Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

A combined bottom-up and top-down strategy to fabricate lanthanide hydrate@2D MOF composite nanosheets for direct white light emission

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Table S1. Crystallographic data and refinement details for HSB-W5d**.**

Empirical formula	$C_{22}H_{32}N_4O_9Zn$
M	561.88
Crystal system	triclinic
Space group	*P*-1
a (Å)	9.561(6)
b (Å)	11.067(7)
c (Å)	14.378(9)
α (°)	104.135(2)
β(°)	95.491(9)
γ(°)	115.421(8)
V/Å^3	1297.1(14)
Z	2
D_c/g cm^{-3}	1.439
μ/mm^{-1}	1.003
$2\theta_{range}$ (°)	4.734 to 54.996
h, k, l, ranges	-12 to 12, -14 to 14, -18 to 18
F(000)	588.0
R_1,[a] wR_2[b] [$I>2\sigma(I)$]	0.0692, 0.1695
GOF on F^2	1.162

[a] $R = \Sigma(||Fo| - |Fc||)/\Sigma|Fo|$. [b] $Rw = \{\Sigma w[(Fo^2 - Fc^2)^2]/\Sigma w[(Fo^2)^2]\}^{1/2}$.

Table S2. Selected bond lengths (Å) and angles (°) of HSB-W5d.

Zn1-N1	2.233(3)
Zn1-N2	2.132(4)
Zn1-N4[a]	2.265(3)
Zn1-O1	1.998(3)
Zn1-O3	2.071(3)
N1-Zn1-N4[a]	170.20(12)
N2-Zn1-N1	82.08(12)
N2-Zn1-N4[a]	90.76(12)
O1-Zn1-N1	98.37(12)
O1-Zn1-N2	116.52(13)
O1-Zn1-N4 [a]	90.81(11)
O1-Zn1-O3	101.95(13)
O3-Zn1-N1	94.02(11)
O3-Zn1-N2	141.51(14)
O3-Zn1-N4 [a]	87.41(11)

Symmetry codes: a) -1+X, +Y, +Z.

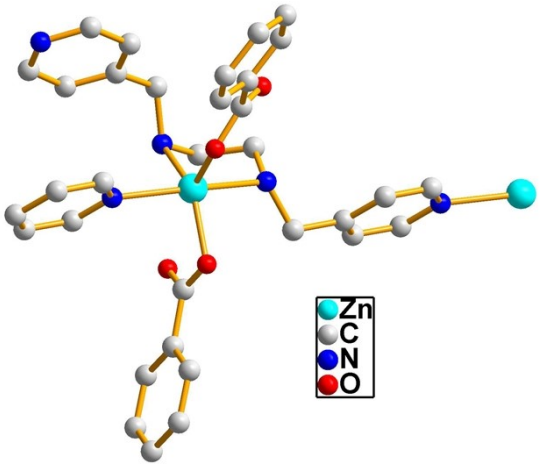
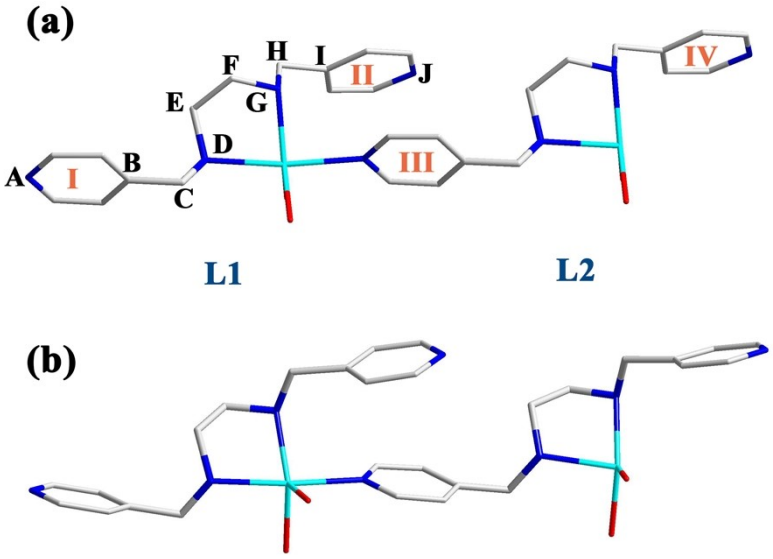


