1. Synthesis and characterization of ligand 1,8-bis(4-methyl-2-hydroxy-benzamido)-3,6-dioxaoctane (L3) and its Tb (III) complex (Tb-L3)

The ligand L3 and complex Tb-L3 were synthesized according the literature methods (shown in Figure S1).[1, 2] The details of L3 are given as the following: ethyl 5-methylsalicylate and triethylenetetramine mixed together and heated at 100 °C on an oil bath under stirring for 24 h. The mass was then crystallized from a 1:1 (in volume) ethanol-water mixture, affording a white solid.

L3: 1H NMR (300 MHz, Chloroform-d, δ): 2.20 (s, 6H, Ar-CH₃), 2.79 (s, 4H, 4,5-CH₂), 2.87 (t, J = 5.63 Hz, 4H, 3,6-CH₂), 3.55 (t, J = 5.49 Hz, 4H, 2,7-CH₂), 6.40...

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*a Institute of Analytical Chemistry, Chemo- and Biosensors, University of Regensburg, D-93040 Regensburg, Germany. E-mail: yujiangbo75@yahoo.com.

*b Research Center of Nano Science and Technology, Shanghai University, 200444 Shanghai, P. R. China

*c Key Laboratory of Luminescence and Optical Information, Ministry of Education, Institute of Optoelectronic Technology, Beijing Jiaotong University, 100044 Beijing, P. R. China

*d These authors contributed equally.

*e Current address: Department of Chemistry, Clemson University, Clemson, SC 29634, USA.

† Electro supplementary information (ESI) available: TGA, Photostability curves, and synthesis and photophysical properties of Tb-L3.
1H NMR (300 MHz, Chloroform-d, δ): 6.85 (d, J = 8.51 Hz, 2H, ArH), 7.09 (d, J = 8.51 Hz, 2H, ArH), 7.31 (d, J = 1.39 Hz, 2H, ArH), 7.74 (s br, 2H, 2,7-(CH2)-NH).

13C NMR (300 MHz, Chloroform-d, δ): 20.47 (Ar–CH3), 39.06 (C2, 7), 48.44 (C3, 6), 48.54 (C4, 5), 115.06(Ar), 117.83 (Ar), 127.08 (Ar), 127.80 (Ar), 134.64 (Ar), 158.19 (ArCOH), 169.40 (C=O).

CI-MS (m/z (%)): 415.2 (100.0) [M+H]+, 416.3 (24.36) [M+2H]+, 417.3 (3.3) [M+3H]+, 418.3 (5.21) [M+4H]+, 419.3 (14.89) [M+5H]+. Anal. Calcd for C22H30N4O4: C 63.75, H 7.30, N 13.52; found: C 63.47, H 7.38, N 13.63.

Tb-L3: Anal. calcd: C 22.50, H, 3.09; N, 11.93%; found for C22H36N10O26Tb2: C, 22.45; H, 3.15; N, 11.84%.

2. Absorption and fluorescence spectra of Tb-L3 in solution.

The absorption spectra of ligands and complexes show some differences among the Tb (III) complexes because the different groups appear in the benzene ring of the ligands, among which ligands L2 and L3 and their corresponding complexes exhibit a little blue and red shift, respectively, in comparison with the ligand L1 and its complex. Accordingly, the excitation spectra of Tb-L2 and Tb-L3 show a little blue and red shift, respectively, being compared with Tb-L1. Being different from the bright emissions of Tb-L1 and Tb-L2 which shows highly pure green colour due to the strongest emissive band peaks around 545 nm and its full width at half maximum (FWHM) being less than 10 nm, Tb-L3 shows blue-green colour emission because there is a broad emission band in the blue region from its ligand (Figure S2) besides the typical emission bands of Tb3+ ion. This indicates that the energy transfer from the triplet state of L3 is not such efficient as that happens in Tb-L1 and Tb-L2. The other photophysical properties of Tb-L3 are also very different from that of the other two Tb (III) complexes (listed in Table S1). Among the three Tb (III) complexes, TbL3 shows a much lower quantum yield, shorter lifetime and weaker brightness. As we know, the methyl is electron-donating group and ethoxyl is electron-drawing group, which can lower and heighten the excited states of the ligands, respectively.
This can explain why differences appear in the absorption spectra and other photophysical properties among three Tb (III) complexes. Therefore, the fluorescence lifetime of Tb-L3 in DMSO solution is 267 μs, which is roughly 3 times less than that of Tb-L1 and Tb-L2 at room. Such photophysical properties can’t enable Tb-L3 to be applied as a good indicator for the temperature-sensitive paints.

Table S1 Photophysical properties of Tb-L3.

<table>
<thead>
<tr>
<th>Complex</th>
<th>$\lambda_{\text{abs}}$/nm&lt;sup&gt;a&lt;/sup&gt;</th>
<th>$\lambda_{\text{ex}}$/nm&lt;sup&gt;b&lt;/sup&gt;</th>
<th>$\tau$/μs&lt;sup&gt;c&lt;/sup&gt;</th>
<th>QY/%&lt;sup&gt;d&lt;/sup&gt;</th>
</tr>
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<tbody>
<tr>
<td>TbL3</td>
<td>319</td>
<td>345</td>
<td>267</td>
<td>2.4</td>
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</tbody>
</table>

<sup>a</sup> Absorption ($\lambda_{\text{abs}}$) and excitation ($\lambda_{\text{ex}}$) spectra peak in solution, 0.1 mM in acetonitrile.  
<sup>b</sup> Excitation ($\lambda_{\text{ex}}$) spectra peak, 40 μM solution in acetonitrile.  
<sup>c</sup> Decay time measured for the transmission of $^5D_4\rightarrow^7F_5$ of Tb<sup>3+</sup> ion.  
<sup>d</sup> Relative quantum yield measured in DMSO.
Fig. S1 Scheme of synthesis of L3 and Tb-L3.
Fig. S2 Absorption and fluorescence spectra of L3 and Tb-L3 at RT. Plot a (----): absorption spectrum of ligand L1 (0.1 mM in acetonitrile); plot b (······): absorption spectrum; plot c (·-·-·-): excitation spectrum; plot d (───): emission spectrum of the Tb-L1 complex (40 µM in acetonitrile).
Fig. S3 Normalized absorption and fluorescence excitation spectra of \( L_1 \), \( L_2 \), \( \text{Tb-L}_1 \) and \( \text{Tb-L}_2 \) at RT. Graph A, plot 1 (dash): absorption spectrum of ligand \( L_1 \) in acetonitrile; plot 2 (dot): absorption spectrum of ligand \( L_1 \) in DMSO; plot 3 (solid): excitation spectrum of \( \text{Tb-L}_1 \) in DMSO. Graph B, plot 4 (dash): absorption spectrum of ligand \( L_2 \) in acetonitrile; plot 5 (dot): absorption spectrum of ligand \( L_2 \) in DMSO; plot 6 (solid): excitation spectrum of \( \text{Tb-L}_2 \) in DMSO.
**Fig. S4** Photodegradation curves of Tb (III) complexes_TSPs under continuous illumination of 330 nm UV light of Xenon lamp at a power of ~1.0 mW in air (solid, \textit{TbL1}, 3 wt% doped into PMMA; dot, \textit{TbL2}, 5 wt% doped into PMMA).
Fig. S5 TGA-DSC curves of Tb (III) complexes (solid: TGA; dot: DSC), A: Tb-L1, B: Tb-L2, measured at air condition.

References
