Electronic Supporting Information

Facile construction of an Ag^0-doped Ag(I)-based coordination polymer *via* self-photoreduction strategy for enhanced visible light driven photocatalysis

Wei Jiang[a,b], Mengying Lv[a], Baihui Gao[a], Bo Liu[a,c,*], Guosong Yan[a,c], Shi Zhou[a,c,*], Chunbo Liu[a,b], Wei Xie[a,c], Guangbo Che[a,c]

[a]Key Laboratory of Preparation and Application of Environmental Friendly Materials (Jilin Normal University), Ministry of Education, Changchun 130103, P. R. China.

[b]College of Environmental Science and Engineering, Jilin Normal University, Siping, 136000, P. R. China.

[c]Key Laboratory of Functional Materials Physics and Chemistry of the Ministry of Education, Jilin Normal University, Changchun 130103, China

* Correspondence authors

E-mail: liubo1999@jlnu.edu.cn (Bo Liu)

E-mail: zhoushi@jlnu.edu.cn (Shi Zhou)

Fax :+86-434-3290623

Experimental

Materials and characterization

All the chemical reagents were obtained commercially and used without further purification. The infrared (IR) spectrum was collected on a Nicolet iS50 FT-IR spectrometer (ThermoFisher, United States). Elemental analysis (C, H, N) was performed on a VarioEL III Elemental Analyzer (Elementar, Germany). The crystalline structures of the materials were analyzed by PXRD (Rigaku, Dmax 2000) with CuKα radiation (λ = 1.5406 Å) at room temperature in the range of 5°-80°. The morphology and size of samples were observed by SEM (Hitachi, Regulus 8100) a. The XPS characterizations were obtained on an ESCALAB250XI electron spectrometer (VG Scientific, America). The UV-vis diffuse reflectance spectra (DRS) were collected by a UV-vis spectrophotometer (UV-2550, Shimidazu). Photocurrents and EIS were recorded using a PGSTAT-302N electrochemical workstation. The photoluminescence (PL) spectra were measured using a F4500 (Hitachi, Japan) photoluminescence detector with an excitation wavelength of 300 nm. ESR analyses were performed on the Bruker EPR JES-FA200 spectrometer.

Photoelectrochemical measurements

Photoelectrochemical performances of the prepared photo-anodes were recorded on an electrochemical work station (CHI760E) with a standard three electrode system. 0.5 M Na_2SO_4 solution was used as the electrolyte. A 300W Xe lamp (Beijing PerfectLight) was used as a light source. Transient photocurrent measurements at a constant bias (0.8 V) with chopped illumination were also conducted to examine the steady-state photocurrent densities of the photoanodes. Electrochemical impedance spectra (EIS) were carried out in the frequency range of 1-10^5 Hz. The Mott-Schottky measurement was performed at the frequency of 1000 Hz.

X-ray crystallorgraphy

Crystal data was collected Bruker Smart Apex II CCD diffractometer with graphitemonochromatic Mo*Kα* radiation (λ = 0.71073 Å) at room temperature. The structures were solved by direct methods of *SHELXS-2014* and refined on F^2 by full-matrix least-squares using the *SHELXL-2014 within WINGX* [1,2]. All the calculations were performed under *WINGX* program. All non-hydrogen atoms were refined anisotropically, and the hydrogen atoms of organic ligands and water molecules were generated geometrically. The crystallographic data for **JLNU-90** is listed in Table S1, selected bond lengths and bond angles are summarized in Table S2.

Table S1 Selected crystallographic data for **JLNU-90**

Compound	**JLNU-90**
Empirical formula	$C_{32}H_{30}N_7O_{8.5}Ag_2$
Formula weight	864.37
Crystal system	Triclinic
Space group	*P*-1
a **(Å)**	11.388(3)

***b* (Å)**	12.621(3)
***c* (Å)**	14.493(4)
***α* (°)**	100.520(5)
***β* (°)**	109.121(5)
***γ* (°)**	97.132(5)
***V* ($Å^3$)**	1896.8(8)
Z	2
Goodness-of-fit on F^2	0.589
Reflns collected/unique	13005
***θ* Range (°)**	3.06-51.3
R (I > 2σ(I))	R_1 =0.0531 ,
	wR_2 =0.1597
R (all data)	R_1 =0.1075 ,
	wR_2 =0.2046
CCDC	2079891

Table S2 Selected bond distances (Å) and angles (°) for **JLNU-90.**

Ag(1)-N(2)$^{\#1}$	2.140(5)	Ag(2)-N(3)$^{\#1}$	2.170(4)
Ag(1)-N(1)	2.159(4)	Ag(2)-N(4)	2.180(4)
Ag(1)-O(3)	2.262(4)	Ag(2)-O(4)	2.591(4)
N(2)$^{\#1}$-Ag(1)-N(1)	174.92(16)	N(3)$^{\#1}$-Ag(2)-N(4)	168.83(15)
N(2)$^{\#1}$-Ag(1)-O(3)	91.39	N(3)-Ag(2)-O(4)	95.30(18)
N(1)-Ag(1)-O(3)	93.66	N(4)-Ag(2)-O(4)	91.07(17)

Symmetry code: $^{\#1}$ 1+x, y, z.

