Supporting Information for

Catalytic membrane reactor of nano (Ag+ZIF-8) @ Poly(tetrafluoroethylene) built by deep-permeation synthesis fabrication

Yangmei Qin, Shizhao Jian, Ke Bai, Yuyang Wang, Zenghui Mai, Senqing Fan*, Boya Qiu, Yu Chen, Yinan Wang, Zeyi Xiao*

School of Chemical Engineering, Sichuan University, No.24 South Section 1, Yihuan Road, Chengdu 610065, China

*Corresponding author: mgch@scu.edu.cn, fansenqing86@scu.edu.cn

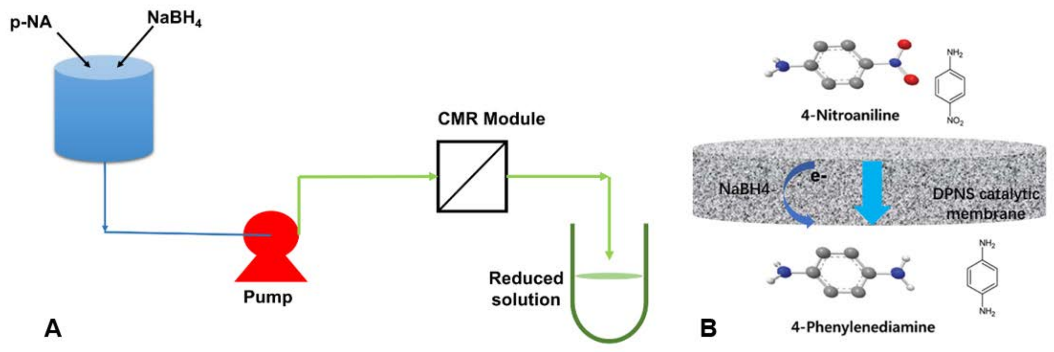


Figure S1. (A) Schematic illustration of the continuous catalytic reaction experiment, (B) mechanism illustration of conversion of p-NA to p-PD via DPNS catalytic membrane.

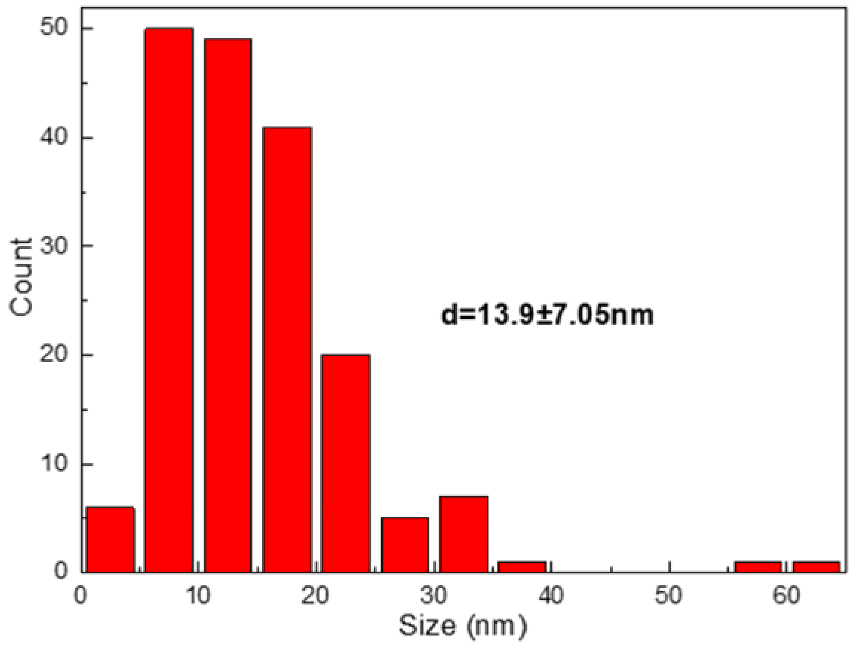


Figure S2. Particle size distribution of Ag+ZIF-8 NPs inside PTFE

Suspension synthesis of Ag+ZIF-8 particles

Briefly, a clear solution of $Zn(NO_3)_2 \cdot 6H_2O$ (9.2 g) in DI water (50 mL) was poured into another clear solution of H-MeIM (8.21 g) in DI water (50 mL) under stirring for 30 min. The clear solution turned milky white and showed suspended particles. The as-prepared ZIF-8/water suspension was centrifuged and washed with fresh water for three times to remove residues of unreacted reagents and by-products. The product was dried at 70 °C overnight in a vacuum drying oven [1]. Similarly, 100 mg of pretreated ZIF-8 was dispersed in 10 mL of DI water under ambient conditions, to which 10 mL of $AgNO_3$ (100 mg) aqueous solution was added under vigorous stirring. The desolvated ZIF-8 was stirred with $AgNO_3$ aqueous solution for 20 min. Then, 20 ml $NaBH_4$ (37.8 mg) aqueous solution was added dropwise under vigorous stirring for the complete reduction of Ag^+. The solid was recovered by filtration and thoroughly washed by water after over 30 min stirring. The sample was finally dried in a vacuum drying oven at room temperature for further use.

