Electronic Supplementary Information

Lanthanide hydroxide ribbons assembled in a 2D network: slow relaxation of the magnetization in the dysprosium(III) complex

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Materials and General Characterization. All reagents and solvents employed were commercially available and used as received without further purification. Elemental analyses for C, H were carried out on a Perkin–Elmer analyzer. Powder X-ray diffraction measurements were recorded on a D/Max-2500 X-ray diffractometer using Cu-Kα radiation. Thermogravimetric analysis (TGA) was carried out on a Delta Series TA-SDTQ600 analyzer in nitrogen atmosphere from room temperature to 800 °C (10 °C min^{-1}) using aluminum crucibles. Magnetic susceptibility measurements were performed on a Quantum Design SQUID-VSM and PPMS magnetometer. Diamagnetic corrections were made for all the constituent atoms with Pascal's constants and the sample holders.

Synthesis of $\{[Dy_2(L)_2(\mu_3\text{-}OH)_2(H_2O)]\cdot H_2O\}_n$ (1·Dy) A mixture of H_2L (0.016 g, 0.1 mmol), $Dy(NO_3)_3\cdot 6H_2O$ (0.091 g, 0.2 mmol), NaOH (0.1 mol/L, 2 mL) and H_2O (5 mL) was added in a 23 mL Teflon-lined autoclave and heated at 100 °C for 72 h, and then slowly cooled down to the room temperature. Colorless crystals suitable for X-ray data collection were obtained by filtration, washed with distilled water, and air-dried. Yield: 30% based on dysprosium. Elemental analysis found (calcd) for , C: 23.54% (23.63%) H: 3.97% (3.68%).

Synthesis of $\{[Tb_2(L)_2(\mu_3\text{-}OH)_2(H_2O)]\cdot H_2O\}_n$ (2·Tb) A mixture of H_2L (0.016 g, 0.1 mmol), $Tb(NO_3)_3\cdot 6H_2O$ (0.091 g, 0.2 mmol), NaOH (0.1 mol/L, 2 mL) and H_2O (5 mL) was added in a 23 mL Teflon-lined autoclave and heated at 100 °C for 72 h, and then slowly cooled down to the room temperature. Colorless crystals suitable for X-ray data collection were obtained by filtration, washed with distilled water, and air-dried. Yield: 40% based on terbium. Elemental analysis found (calcd) for , C: 24.40% (23.87%) H: 3.99% (3.72%).

Crystallographic Studies

Single-crystal X-ray diffraction measurements of **1·Dy** and **2·Tb** were recorded on a diffractometer with a graphite monochromatic *Mo-Kα* radiation (λ = 0.71073 Å). The structures were solved by direct method and refined by full-matrix least-squares techniques on F^2 using the *SHELXS-97* and *SHELXL-97* programs[2] contained in Olex 2.[3] Anisotropic thermal parameters were assigned to all non-hydrogen atoms. The hydrogen atoms were placed in idealized positions and located in the difference Fourier map. The formula was identified by combining single-crystal structure, element analysis and thermogravimetric analysis (Fig S11). The crystallographic data for **1·Dy-2·Tb** are listed in Table S1. CCDC 1038140 and 1038139 for **1·Dy** and **2·Tb** contains the supplementary crystallographic data for this paper. The data can be obtained free of charge from the Cambridge Crystallographic Data Centre (www.ccdc.cam.ac.uk/data_request/cif).

Restricted instructions (ISOR) are placed on C1, C3, O9 in **1·Dy** and C1, C5, C8, O8 in **2·Tb** to avoid non-positive definite. The detailed information of the restraints employed has been listed in the _olex2_refinement_description section of the cif file.

Table S1. Crystal data and structure refinements.

compound	**1·Dy**	**2·Tb**
formula	$C_{14}H_{24}O_{12}Dy_2$	$C_{14}H_{24}O_{12}Tb_2$
formula weight	709.33	702.17
crystal system	Triclinic	Triclinic
space group	*P*-1	*P*-1
a (Å)	7.1628(5)	7.1577(5)
b (Å)	9.9371(6)	9.9319(10)
c (Å)	14.9972(10)	14.9339(17)
α (°)	71.520(6)	71.781(10)
β (°)	83.425(6)	82.756(8)
γ (°)	75.425(6)	75.432(8)
V (Å^3)	979.13(11)	974.70(17)
Z	2	2
D_c, (g cm^{-3})	2.406	2.392
μ, (mm^{-1})	7.632	7.257
F (000)	672.0	668.0
GOF on F^2	1.046	1.029
R_{int}	0.0356	0.0446
R_1, wR_2 [$I > 2\,\sigma(I)$]	0.0392, 0.1007	0.0278,0.0668

