# Electronic Supplementary Information for

## The 2-Phenylbenzimidazole-5-sulfonate /layered double hydroxides co-intercalation composites and its luminescence response for nucleotides

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### 1. Structural characterization of PBS(15%)– DES/LDH composites

As is shown in Figure S1, the XRD patterns of PBS(15%)-DES/LDH thin film appears strong (00 l) diffraction peak compared with solid powder，the lack of benchmark diffraction peak (110) ($h$, $k \neq 0$) presents good $c$ axis orientation, that is the *ab* plane of the LDH particles is paralleled to the basement [1].
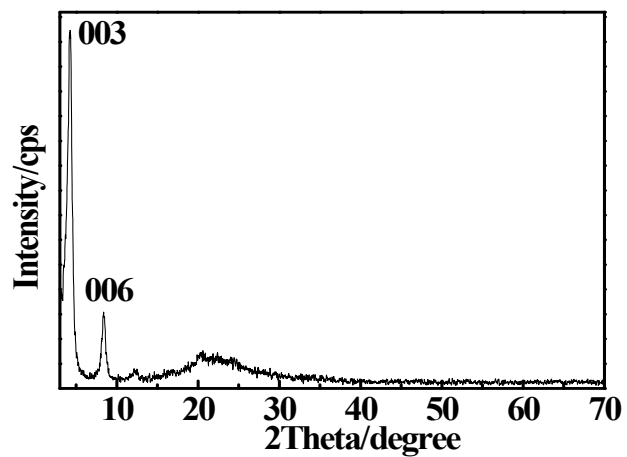
**Fig. S1.** XRD patterns of PBS(15%)-DES/LDH thin film

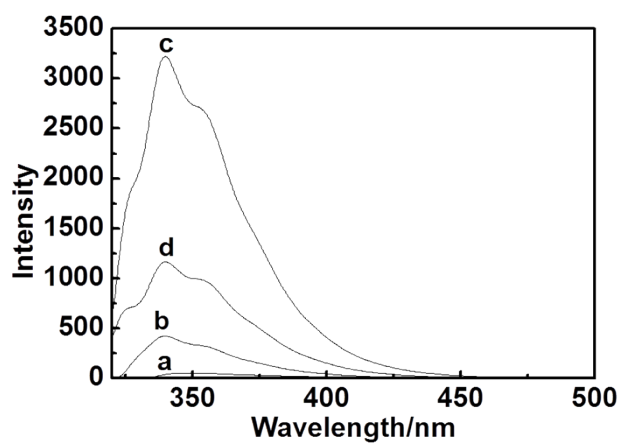## 2.Optical properties of PBS solutions and PBS(15%)–DES/LDH thin film



**Fig. S2** The fluorescence spectra of the PBS solutions （a-$10^{-2}$M , b-$10^{-3}$M, c-$10^{-4}$M ,d-$10^{-5}$ M）
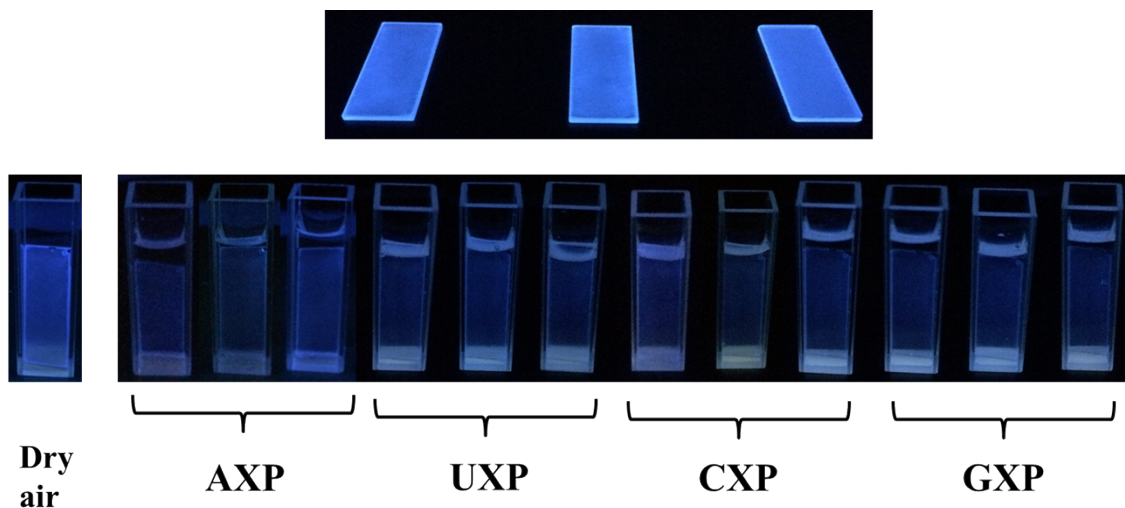
**Fig. S3** Optical photographs of the thin film under 254 nm UV irradiation. all the solution is $10^{-4}$ M nucleotides under physiological conditions(10 mM HEPES, pH = 7.4)