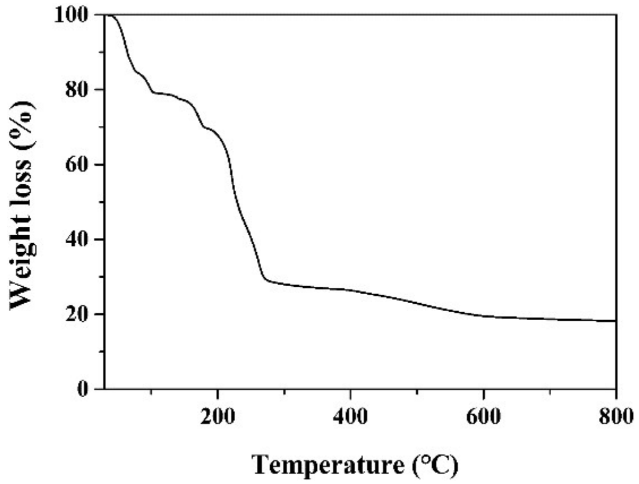

Fig. S1. TG curve of the as-synthesized **JLNU-90**.

The guest molecules in **JLNU-90** were evaluated through TG analysis (Fig. S1). The lost weight of before 100 ℃ corresponds to the release of wo acetonitrile and two and a half water molecules (obsd 18.15 %, calcd 17.23 %). The second weight loss occurs from 180 ℃ should be attributed to the decomposition of organic ligands.

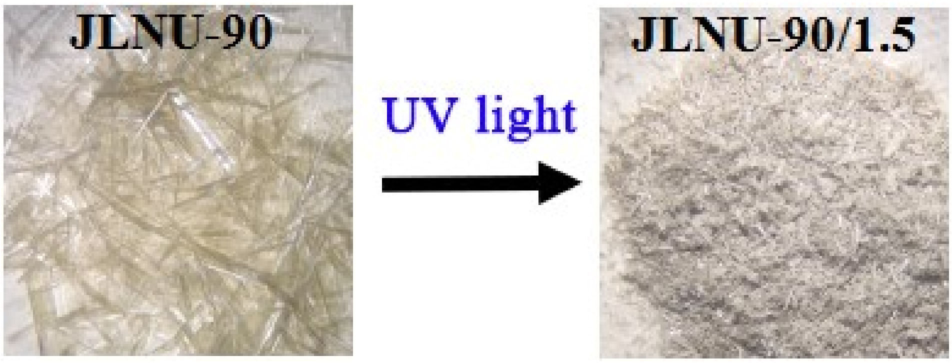

Fig. S2. The optical photographs of **JLNU-90** and **JLNU-90/1.5**.

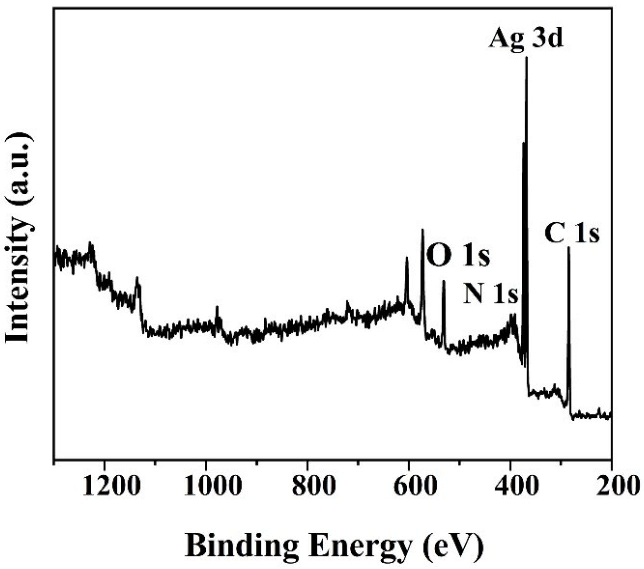

Fig. S3. The XPS survey spectrum of **JLNU-90/1.5**.