Figure S1. View of the coordination environment of Zn(II) ion in HSB-W5d (hydrogen atoms and free water molecules have been omitted for clarity).



HSB-W5d

Torsion Angles (°)	L1	L2
A-C-H-J	-146.5	-146.5
C-D-G-H	-160.0	-160.0
B-C-D-E	60.1	60.1
C-D-E-F	97.9	97.9
D-E-F-G	57.7	57.7
E-F-G-H	78.2	78.2
F-G-H-I	174.0	174.0

Dihedral Angle (°)	
I-II	16.0
III-IV	16.0
I-III	0
II-IV	0

HSB-W5e

Torsion Angles (°)	L1	L2
A-C-H-J	162.7	131.8
C-D-G-H	158.8	164.6
B-C-D-E	-39.7	-67.2
C-D-E-F	-104.2	-102.7
D-E-F-G	-57.4	-56.0
E-F-G-H	-94.7	-73.9
F-G-H-I	-169.9	-172.2

Dihedral Angle (°)	
I-II	24.0
III-IV	22.2
I-III	7.8
II-IV	14.0

Figure S2. Comparation of the conformation of neighboring hsb-2 ligands in HSB-W5d (a) and HSB-W5e (b).

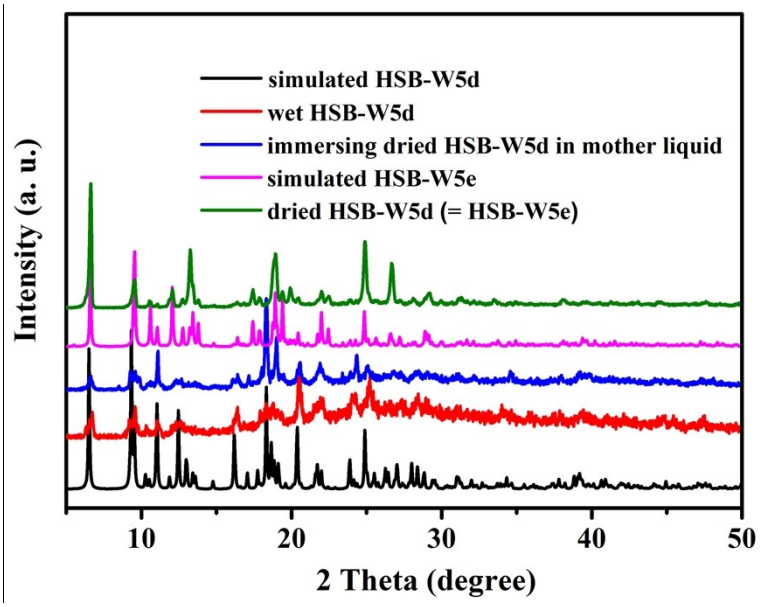


Figure S3. PXRD patterns of simulated HSB-W5d, wet crystal HSB-W5d, as-synthesized HSB-W5d (after drying), as-synthesized HSB-W5d immersing in the mother liquid, and simulated HSB-W5e.