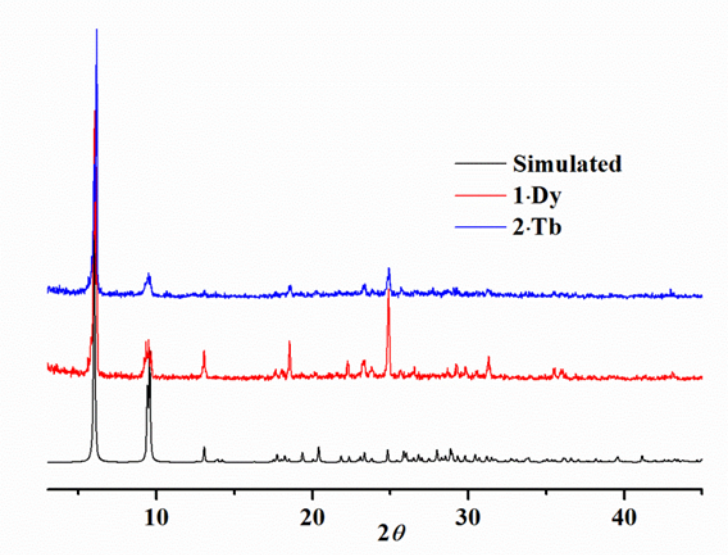


Fig. S1 Comparison of the experimental PXRD pattern of the as-synthesized **1·Dy** and **2·Tb** with the one simulated from the single crystal data of **1·Dy**.

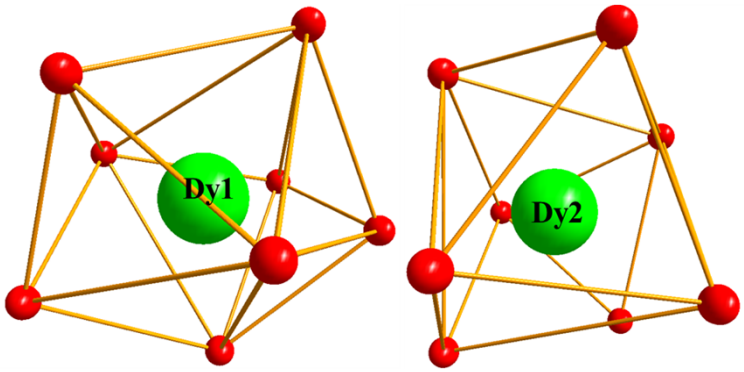
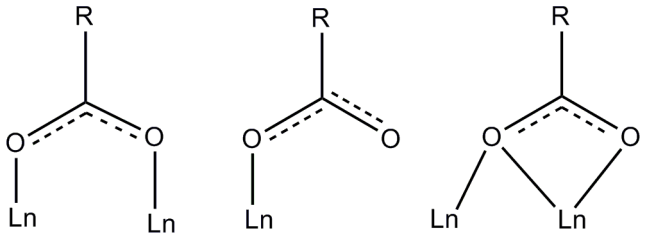


Fig. S2 Coordination geometries of Dy1 and Dy2.



Scheme. S1 Binding modes observed for ligands with lanthanide metals. (from left):μ_2-η^1:η^1, η^1, μ_2-η^2:η^1.

