

## Supporting Information

### **Assembling Exceptional-Structured Janus Nanoribbons into Highly Anisotropic Electrically Conductive Array Film of Red Fluorescence and Superparamagnetism**

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## Experimental Sections

### Chemicals:

Eu<sub>2</sub>O<sub>3</sub> (99.99%), benzoic acid (BA), 1,10-phenanthroline (phen), FeCl<sub>3</sub>·6H<sub>2</sub>O, FeSO<sub>4</sub>·7H<sub>2</sub>O, NH<sub>4</sub>NO<sub>3</sub>, polyethylene glycol (PEG, Mw ≈ 20 000), ammonia (NH<sub>3</sub>·H<sub>2</sub>O), CHCl<sub>3</sub>, *N,N*-dimethylformamide (DMF), Anhydrous ethanol, methylmethacrylate (MMA), benzoylperoxide (BPO), aniline (ANI), (1S)-(+)-camphor-10 sulfonic acid (CSA), oleic acid (OA), HNO<sub>3</sub> and ammonium persulfate (APS) were used. All the reagents were analytically pure. Deionized water was made by ourselves.

### Preparation of PMMA:

PMMA was prepared in accordance with the paper [1].

### Preparation of OA Modified Fe<sub>3</sub>O<sub>4</sub> NPs:

Fe<sub>3</sub>O<sub>4</sub> NPs used in this study was prepared according to the paper [2]. The as-prepared Fe<sub>3</sub>O<sub>4</sub> NPs are spherical in shape, and the mean diameter and saturation magnetization are 10 nm and 48.59 emu·g<sup>-1</sup>, respectively.

### Preparation of Eu(BA)<sub>3</sub>phen Compounds:

Eu(BA)<sub>3</sub>phen powders was synthesized in the light of the reference. [3].

### Preparation of Spinning Solutions for Preparing [M@P]//C JAF:

Table S1 Compositions and amounts of the spinning solution I

Samples	Fe <sub>3</sub> O <sub>4</sub> /g	CHCl <sub>3</sub> /g	DMF/g	PMMA/g
S <sub>a1</sub>	0.4000	9.1200	0.9026	0.8000
S <sub>a2</sub>	0.8000	9.1200	0.9026	0.8000
S <sub>a3</sub>	1.6000	9.1200	0.9026	0.8000
S <sub>a4</sub>	2.4000	9.1200	0.9026	0.8000

Table S2 Compositions and masses of the spinning solution II

Samples	Eu(BA) <sub>3</sub> phen/g	CHCl <sub>3</sub> /g	DMF/g	PMMA/g
S <sub>b1</sub>	0.0375	8.3215	0.9615	0.7500
S <sub>b2</sub>	0.0750	8.3215	0.9615	0.7500
S <sub>b3</sub>	0.1125	8.3215	0.9615	0.7500
S <sub>b4</sub>	0.1500	8.3215	0.9615	0.7500
S <sub>b5</sub>	0.1875	8.3215	0.9615	0.7500

Table S3 Compositions and quantities of the spinning solution III

Samples	ANI/g	CSA/g	APS/g	PMMA/g	DMF/g	CHCl <sub>3</sub> /g
S <sub>c1</sub>	0.2100	0.2619	0.5146	1.4000	16.2000	1.8000
S <sub>c2</sub>	0.4200	0.5237	1.0292	1.4000	16.2000	1.8000
S <sub>c3</sub>	0.7000	0.8729	1.7153	1.4000	16.2000	1.8000
S <sub>c4</sub>	0.9800	1.2220	2.4013	1.4000	16.2000	1.8000

### Preparation of Spinning Solutions for Preparing Contrastive Samples:

The spinning solutions for preparing the [M@P]//C JNF were the same as those for fabricating [M@P]//C JAF. The spinning solutions for the M-P nanoribbon of the [M-P]//C JAF and JNF were fabricated by mixing spinning solutions S<sub>a2</sub> and S<sub>b2</sub>, and another spinning solution for conductive nanoribbon was S<sub>c2</sub>. The spinning solutions for M-P-C CAF and CNF were prepared by blending spinning solutions S<sub>a2</sub>, S<sub>b2</sub> and S<sub>c2</sub> together at the volume ratio of 1: 1: 1. The compositions of contrastive samples were summarized in Table S4.