Figure S3A showed low magnification TEM image of ethanol-based Ag+ZIF-8 suspensions, which indicated the particle size about 30–50 nm. Those individual particles were agglomerated. The high-resolution TEM (HRTEM) image of Ag+ZIF-8 can be found in Figure S3B. ZIF-8 displayed a mesoporous structure, as mentioned in previous reports [2, 3]. Figure S3B exhibited the crystal lattice fringes of Ag+ZIF-8, with the d-spacing of 0.201 nm and 0.242 nm correspond to the crystal plane of Ag (200) and Ag (111), which were close to the d spacing of the (200) and (111) plane of metallic Ag (Joint Committee on Powder Diffraction Standards 040783 File Card) [4].

The HRTEM image proved that the Ag and ZIF-8 crystals could coexist. If we consider the membrane pore as a microreactor, the similar individual Ag+ZIF-8 crystal could be obtained. In combination with the other characterizations described above, it can be judged that the Ag was combined with the outer sphere of the ZIF-8 in some way.

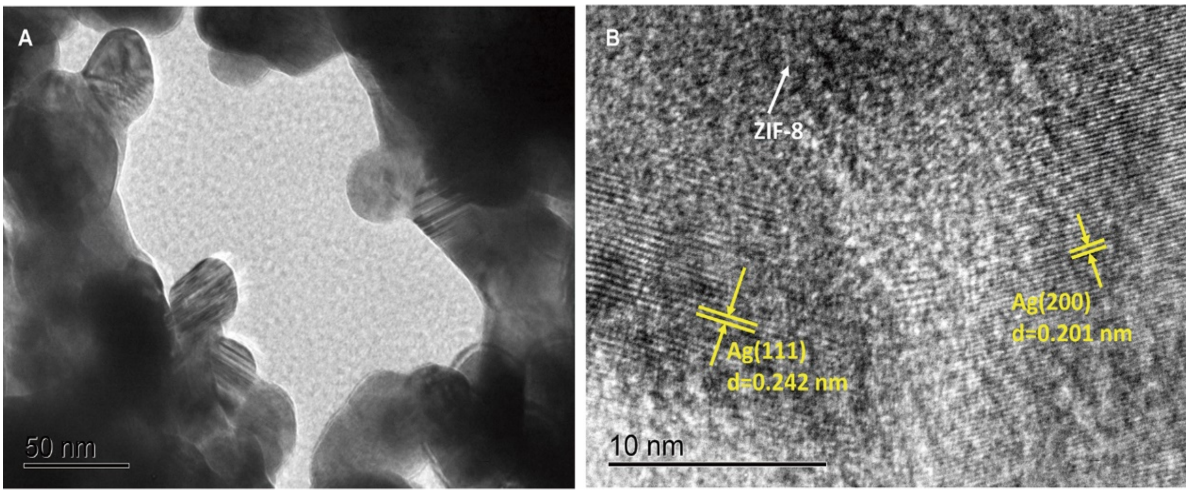
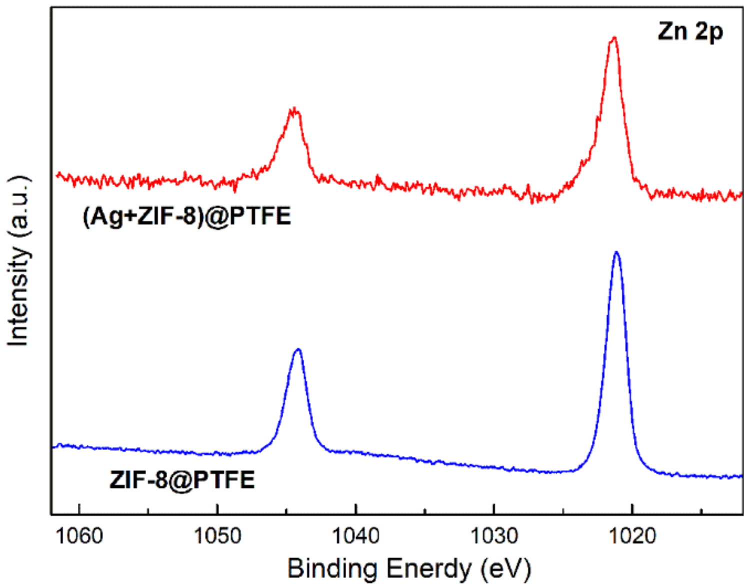
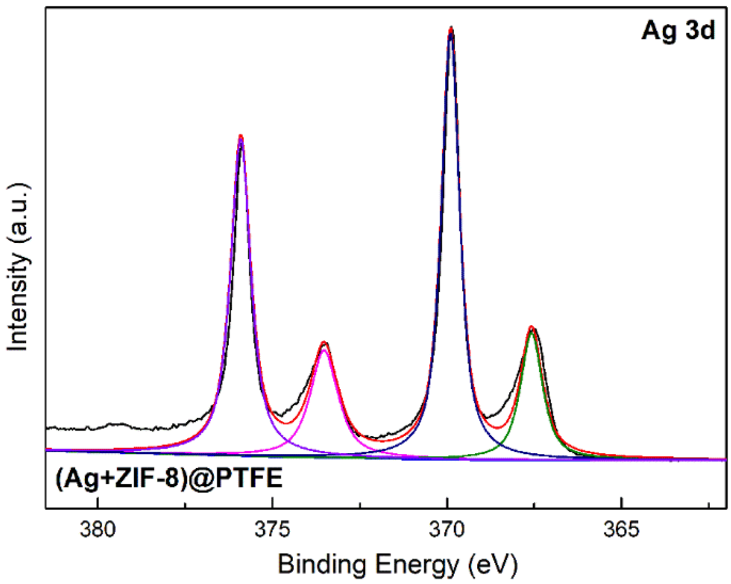