Table S3. Comparison of Ag(I)-based coordination polymers

Catalysts	Light source	MB concentration (mg/L)	Dosage of catalysts	Time (min)	Degradation efficiency (%)	k value (min^{-1})	Ref.
JLNU-90/1.5	10 W LED (vis)	10	20 mg	120	70	0.00896	This work
$[Ag(HIPA)(L)]_n$	500 W Hg lamp (UV)	10	0.01 mmol	150	95.9	0.0177	3
$[Ag(L)(HNTP)]_n$	500 W Hg lamp (UV)	10	0.01 mmol	240	93.5	0.0106	4
$[Ag_2(dmt)_2(tph)]_n$	300 W Hg lamp (UV)	3.2	100 mg	130	96	0.015	5
$[Ag_2(dmt)_2(oxalate)]_n$	300 W Hg lamp (UV)	3.2	100 mg	130	~80	0.011	5
$[Ag_2(dmt)_4(SO_4)]\cdot_2(dmt)\cdot_2(H_2O)$	300 W Hg lamp (UV)	3.2	100 mg	130	~68	0.007	5
$[Ag_4(L^1)_2(HSiW^{VI}_{11}V^{V}O_{40})]\cdot{\sim}25H_2O$	UV	6.4	150 mg	120	93	-	6
$[Ag_4(L^2)_2(H_2O)_2(PW^{VI}_{11}V^{V}O_{40})]\cdot 2H_2O$	UV	6.4	150 mg	120	87.3	-	6

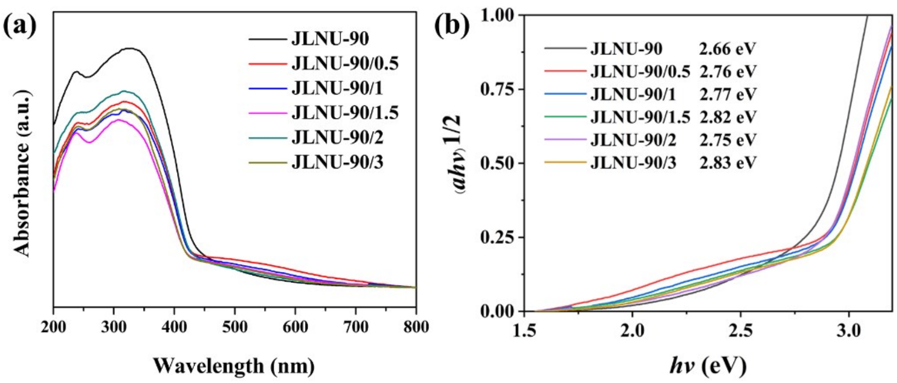

Fig. S4. (a) UV-vis DRS and (b) direct energy band gap of **JLNU-90** and **JLNU-90/x**.

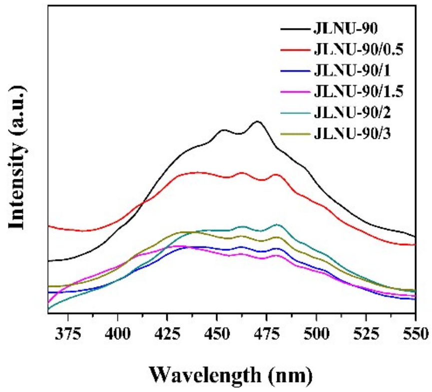

Fig. S5. PL spectra of **JLNU-90** and **JLNU-90/x**.

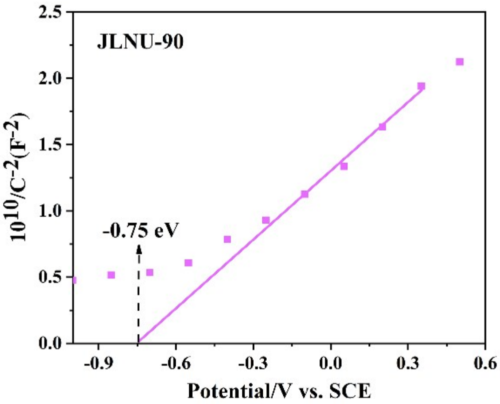

Fig. S6. The Mott-Schott curve of **JLNU-90**.

Reference

1 G. M. Sheldrick *SHELXS-2014*, *Program for the Solution of Crystal Structures* (University of Göttingen, Germany, 2014).

2 G. M. Sheldrick *SHELXL-2014*, *Program for the Refinement of Crystal Structure* (University of Göttingen, Germany, 2014).

3 A. Li, Z. Hao, C. Han and G. Cui, *Appl. Organomet. Chem.*, 2019, 34, e5313.

4 H. Zhu, D. Liu, Y.-H. Li and G.-H. Cui, *Inorg. Chem. Commun.*, 2019, **108**, 107539.

5 S. Kulovi, S. Dalbera, S. Das, E. Zangrando, H. Puschmann and S. Dalai, *ChemistrySelect*, 2017, **2**, 9029–9036.

6 X.-L. Wang, J.-J. Cao, G.-C. Liu, A.-X. Tian, J. Luan, H.-Y. Lin, J.-W. Zhang and N. Li, *CrystEngComm*, 2014, **16**, 5732–5740.