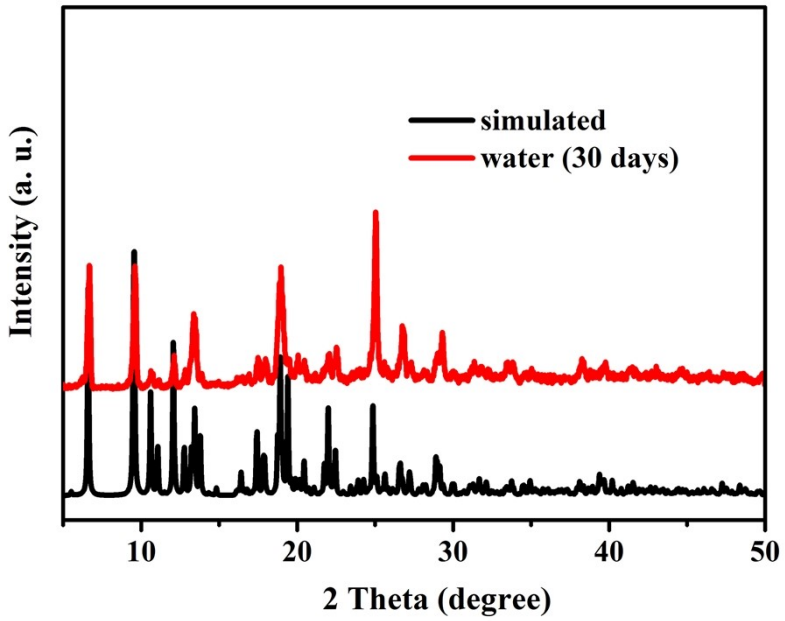


Figure S4. PXRD patterns of HSB-W5 after immersing in water for one month.

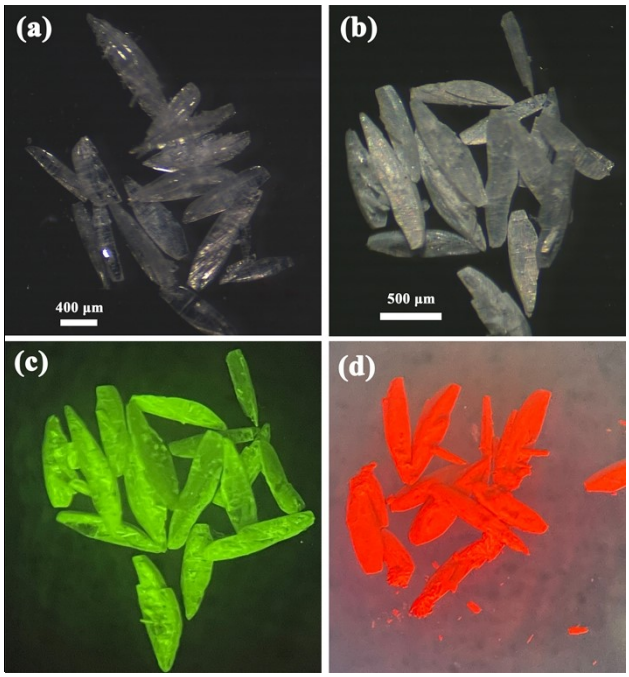


Figure S5. The photographs of as-synthesized HSB-W5 under sunlight (a), $Tb(H_2O)_8^{3+}$@HSB-W5 under sunlight (b), $Tb(H_2O)_8^{3+}$@HSB-W5 irradiated by a standard 254 nm laboratory UV lamp (c), and $Eu(H_2O)_8^{3+}$@HSB-W5 irradiated by a standard 254 nm laboratory UV lamp (d).

