

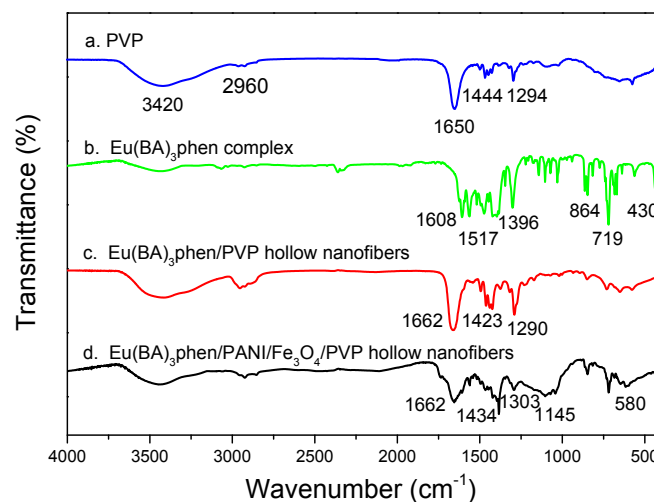
# A Novel Strategy to Directly Fabricate Flexible Hollow Nanofibers with Tunable Luminescence-Electricity-Magnetism Trifunctionality Using One-Pot Electrospinning

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## Supplementary Information

### Infrared spectra analysis

In order to better illustrate, we also performed the Fourier-transform infrared (FT-IR) test for PVP,  $\text{Eu}(\text{BA})_3\text{phen}$  complex,  $\text{Eu}(\text{BA})_3\text{phen}/\text{PVP}$  hollow nanofibers and  $\text{Eu}(\text{BA})_3\text{phen}/\text{PANI}/\text{Fe}_3\text{O}_4/\text{PVP}$  hollow nanofibers, as presented in Fig. S1. A predominant peak at  $1650\text{ cm}^{-1}$  is attributed to the  $\text{C}=\text{O}$  groups in PVP (Fig. S1a), and the peaks at  $1444$  and  $1294\text{ cm}^{-1}$  correspond to the bending vibration of  $-\text{CH}$  and the stretching vibration of  $-\text{CN}$ , respectively. The broad band centered at  $3420\text{ cm}^{-1}$  ( $\nu_{\text{O-H}}$ ) is attributed to coordinated waters, and the broad band located at  $2960\text{ cm}^{-1}$  is assigned to  $\text{C-H}$  stretching vibration. Fig. S1b shows the FT-IR spectrum of  $\text{Eu}(\text{BA})_3\text{phen}$  complex. The peaks at  $1608\text{ cm}^{-1}$  and  $1396\text{ cm}^{-1}$  can be assigned to the antisymmetric and symmetric stretching vibration of  $\text{COO}^-$  group in  $\text{Eu}(\text{BA})_3\text{phen}$  complex. One sharp peak is observed at  $1517\text{ cm}^{-1}$ , which is attributed to  $\text{C}=\text{N}$  group in  $\text{Eu}(\text{BA})_3\text{phen}$  complex. It is also observed that  $\text{Eu}^{3+}-\text{O}^{2-}$  stretching vibration peaks locate at  $430\text{ cm}^{-1}$ .<sup>1</sup> The FT-IR spectrum of  $\text{Eu}(\text{BA})_3\text{phen}/\text{PVP}$  hollow nanofibers is similar to that of pure PVP. The reason is that  $\text{Eu}(\text{BA})_3\text{phen}$  complex is doped in PVP matrix. Through careful analysis, one can find that Fig. S1c is not the simple mixture of Fig. S1a and Fig. S1b, and the peak at  $1662\text{ cm}^{-1}$  shifts from  $1650\text{ cm}^{-1}$ , which may be due to complexing interaction between  $\text{Eu}^{3+}$  ions of  $\text{Eu}(\text{BA})_3\text{phen}$  complex and  $\text{C}=\text{O}$  groups of PVP.<sup>2</sup> The FT-IR spectrum of  $\text{Eu}(\text{BA})_3\text{phen}/\text{PANI}/\text{Fe}_3\text{O}_4/\text{PVP}$  hollow nanofibers is shown in Fig. S1d. Peaks at  $3200\text{--}3000\text{ cm}^{-1}$  and  $3000\text{--}2800\text{ cm}^{-1}$  correspond to  $-\text{N-H}$  and  $-\text{C-H}$  stretching vibrations of polyaniline. Absorption peak at  $1434\text{ cm}^{-1}$  is assigned to  $\text{C}=\text{C}$  stretching of benzenoid rings of emeraldine form of polyaniline. The characteristic bands at  $1303$  and  $1145\text{ cm}^{-1}$  represent the  $\text{C-N}$  stretching of benzenoid structure and in-plane  $\text{C-H}$  bending of quinoid structure, respectively.<sup>3</sup> The band at  $580\text{ cm}^{-1}$  corresponds to the vibration of the  $\text{Fe-O}$  bonds in the crystalline lattice of  $\text{Fe}_3\text{O}_4$ .<sup>4</sup> The above results indicate that PANI has been synthesized, and  $\text{Fe}_3\text{O}_4$  nanoparticles have been successfully added into the hollow nanofibers.



**Fig. S1** FT-IR spectra of PVP (a),  $\text{Eu}(\text{BA})_3\text{phen}$  complex (b),  $\text{Eu}(\text{BA})_3\text{phen}/\text{PVP}$  hollow nanofibers (c) and  $\text{Eu}(\text{BA})_3\text{phen}/\text{PANI}/\text{Fe}_3\text{O}_4/\text{PVP}$  hollow nanofibers (d).

### References

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