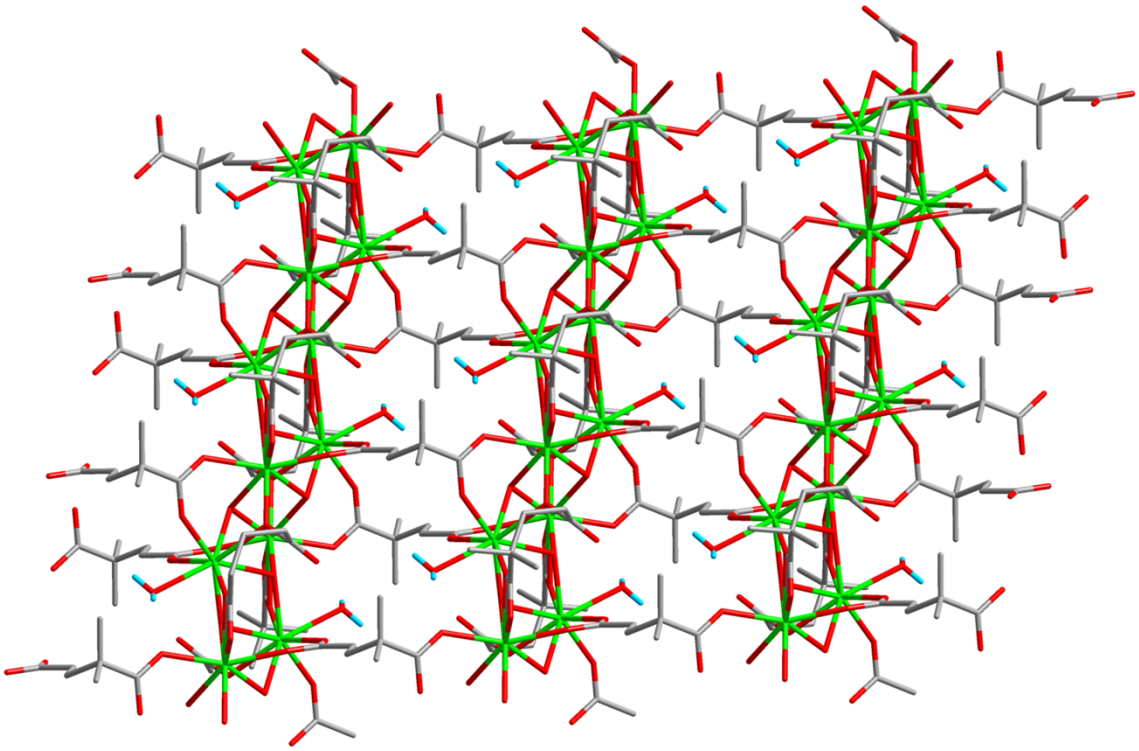


Fig. S3 Top view of the two-dimensional network.

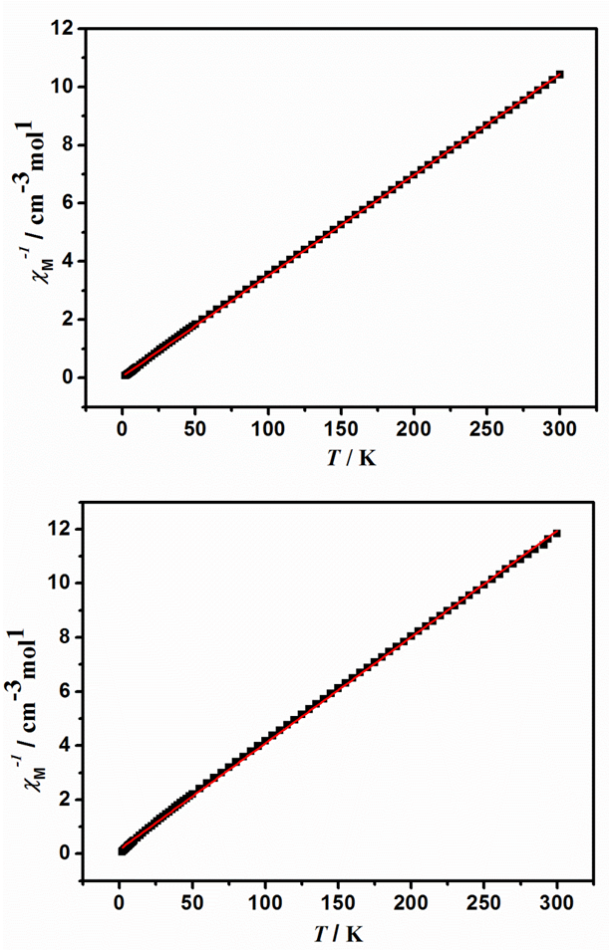


Fig. S4 χ^{-1} vs T plot of **1·Dy** (top), **2·Tb** (bottom) and the solid line is the best fit to Curie-Weiss law.