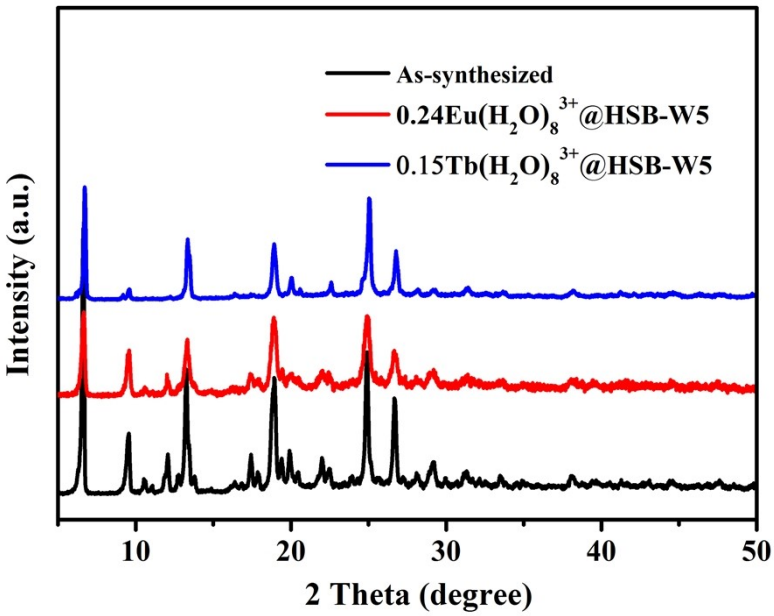


Figure S6. PXRD patterns of $Eu(H_2O)_8^{3+}$@HSB-W5 and $Tb(H_2O)_8^{3+}$@HSB-W5.

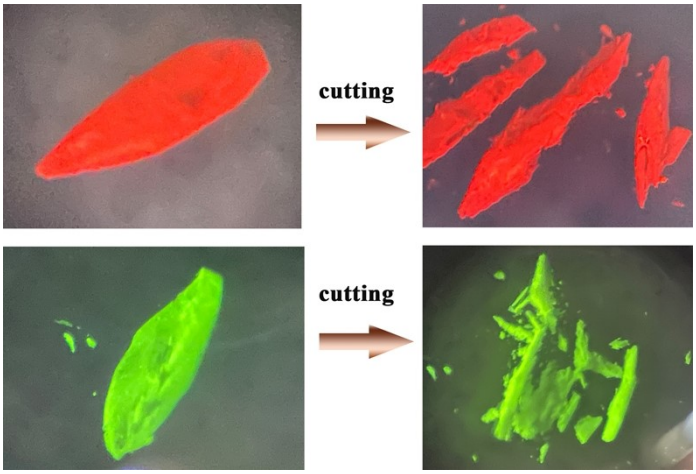


Figure S7. The photographs of crystals $Eu(H_2O)_8^{3+}$@HSB-W5 and $Tb(H_2O)_8^{3+}$@HSB-W5, and their pieces irradiated by a standard 254 nm laboratory UV lamp.

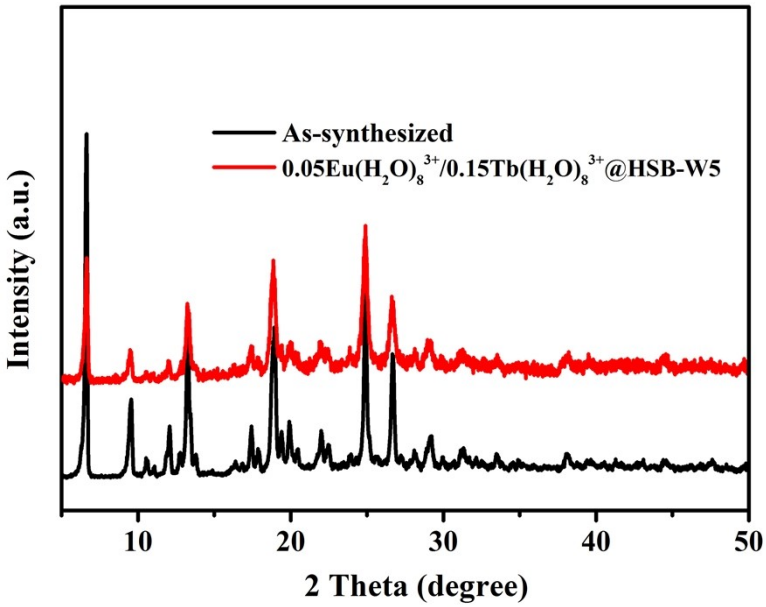


Figure S8. PXRD patterns of 0.03$Eu(H_2O)_8^{3+}$/0.15$Tb(H_2O)_8^{3+}$@HSB-W5 composite.

