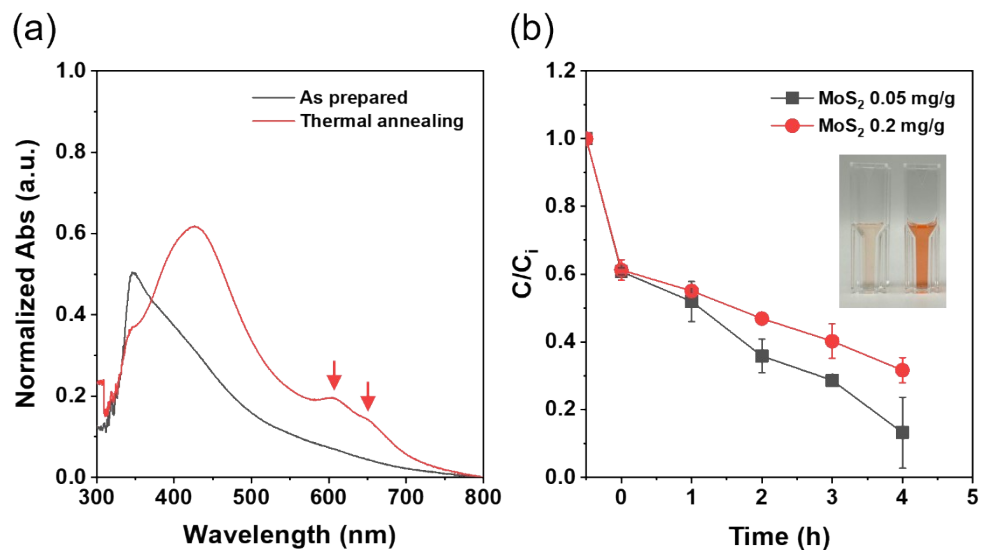
**Fig S8.** UV-Vis spectra of MO solution at different pH conditions.



**Fig S9.** (a) MO adsorption of MPB in the dark under various pH conditions. (b) MO photolysis under visible light.  $C_i$  is the initial concentration of MO and  $C$  is the concentration of MO at reaction time  $t$ .



**Fig S10.** UV-vis spectra of MO during photodegradation at pH 3 with (a) MPB<sub>0.2</sub> crosslinked by less Ca<sup>2+</sup> ions (2 wt%), and (b) large size of MPB<sub>0.2</sub> (Diameter: 3.6 mm), respectively. (c) Plots of  $C/C_i$  versus time for the photodegradation of MO using different catalysts.  $C_i$  is the initial concentration of MO and  $C$  is the concentration of MO at reaction time  $t$ .



**Fig S11.** (a) UV-Vis spectra of MoS<sub>2</sub> dispersion before and after thermal annealing. (b) Plots of  $C/C_i$  versus time for the photodegradation of MO using thermal annealed MoS<sub>2</sub>-immobilized porous beads catalysts.  $C_i$  is the initial concentration of MO and  $C$  is the concentration of MO at reaction time  $t$ . The inset of (b) is the photograph of MO solution after the photodegradation reaction (left: 0.05 mg/g of MoS<sub>2</sub>, right: 0.2 mg/g of MoS<sub>2</sub>).

**Table S1.** Comparison with MoS<sub>2</sub>-based photocatalyst for photodegradation of dye.

Catalyst	Synthetic methods	Mass of catalyst (mg)	Conc. of dye	Degradation (%)	Time (min)	Light source	Reuse	Ref.
MoS <sub>2</sub> /Co <sub>3</sub> O <sub>4</sub> nanohybrids	Hydrothermal	10	20 mg/L of MO	95.6	170	350 W Xe lamp	O	43
Layered MoS <sub>2</sub>	Hydrothermal	50	0.5 mM of MB	97.5	120	150 W Excimer lamp	X	44
MoS <sub>2</sub> /Fe <sub>3</sub> O <sub>4</sub>	Hydrothermal	50	10 mg/L of MO	79.5	100	300 W Xe lamp	O	45
Leaf-MoS <sub>2</sub> nanosheets	Hydrothermal	100	50 mg/L of MO	>99	70	300 W Incandescent lamp	O	46
TiO <sub>2</sub> /MoS <sub>2</sub> @zelolite	Ultrasonic, hydrothermal	250	20 mg/L of MO	95	60	Xe long-arc lamp	X	47
MoS <sub>2</sub> nanoflowers	Hydrothermal	20	0.1 mM of MB	>99	20	Natural day sun light	X	48
MoS <sub>2</sub> nanosheets	Hydrothermal	30	20 mg/L of MB	90	330	25 W LED	O	49
2H-MoS <sub>2</sub> nanosheets	Exfoliation	0.08	5 mg/L of MB	85	720	22 W LED	X	50
1T@2H MoS <sub>2</sub>	Exfoliation	10	20 mg/L of MB	72.7	60	Xe light	X	51
MPB	Exfoliation	1	20 mg/L of MO	>99	240	120 W LED	O	This study