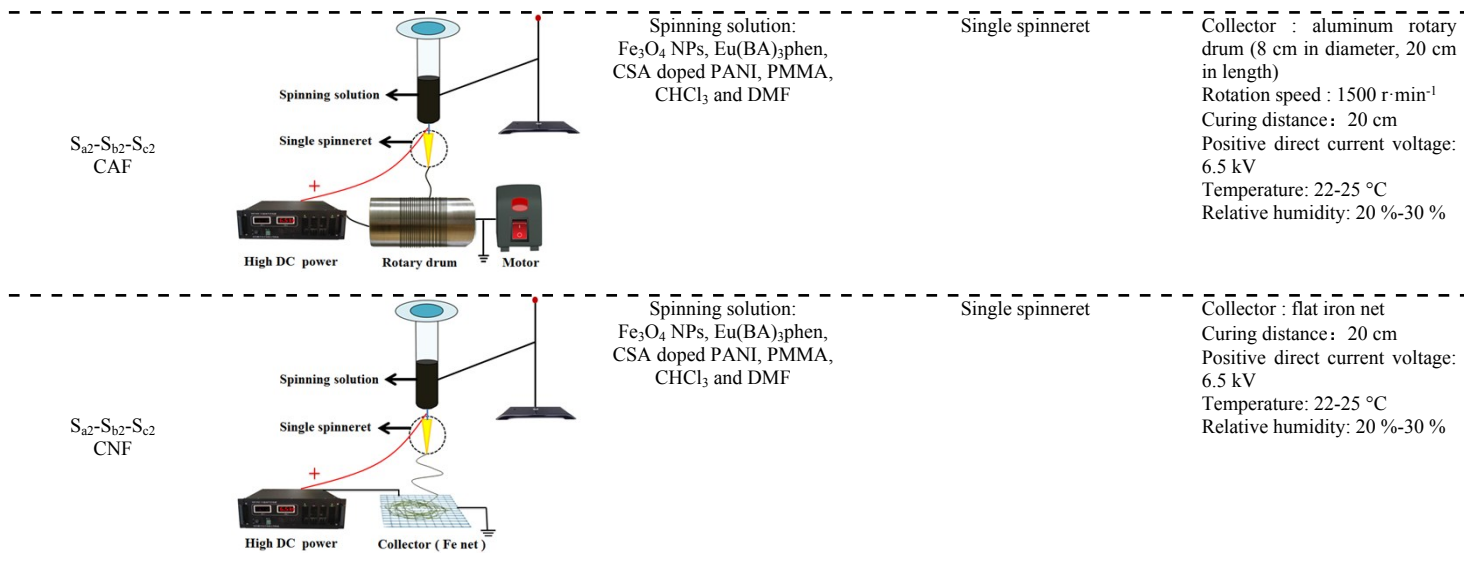
### Electrospinning Equipments for Preparing Contrastive Samples:

Home-assembled parallel spinnerets were used for preparing [M-P]//C JAF and JNF. Two truncated 12# stainless steel needles were bended to an angle of *ca.* 120°, and then assembled side-by-side using double-sided sticky tape to obtain parallel spinneret. The M-P-C CAF and

CNF were fabricated by traditionally used single spinneret electrospinning setup. The electrospinning equipments, compositions of spinning solutions, spinnerets and electrospinning conditions of the contrastive samples were also systematically listed in Table S4.

Table S4 Electrospinning equipments, compositions of spinning solutions, spinnerets and electrospinning conditions of samples

Samples	Electrospinning equipments	Compositions of spinning solutions	Homemade spinnerets	Electrospinning conditions
$[S_{ax}@S_{by}]/S_{cz}$ JAF (x:1-4, y:1-5, z:1-4)		Spinning solution I: $Fe_3O_4$ NPs, PMMA, $CHCl_3$ and DMF Spinning solution II: $Eu(BA)_3phen$ , PMMA, $CHCl_3$ and DMF Spinning solution III: CSA doped PANI, PMMA, $CHCl_3$ and DMF	Specially designed and assembled co-axis/single-axis spinneret	Collector: aluminum rotary drum (8 cm in diameter, 20 cm in length) Rotation speed: $1500\text{ r}\cdot\text{min}^{-1}$ Curing distance: 20 cm Positive direct current voltage: 6.5 kV Temperature: $22-25\text{ }^\circ\text{C}$ Relative humidity: 20 %-30 %
$[S_{a2}@S_{b2}]/S_{c2}$ JNF		Spinning solution I: $Fe_3O_4$ NPs, PMMA, $CHCl_3$ and DMF Spinning solution II: $Eu(BA)_3phen$ , PMMA, $CHCl_3$ and DMF Spinning solution III: CSA doped PANI, PMMA, $CHCl_3$ and DMF	Specially designed and assembled co-axis/single-axis spinneret	Collector: flat iron net Curing distance: 20 cm Positive direct current voltage: 6.5 kV Temperature: $22-25\text{ }^\circ\text{C}$ Relative humidity: 20 %-30 %
$[S_{a2}-S_{b2}]/S_{c2}$ JAF		Spinning solution I: $Fe_3O_4$ NPs, $Eu(BA)_3phen$ , PMMA, $CHCl_3$ and DMF Spinning solution II: CSA doped PANI, PMMA, $CHCl_3$ and DMF	Parallel spinneret	Collector: aluminum rotary drum (8 cm in diameter, 20 cm in length) Rotation speed : $1500\text{ r}\cdot\text{min}^{-1}$ Curing distance: 20 cm Positive direct current voltage: 6.5 kV Temperature: $22-25\text{ }^\circ\text{C}$ Relative humidity: 20 %-30 %
$[S_{a2}-S_{b2}]/S_{c2}$ JNF		Spinning solution I: $Fe_3O_4$ NPs, $Eu(BA)_3phen$ , PMMA, $CHCl_3$ and DMF Spinning solution II: CSA doped PANI, PMMA, $CHCl_3$ and DMF	Parallel spinneret	Collector: flat iron net Curing distance: 20 cm Positive direct current voltage: 6.5 kV Temperature: $22-25\text{ }^\circ\text{C}$ Relative humidity: 20 %-30 %