**Table S1.** Fluorescence lifetimes of PBS(15%)-DES/LDH thin film with 300 nm excitation

| PBS(15%)-DES/LDH thin film | Emission peak | $<\tau_i>$(ns)[a] | $A_i$(%) | $<\tau>$(ns) | $\chi^2$ [b] |
|---|---|---|---|---|---|
| In dry air | 342 nm | 0.503 | 86.12 | 0.711 | 1.187 |
| | | 2.004 | 13.88 | | |
| | 402 nm | 0.932 | 58.87 | 3.403 | 1.413 |
| | | 6.941 | 41.13 | | |
| In ATP solution | 342 nm | 1.203 | 59.49 | 1.452 | 1.133 |
| | | 1.817 | 40.51 | | |
| | 402 nm | 1.369 | 86.77 | 1.700 | 1.135 |
| | | 3.867 | 13.23 | | |

[a] $\tau_i$ (i = 1, 2, 3) is the fitted fluorescence lifetime. $A_i$ is the percentage of $\tau_i$ in the double-exponential case, $<\tau> = A_1\tau_1 + A_2\tau_2 + A_3\tau_3$; $A_1 + A_2 + A_3 = 1$.) [b] The goodness-of-fit is indicated by the value of $\chi2$.
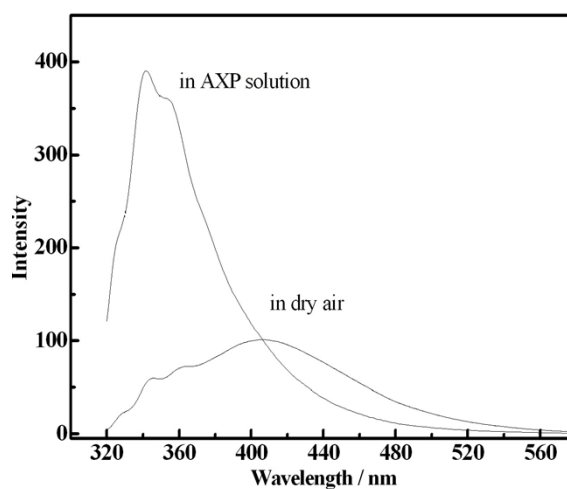