Table S3. The amounts of Eu^{3+} in $Eu(H_2O)_8^{3+}$@HSB-W5 composites based on ICP measurement.

Composite name $x$$Eu(H_2O)_8^{3+}$@HSB-W5	Initial concentration of Eu^{3+} (mol L^{-1})	Amount of Zn^{2+} (%)	Amount of Eu^{3+} (%)
0.08$Eu(H_2O)_8^{3+}$@HSB-W5	0.009	9.55	1.70
0.13$Eu(H_2O)_8^{3+}$@HSB-W5	0.018	9.76	2.91
0.24$Eu(H_2O)_8^{3+}$@HSB-W5	0.027	9.41	5.21

Table S4. The amounts of Tb^{3+} in $Tb(H_2O)_8^{3+}$@HSB-W5 composites based on ICP measurement.

Composite name $x$$Tb(H_2O)_8^{3+}$@HSB-W5	Initial concentration of Tb^{3+} (mol L^{-1})	Amount of Zn^{2+} (%)	Amount of Tb^{3+} (%)
0.04$Tb(H_2O)_8^{3+}$@HSB-W5	0.002	9.97	1.04
0.08$Tb(H_2O)_8^{3+}$@HSB-W5	0.007	9.80	1.87
0.15$Tb(H_2O)_8^{3+}$@HSB-W5	0.014	9.71	3.48

Table S5. The amounts of Eu^{3+} and Tb^{3+} in WLE $Eu(H_2O)_8^{3+}$/$Tb(H_2O)_8^{3+}$@HSB-W5 composites based on ICP measurement.

Composite name $x$$Eu(H_2O)_8^{3+}$/$y$$Tb(H_2O)_8^{3+}$@HSB-W5	Amount of Zn^{2+} (%)	Amount of Eu^{3+} (%)	Amount of Tb^{3+} (%)
0.03$Eu(H_2O)_8^{3+}$/0.15 $Tb(H_2O)_8^{3+}$@HSB-W5	9.22	0.72	3.41