Figure S3. TEM image of Ag+ZIF-8 particles (A), HRTEM image of Ag+ZIF-8 particles (B).



A



B

Figure S4. High-resolution XPS spectra of Zn 2p (A), Ag 3d (B)

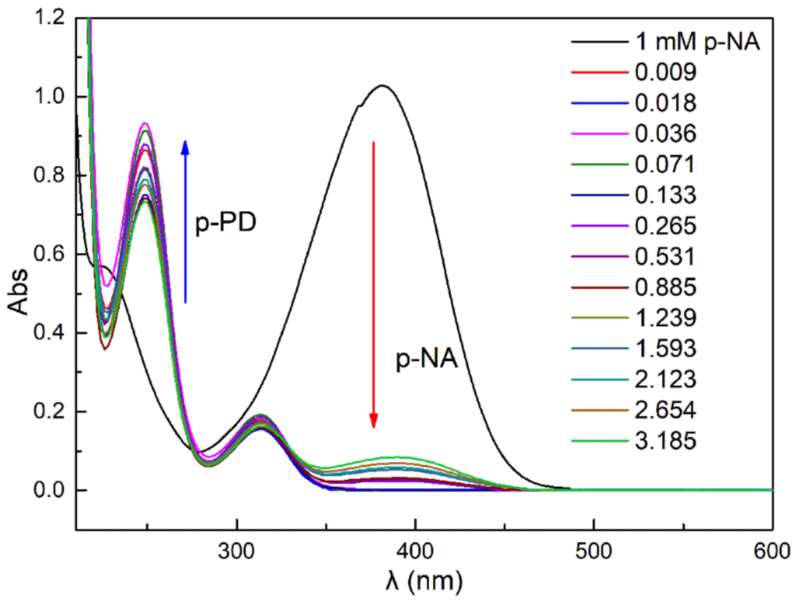


Figure S5. UV–vis absorption spectra of the p-NA solution (1 mM) reduced by $NaBH_4$ in different v (ml cm^2 min^{-1}).

Table S1. Ag content of three catalytic membranes by ICP analysis

Samples	Ag content (wt %)
(Ag+ZIF-8)@PTFE before catalysis	6.96
(Ag+ZIF-8)@PTFE after deactivation	6.27
Ag@PTFE	0.59

Table S2. Comparison of p-NA catalytic activities of several Ag-Based systems

Ag-based catalysts	Concentration of p-NA (mM)	$NaBH_4$ (mM)	Temperature °C	R	k_{app} (min^{-1})	ref
Silver-doped magnetic nanoparticles	1	30	Room temperature	100%, 4min	1.110	5
AgNPs on porous glass filters	1	30	50	100%, 10min	0.426	6
Ag-p(NiPA-co-AAc) Hybrid Microgels	0.05	10	23	100%,13min	0.415	7
AgNPs/T. indica seed coat extract	1	50	Not mentioned	100%, 10min	0.373	8
Ag-Cu nanoshells	0.01	50	Room temperature	100%, 21min	0.12	9
Ag-Au nano-alloy	2	150	Not mentioned	87.2%, 20min	0.038	10
Ag nanoclusters @MIL-101(Fe)	0.2	100	Room temperature	100%, 12min	0.315	11
Ag- poly(N-isopropylacrylamide-acrylicacid-acrylamide) microgels	0.09	18	22	100%, 11min	0.244	12
Ag rhombic dodecahedra	0.1	0.4($NH_3 \cdot BH_3$)	50	100%, 1 hour	Not mentioned	13
(Ag+ZIF-8)@PTFE DPNS	1	200	Room temperature	100% 0.015 min	1128	This work
(Ag+ZIF-8)@PTFE DPNS	0.06	12	Room temperature	100% 0.007 min	991.89	This work

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