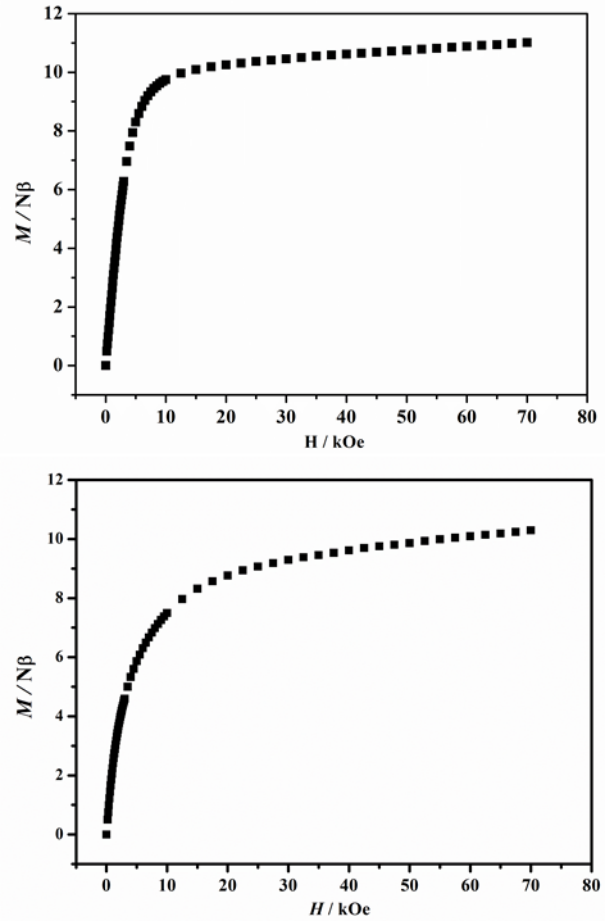


Fig. S5 The Field dependence of the magnetization for **1·Dy** (top) and **2·Tb** (bottom) at 2 K.

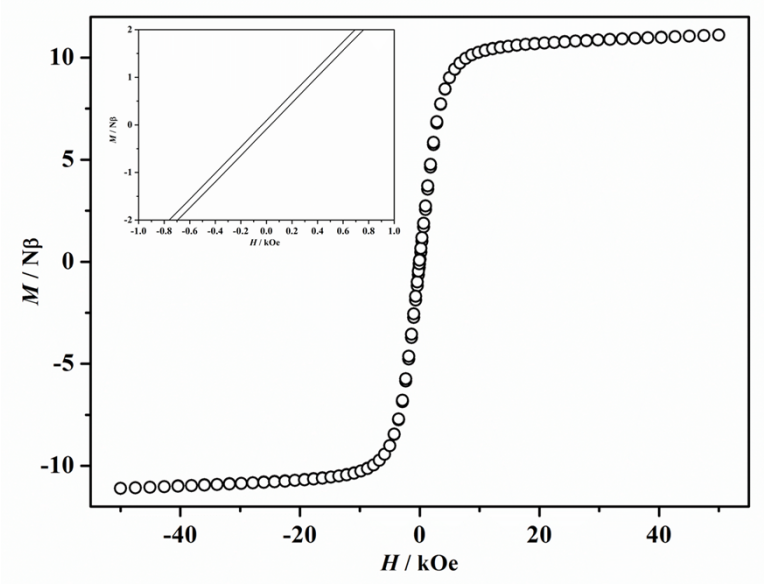


Fig. S6 Magnetic hysteresis of **1·Dy** at 2 K.