**Fig. S4**. The fluorescence spectra of PBS(15%)-DES/LDH thin film in the mixture solution of AXP ($10^{-4}$M) under physiological conditions (10mM HEPES, pH = 7.4)
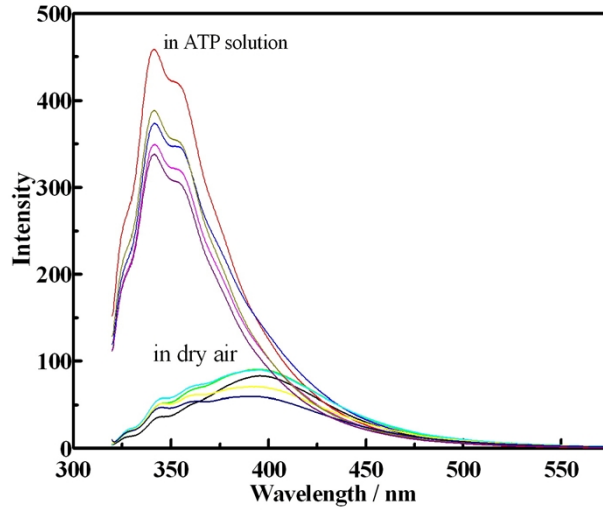
**Fig. S5.** Fluorescence response recycles of PBS(15%)-DES/LDH thin film to ATP soultion ($10^{-4}$M) under physiological conditions(10 mM HEPES, pH = 7.4)
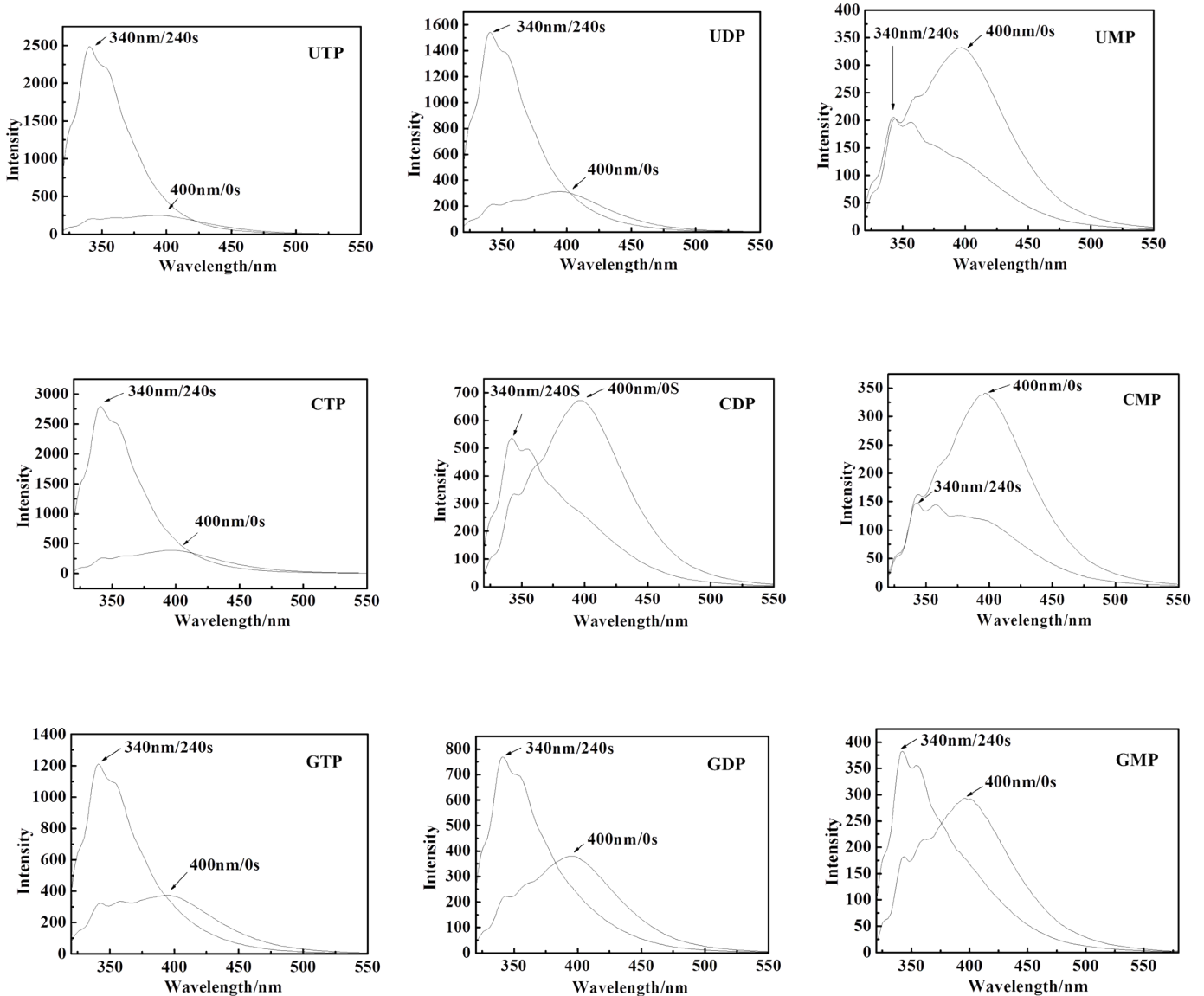
**Fig. S6**. The fluorescence spectra of PBS(15%)-DES/LDH thin film with nucleotides($10^{-4}$M) under physiological conditions(10mM HEPES, pH = 7.4)

