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Comparison of the Ultrafast Optical Phenomena in Thin Films of Eosin Y (EY) and Palladium (II) octa ethylporphyrin (PdOEP) Sensitizers and Bis(terpyridine-4'-yl) terthiophene Annihilator for Optoelectronic Applications

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INTRODUCTION & AIM

Ultrafast photophysical processes in thin films play an important role in high-performance optoelectronic devices such as LEDs, photodetectors, and photocatalytic systems. Triplet sensitizers like Eosin Y (**EY**) and Palladium(II) octaethylporphyrin (**PdOEP**) generate long-lived triplet states that transfer energy to the annihilator bis(terpyridine-4′-yl) terthiophene (**T**) [1,2]. Polymer thin films offer stability and device compatibility, but efficient triplet transfer can be limited by aggregation, restricted molecular mobility, and triplet quenching [3–5]. **PdOEP** provides high intersystem crossing efficiency, while EY is widely available and cost-effective. This study compares **EY+T** and **PdOEP+T** thin films prepared via spin-coating to investigate how sensitizer choice, solvent, film morphology, and aggregation influence triplet formation and energy transfer, providing guidance for optimizing solid-state optoelectronic and photonic devices.

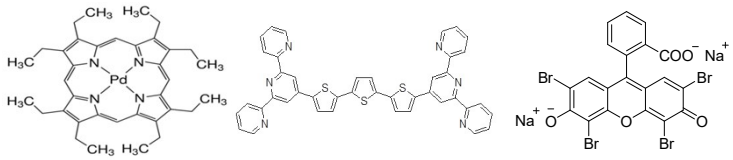

Figure 1. Molecular structure of **PdOEP, T,** and **EY**

Steady State UV/Vis &Fluorescence

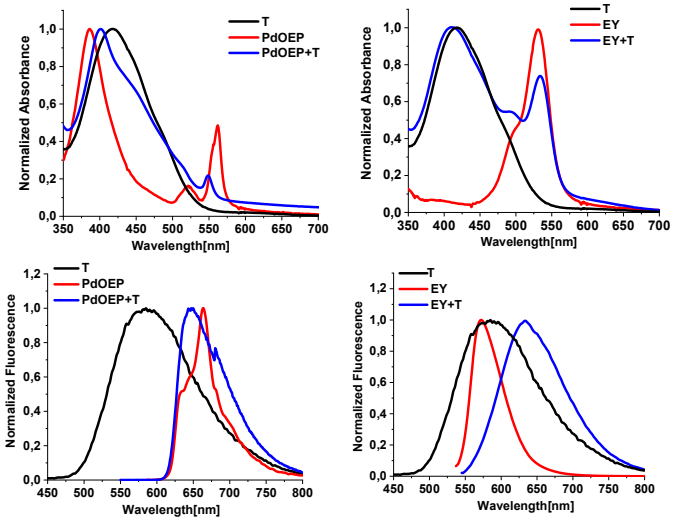

Figure 2. Normalized UV/Vis absorption and normalized emission spectra of **T**, **PdOEP**, **EY**, **PdOEP+T** (ratio 1:4) and **EY+T** (ratio 1:4) in thin film (casted 1000 rpm, 30 s on to quartz glass substrate). Excitation wavelength was set to the absorption maximum (λ_{exc}= 418, 535,548 and 562 nm).

Transient Absorption (TA)