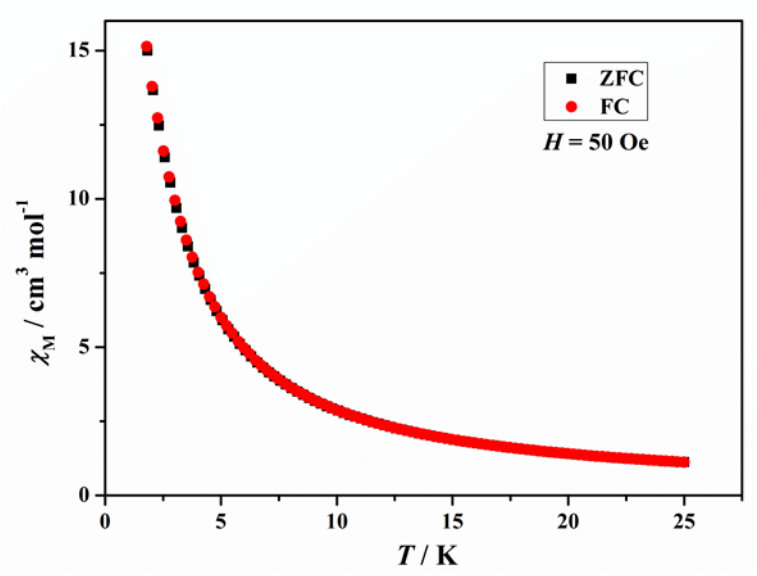


Fig. S7 ZFC and FC data of **1·Dy**.

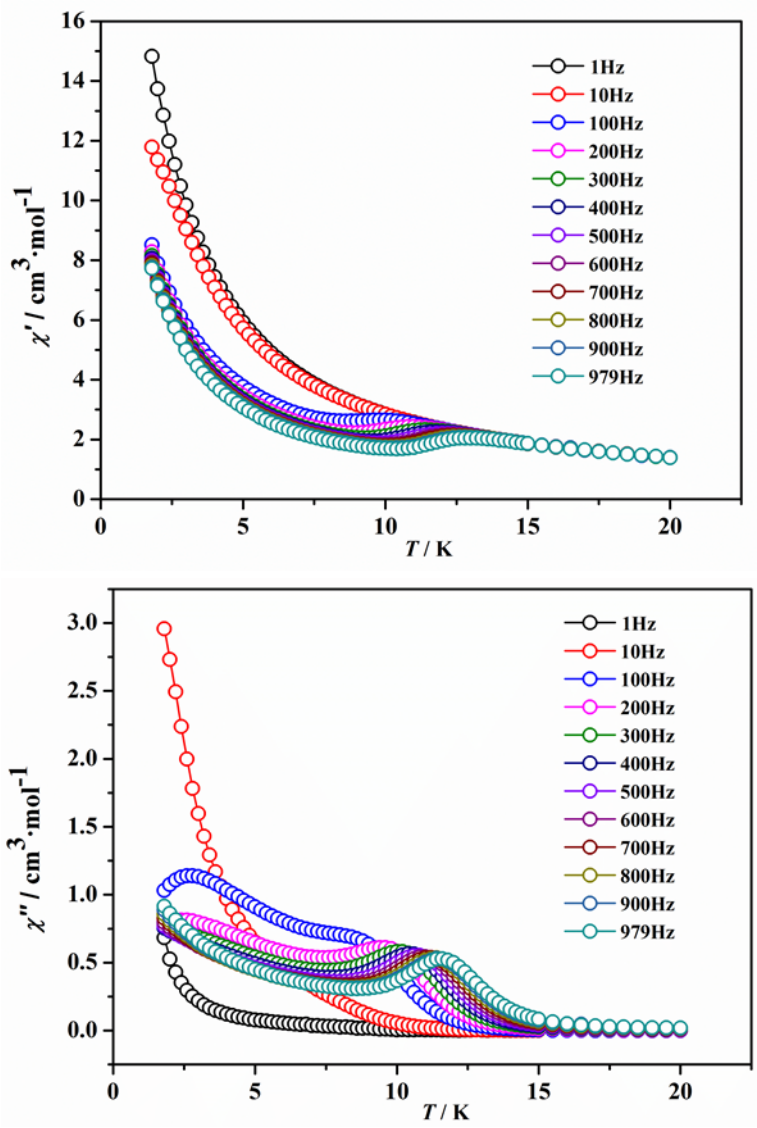


Fig. S8 Temperature dependence of the in-of-phase (χ') and out-of-phase (χ'') ac susceptibilities measured on a polycrystalline sample **1·Dy** in the zero static filed. Solid lines are eye guides.