### Characterization Methods:

The phase compositions of samples were identified by an X-ray powder diffractometer (Bruker, D8 FOCUS) with CuK $\alpha$  radiation, the operation voltage and current were kept at 40 kV and 20 mA, respectively. The morphologies and internal structures were observed by a field-emission scanning electron microscope (SEM, JSM-7610F) and biological microscopy (BM, CVM500E). The elemental analysis was performed by an energy dispersive spectroscope (EDS, X-MaxN80). The electrical properties were measured by a Hall effect measurement system (ECOPIA HMS-3000). The fluorescent properties were investigated by Hitachi fluorescence spectrophotometer F-7000. The UV-Vis absorption spectra were recorded by a UV-Vis spectrophotometer (SHIMADZU UV mini 1240). Then, the magnetic performances were measured by a vibrating sample magnetometer (VSM, MPMS SQUID XL). All the determinations were carried out at ambient temperature.

### Fluorescent Property:

A series of [M@P]//C JAF are fabricated to find the optimum percentage of Eu(BA)<sub>3</sub>phen to PMMA. To do the experiments, the mass ratio of Fe<sub>3</sub>O<sub>4</sub> to PMMA was fixed as 1:1, the mass percentage of PANI to PMMA was settled as 30 % and the mass percentages of Eu(BA)<sub>3</sub>phen to PMMA were varied from 5 % to 25 % (samples [S<sub>a2</sub>@S<sub>bx</sub>]//S<sub>c2</sub>, x = 1-5). The excitation

(abbreviated as EX) spectra of the samples are provided in the left part of Figure S1, it is found that the broad EX bands extending from 200 nm to 360 nm are observed when monitoring wavelength is 615 nm in various samples. The peak at 289 nm assigned to the  $\pi$ - $\pi^*$  electron transition of the ligands is confirmed. From the emission (abbreviated as EM) spectra in the right part of Figure S1, characteristic EM peaks of  $\text{Eu}^{3+}$  are observed under the EX of 289-nm ultraviolet light and ascribed to  ${}^5\text{D}_0 \rightarrow {}^7\text{F}_0$  (581 nm),  ${}^5\text{D}_0 \rightarrow {}^7\text{F}_1$  (592 nm),  ${}^5\text{D}_0 \rightarrow {}^7\text{F}_2$  (615 nm) energy level transitions of  $\text{Eu}^{3+}$  ions, and the  ${}^5\text{D}_0 \rightarrow {}^7\text{F}_2$  hypersensitive transition at 615 nm is the predominant EM peak. As seen from Figure S1, the sample exhibits the strongest fluorescent intensity when the mass percentage of  $\text{Eu}(\text{BA})_3\text{phen}$  to PMMA is 10 %, so the optimum mass percentage of  $\text{Eu}(\text{BA})_3\text{phen}$  to PMMA is 10 %.

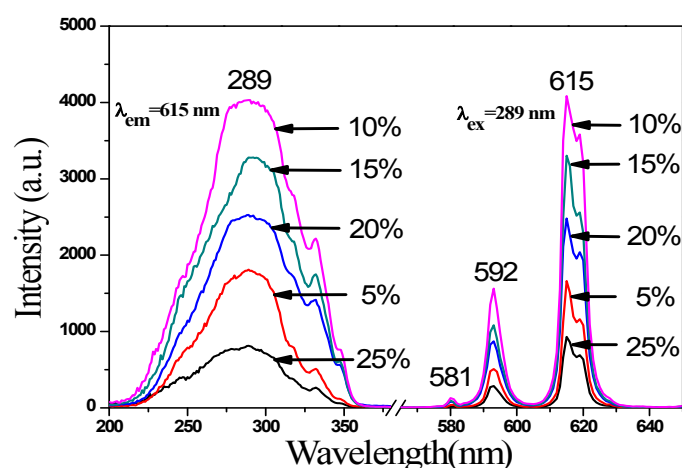


Figure S1 EX (left) and EM spectra (right) of  $[\text{M}@\text{P}]/\text{C}$  JAF containing various mass percentages of  $\text{Eu}(\text{BA})_3\text{phen}$  complex

## References

- [1] J. Tian, Q.L. Ma, X.T. Dong, M. Yang, Y. Yang, J.X. Wang, W.S. Yu and G.X. Liu, J. Mater. Sci.-Mater. Eletron., 2015, **26**, 8413-8420.
- [2] Y.Y. Zheng, X.B. Wang, L. Shang, C.R. Li, C. Cui, W.J. Dong, W.H. Tang and B.Y. Chen, Mater. Charact., 2010, **61**, 489-492.
- [3] S. Meshkova, J. Fluoresc., 2000, **10**, 333-337.