**Table S2**.The $I_{342}/I_{402}$ ratio of PBS(15%)-DES/LDH thin film for sensing the nucleotides solution ($10^{-4}$M)

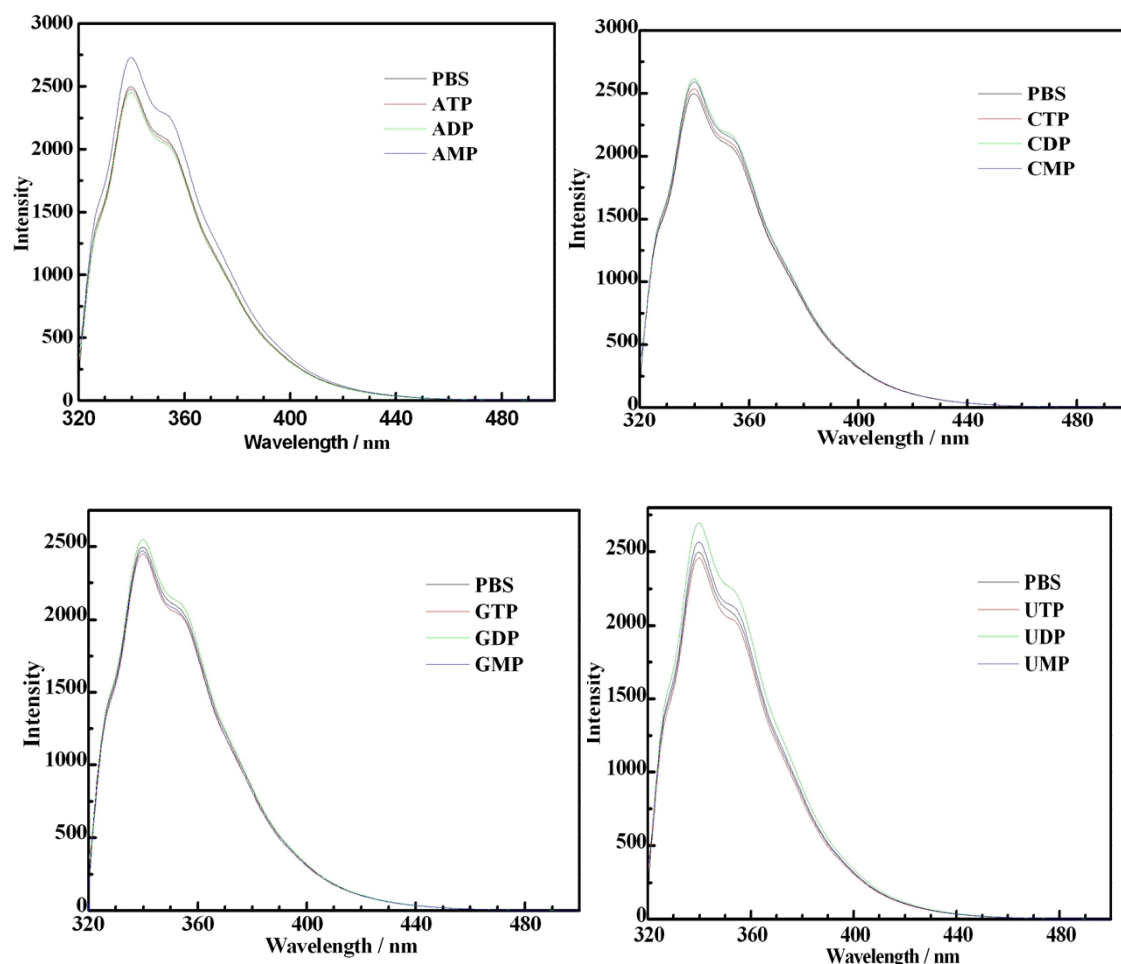| nucleotides | $I_{402}$ | $I_{342}$ | $I_{342}/I_{402}$ |
|---|---|---|---|
| UTP | 245 | 2480 | 10.12 |
| UDP | 307 | 1540 | 5.02 |
| UMP | 329 | 197 | 0.60 |
| CTP | 386 | 2784 | 7.21 |
| CDP | 667 | 523 | 0.78 |
| CMP | 337 | 140 | 0.42 |
| GTP | 367 | 1202 | 3.76 |
| GDP | 374 | 766 | 2.05 |
| GMP | 291 | 374 | 1.28 |

**Fig. S7.**The fluorescence spectra of PBS ($10^{-4}$ M) and nucleotides($10^{-4}$ M) mixture solution under physiological conditions (10 mM HEPES, pH = 7.4)
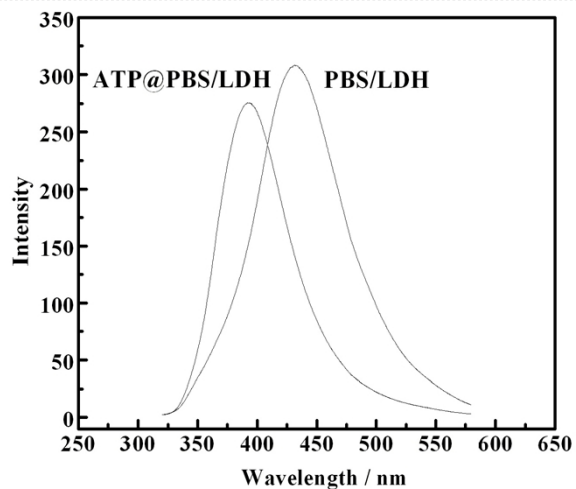


**Fig. S8.** The fluorescence spectra of PBS/LDH and ATP@PBS/LDH under physiological conditions(10 mM HEPES, pH = 7.4)

**Reference**

[1] Gursky J A, Blough S D, Luna C, Gomez C, Luevano A N, Gardner E A. Particle-particle interactions between layered double hydroxide nanoparticles. *J. Am. Chem. Soc*., 2006, **128**, 8376.