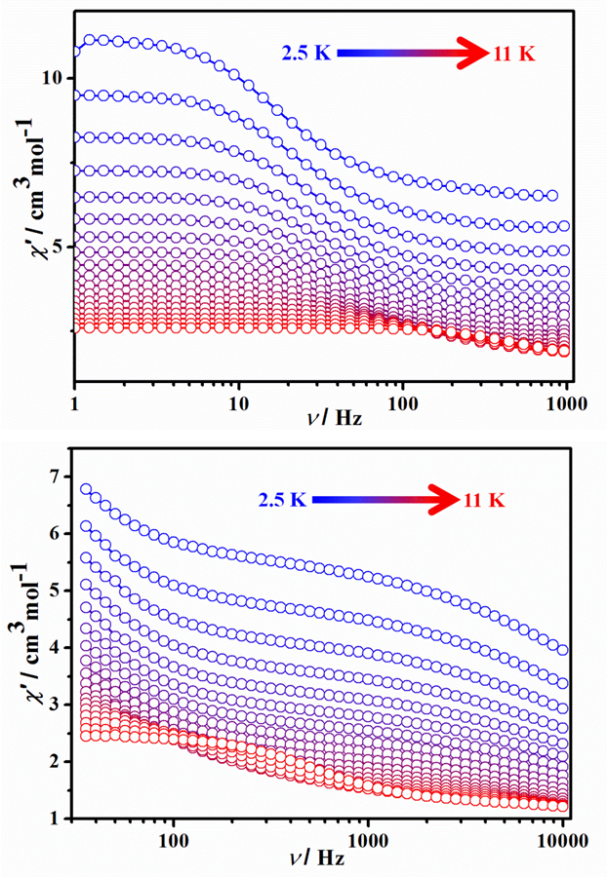


Fig. S9 Frequency dependence of the in-of-phase (χ') at 1-1000 Hz (top) and 35- 10000Hz (bottom) susceptibilities measured on a polycrystalline sample **1·Dy** in the zero static filed. Solid lines are eye guides.

$$\chi_{AC}(\omega) = \chi_{S1} + \chi_{S2} + \frac{\chi_{T1} - \chi_{S1}}{1 + (i\omega\tau_1)^{(1-\alpha 1)}} + \frac{\chi_{T2} - \chi_{S2}}{1 + (i\omega\tau_2)^{(1-\alpha 2)}}$$

$$\chi'(\omega) = \chi_{S1} + \chi_{S2} + \frac{(\chi_{T1} - \chi_{S1})(1 + (\omega\tau_1)^{(1-\alpha 1)}(\sin \pi\alpha_1/2))}{1 + (\omega\tau_1)^{(1-\alpha 1)}\sin(\pi\alpha_1/2) + (\omega\tau_1)^{(2-2\alpha 1)}} + \frac{(\chi_{T2} - \chi_{S2})(1 +$$

$$\chi''(\omega) = \chi_{S1} + \chi_{S2} + \frac{(\chi_{T1} - \chi_{S1})(1 + (\omega\tau_1)^{(1-\alpha 1)}\cos(\pi\alpha_1/2))}{1 + (\omega\tau_1)^{(1-\alpha 1)}\sin(\pi\alpha_1/2) + (\omega\tau_1)^{(2-2\alpha 1)}} + \frac{(\chi_{T2} - \chi_{S2})(1 +$$

Equation S1. The fitting equation of the cole-cole plots.[4]

Table S2. The fitting results of the Cole-Cole plots.

	2.5K	3K	3.5K	4K	4.5K	5K
$\alpha 1$	0.08	0.07	0.07	0.06	0.05	0.05
$\alpha 2$	0.39	0.40	0.38	0.41	0.42	0.43
$\tau 1$	0.010	0.008	0.006	0.005	0.005	0.004
$\tau 2$	7.35E-6	7.28E-6	8.61E-6	7.50E-6	7.49E-6	7.65E-6
	5.5K	6K	6.5K	7K	7.5K	8K
$\alpha 1$	0.04	0.04	0.03	0.03	0.02	0.04
$\alpha 2$	0.42	0.44	0.44	0.42	0.42	0.36
$\tau 1$	0.004	0.004	0.003	0.003	0.003	0.002
$\tau 2$	8.78E-6	8.13E-6	8.08E-6	8.87E-6	9.11E-6	1.07E-5
	8.5K	9K	9.5K	10K	10.5K	11K
$\alpha 1$	0.02	0.01	0.03	0.03	0.02	0.02
$\alpha 2$	0.34	0.32	0.25	0.22	0.23	0.24
$\tau 1$	0.002	0.001	0.001	7.54E-4	4.69E-4	3.08E-4
$\tau 2$	1.04E-5	9.10E-6	8.86E-6	6.79E-6	4.22E-6	2.69E-6