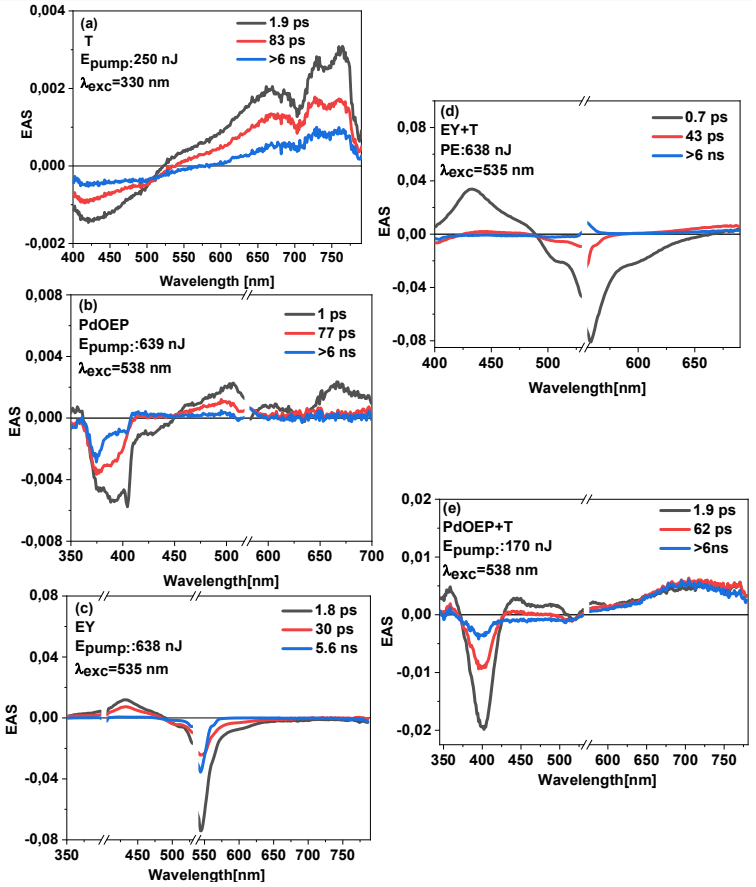

Figure 3: (a) Spectral profiles of **T, PdOEP, PdOEP+T** (1:4) **and EY+T** (ratio 1:4) in thin film, i.e. the Evolution Associated Spectra (EAS), extracted from the TA spectrotemporal evolution by global analysis method observed short, intermediate and long delay time. The wavelength region between 538 and 560 nm (in panels b, c, d and e) was removed from the plot because of its overlap with scattered pump light residues.

Table 1. Steady state UV/Vis absorption and emission maxima and time constants τ_i (ps and ns) obtained by the Global Analysis of the TA spectra of **T**, **PdOEP**, **EY**, **PdOEP+T** and **EY+T** thin film for short, intermediate and long delay times.

Sample	E_{pump} (nJ)	τ_1 (ps)	τ_2 (ps)	τ_3 (ns)	λ_{abs} [nm]	λ_{exc} [nm]	λ_{em} [nm]
T	250	1.9	83	>6	418	418	585
PdOEP	639	1.1	77	>6	385,521,562	562	664
PdOEP+T	170	1.9	62	>6	401,548	548	646
EY	638	1.8	30	5.6	531	535	572
EY+T	638	0.7	43	>6	410,494,535	535	634

CONCLUSION

- We observed faster decay for **EY+T** mixture than **PdOEP+T** in TA spectra.
- The red-shift in fluorescence spectra of **EY+T** indicates molecular interactions that could promote triplet exciton formation and energy transfer.
- These results demonstrate the effectiveness of **EY** and **PdOEP** as sensitizers for triplet excitons generation and the effective energy transfer to **T**.
- **EY+T** shows faster triplet decay and stronger quenching, while **PdOEP+T** has longer-lived triplets. The red-shifted **EY+T** fluorescence indicates molecular interactions that may enhance triplet formation and energy transfer, guiding optimization of solid-state optoelectronic devices.

REFERENCES

1-Rodríguez H.B., San Román E., Duarte P., Machado I.F., Vieira Ferreira L.F., *Photochem. Photobiol.*, 2012, 88, 831.
2-Yee E.H., Kim S., Sikes H.D., *Polym. Chem.*, 2021, 12, 2881.
3-Mikhnenko O.V., Blom P.W.M., Loi M.A., *Phys. Chem. Chem. Phys.*, 2011, 13, 14453.
4-Jiang X., Guo X., Peng J., Zhao D., Ma Y., *ACS Appl. Mater. Interfaces*, 2016, 8, 11441.
5-Pedrini J., et al., *J. Photonics Energy*, 2018, 8, 022005.

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