

Comprehensive molecular design aimed at high-performance organic light-emitting diodes

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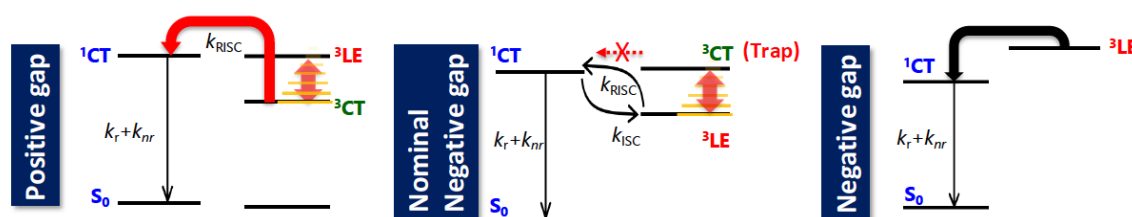
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Abstract

In the last 10 years, there have been a wide variety of studies on thermally activated delayed fluorescence (TADF)-OLEDs based on the unlimited possibilities of TADF molecular design¹. Further, hyperfluorescence (HF)-OLEDs have been developed since they can realize the compatibility of high efficiency with narrow spectral width, which is ideal for practical display applications. The advanced HP-OLEDs realized high light-emitting performance by engineering host, TADF, and terminal emitter (TE) molecules, respectively. In this talk, we mention the comprehensive design principle for the materials used in HF-OLEDs by focusing on fast T-S upconversion, very small S-T gap, efficient FRET, GSP, and escaping carrier trapping aimed at high-performance OLEDs²⁻⁵. Further, we mention that high performance has been achieved through sophisticated molecular design based on various electron-donating and -accepting units, which control electrical conduction, exciton generation, charge separation processes, and even spontaneous dipole orientation in thin films.

From the aspect of charge transfer phenomena, we mention the improvement of the efficiency and durability of organic devices, clarify the correlation between individual molecular design and macroscopic device characteristics, and provide an overview of the future development of organic optoelectronic devices⁶.

- [1] T. Uoyama, et al., *Nature*, **492**, 234 (2012)
- [2] C.-Y. Chan et al., *Nature Photon.*, **15**, 203 (2021)
- [3] Y.-T. Lee et al., *Adv. Elect. Mater.*, **7**, 2001090 (2021)
- [4] M. Tanaka et al., *ACS Appl. Mater. & Inter.*, **12**, 50668 (2020)
- [5] Y.-T. Lee et al., *Nature Commun.*, **15**, 3659 (2024)
- [6] S. Kondo, C. Adachi et al., *Nature Commun.*, **15**, 8115 (2024)



Biography



Prof. Chihaya Adachi obtained his doctorate in Materials Science and Technology in 1991 from Kyushu University (KU), Japan. Before returning to Kyushu University as a professor, he held positions as a research chemist and physicist in the Chemical Products R&D Center at Ricoh Co., a research associate at Shinshu University, a research staff at Princeton University, and a professor at Chitose Institute of Science and Technology. He became a distinguished professor at KU in 2010, and his current posts also include the director of Center for Organic Photonics and Electronics Research (OPERA). His research has been concentrated on organic synthesis, device fabrication and optical and electrical device characterization of organic semiconductors. He has been serving as an editor of “Organic Electronics” (Elsevier) (2007-2019) and CCS Chemistry (2019-). His publications include over 730 research papers.

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