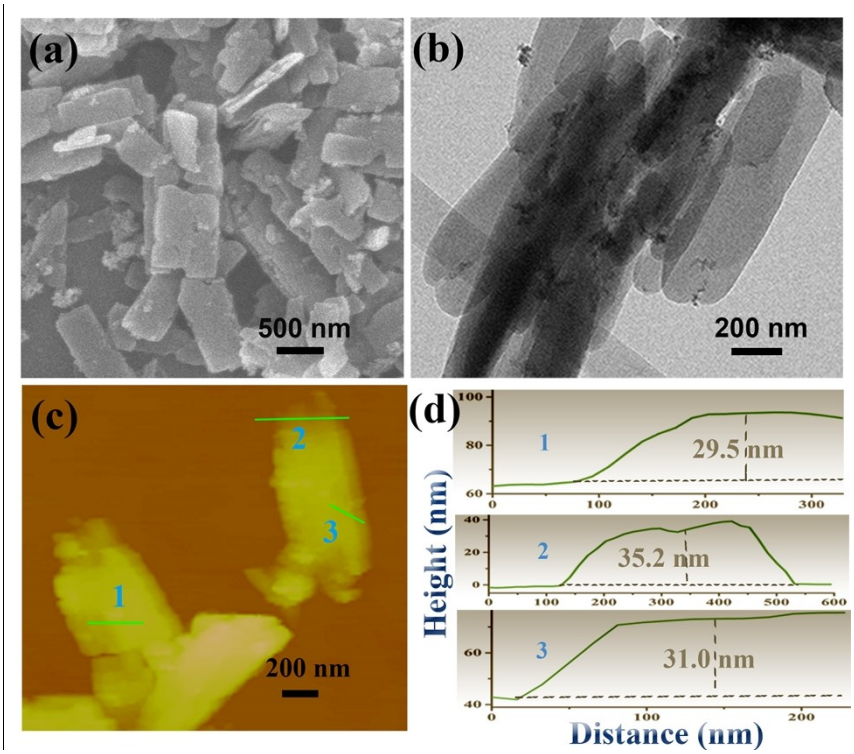


Figure S9. (a) SEM and (b) TEM images of the HSB-W5-NS nanosheets. (c, d) AFM images of the HSB-W5-NS nanosheets and the corresponding height profiles.

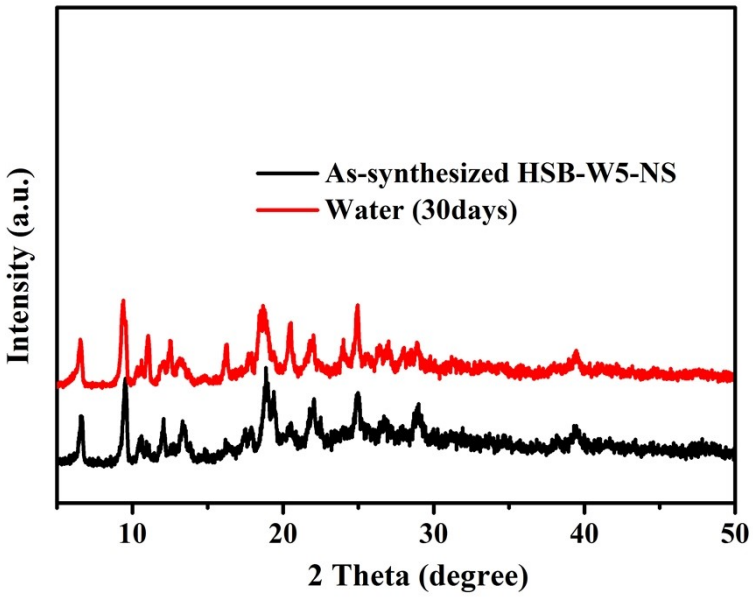


Figure S10. PXRD patterns of HSB-W5-NS after immersing in water for one month.

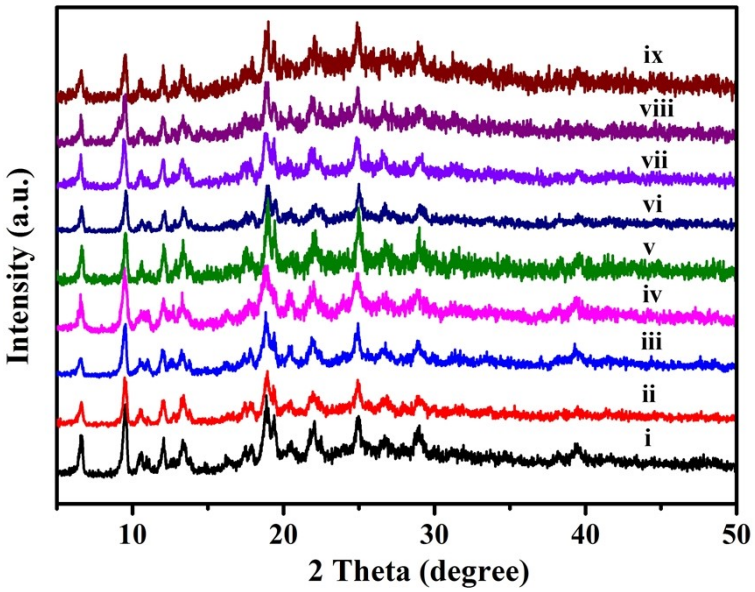


Figure S11. PXRD patterns of as-synthesized HSB-W5-NS (i), xEu$(H_2O)_8^{3+}$@HSB-W5-NS (ii-v: $x = 0.26$-1.60), and xTb$(H_2O)_8^{3+}$@HSB-W5-NS (vi-ix: $x = 0.08$-0.48).