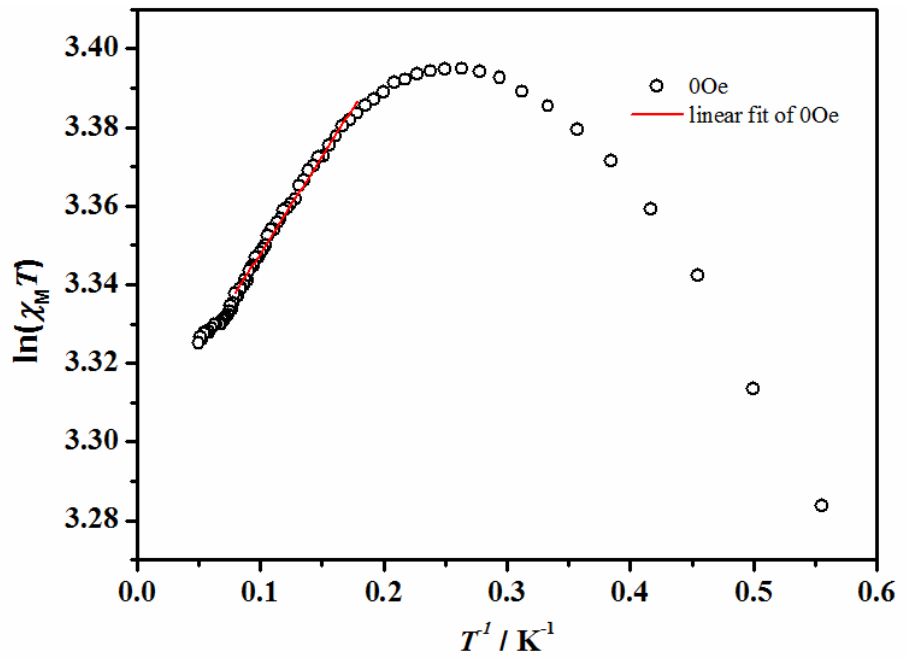


Fig. S10 The ln(χT) versus 1/T of **1·Dy** at zero external field

Δ_ξ/k_B = 0.49 K (with C_{eff} = 1.04 cm^{3}mol^{-1}K), ($\chi T = C_{eff}\exp(\Delta_\xi/k_B T)$

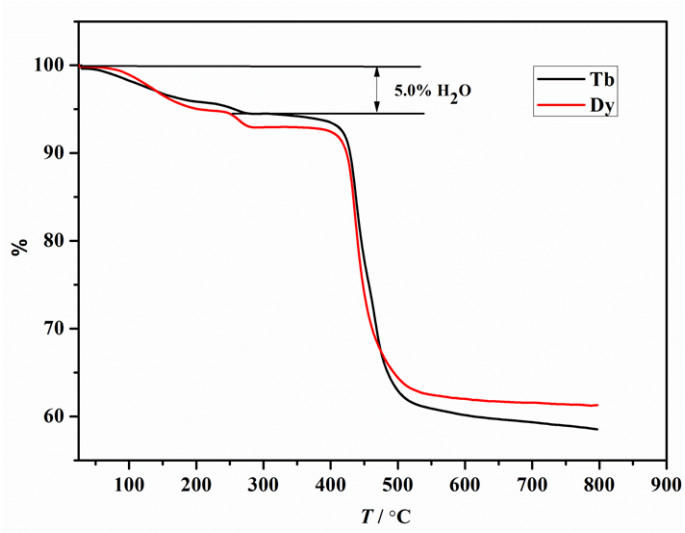


Fig. S11 The thermal gravimetric analysis (TGA) of **1·Dy** and **2·Tb**.

1. Z. J. Michael, C. L. Miranda, *PCT Int. Appl.,* 2008073613, 2008.

2. M. Sheldrick, *Acta Crystallogr.*, *Sect. A*: *Fundam. Crystallogr.*, 2008, **64**, 112.

3. O. V. Dolomanov, L. J. Bourhis, R. J. Gildea, J. A. K. Howard and H. Puschmann, *J. Appl. Cryst.*, 2009, **42**, 339.

4. Y. N. Guo, G. F. Xu, Y. Guo, and J. K. Tang, *Dalton Trans.*, 2011, **40**, 9953.