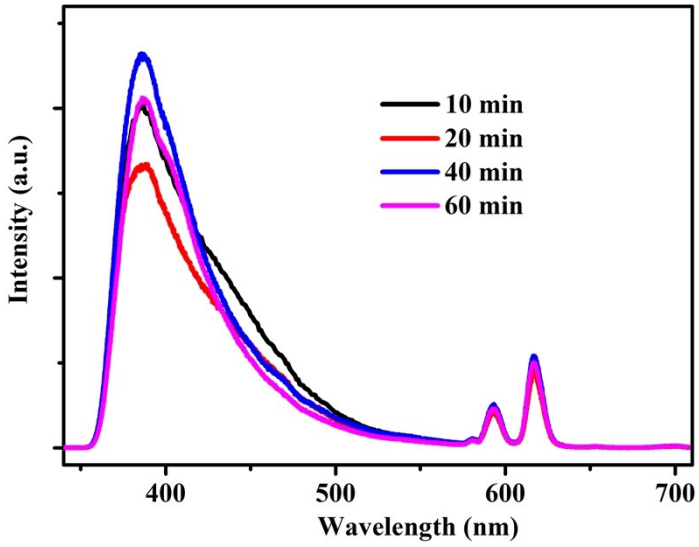


Figure S12. Emission changes with the reaction time.

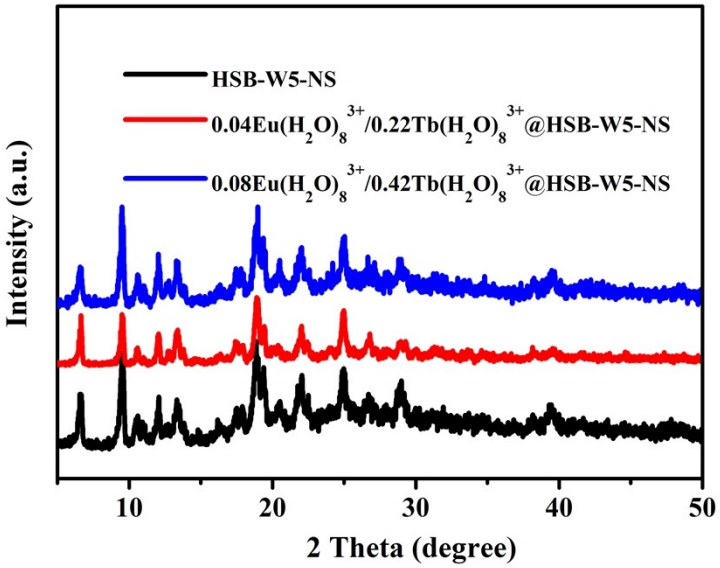


Figure S13. PXRD patterns of $Eu(H_2O)_8^{3+}$/$Tb(H_2O)_8^{3+}$@HSB-W5-NS composite.

Table S6. The amounts of Eu^{3+} in $Eu(H_2O)_8^{3+}$@HSB-W5-NS composites based on ICP measurement.

Composite name xEu$(H_2O)_8^{3+}$@HSB-W5-NS	Initial concentration of Eu^{3+} (mol L^{-1})	Amount of Zn^{2+} (%)	Amount of Eu^{3+} (%)
0.26Eu$(H_2O)_8^{3+}$@HSB-W5-NS	0.001	9.52	5.80
0.55Eu$(H_2O)_8^{3+}$@HSB-W5-NS	0.002	8.45	10.78
1.24Eu$(H_2O)_8^{3+}$@HSB-W5-NS	0.003	6.15	17.76
1.60Eu$(H_2O)_8^{3+}$@HSB-W5-NS	0.004	5.68	21.15

Table S7. The amounts of Tb^{3+} in $Tb(H_2O)_8^{3+}$@HSB-W5-NS composites based on ICP measurement.

Composite name xTb$(H_2O)_8^{3+}$@HSB-W5-NS	Initial concentration of Tb^{3+} (mol L^{-1})	Amount of Zn^{2+} (%)	Amount of Tb^{3+} (%)
0.08Tb$(H_2O)_8^{3+}$@HSB-W5-NS	0.00055	12.80	2.51
0.13Tb$(H_2O)_8^{3+}$@HSB-W5-NS	0.001	12.23	4.02
0.21Tb$(H_2O)_8^{3+}$@HSB-W5-NS	0.0013	11.47	5.90
0.48Tb$(H_2O)_8^{3+}$@HSB-W5-NS	0.0022	9.60	11.24

Table S8. The amounts of Eu^{3+} and Tb^{3+} in WLE $Eu(H_2O)_8^{3+}$/$Tb(H_2O)_8^{3+}$@HSB-W5-NS composites based on ICP measurement.

Composite name xEu$(H_2O)_8^{3+}$/yTb$(H_2O)_8^{3+}$@HSB-W5-NS	Amount of Zn^{2+} (%)	Amount of Eu^{3+} (%)	Amount of Tb^{3+} (%)
0.04Eu$(H_2O)_8^{3+}$/0.22 Tb$(H_2O)_8^{3+}$@HSB-W5-NS	11.13	1.04	6.03
0.08Eu$(H_2O)_8^{3+}$/0.42 Tb$(H_2O)_8^{3+}$@HSB-W5-NS	9.52	1.76	9.75

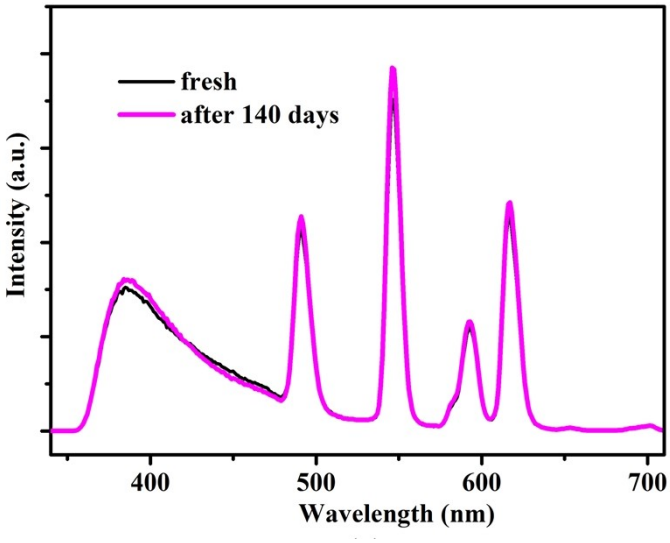


Figure S14. Comparation of the emission spectra of $0.04Eu(H_2O)_8^{3+}/0.22Tb(H_2O)_8^{3+}$@HSB-W5-NS (fresh vs. after 140 days).

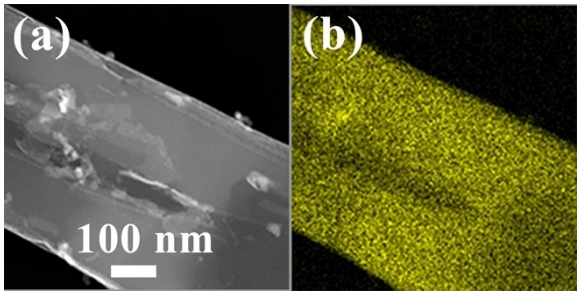


Figure S15. TEM image of $0.04Eu(H_2O)_8^{3+}/0.22Tb(H_2O)_8^{3+}$@HSB-W5-NS (a) and corresponding EDX mapping image for C element (b).