Phosphorescent Pt(II) and Au(III) Complexes and Deuterated Materials for Applications in Organic Light-Emitting Diodes (OLEDs)

Kobe Man-Chung Tang
Institute of Materials Research, Tsinghua Shenzhen International School, Tsinghua University, China
E-mail: *kobetang2021@sz.tsinghua.edu.cn*

Open TASQ seminar

Monday June 2nd, 2025, 12.00 a.m. CEST,
Library of Faculty of Chemistry

The development of high-efficiency, stable, and long-lived organic light-emitting diodes (OLEDs) remains a critical challenge in display and lighting technologies. This talk highlights recent advances in the design and synthesis of phosphorescent transition metal complexes, specifically platinum(II) (Pt(II)) and gold(III) (Au(III)), as sensitizer emitters for OLEDs. These complexes exhibit unique photophysical properties, including tunable emission colors, high quantum yields, and short excited-state lifetimes, which are advantageous for mitigating Froster Rasonance Energy Transfer (FRET) from phosphors sensitizer to teminal emitter and enhancing device efficiency.

Additionally, we explore the integration of deuterated organic materials, including exciplex host and MRTADF emitter into OLED architectures to improve operational stability. Deuteration reduces the vibrational energy loss in host and emitter molecules, thereby suppressing non-radiative decay pathways and extending device lifetimes. By combining Pt(II) and Au(III) phosphors with deuterated host materials, we demonstrate synergistic improvements in OLED performance and prolonged operational LT90 (>1000 hours at 1000 cd/m²) under TTU OLED structures. This work underscores the potential of heavy-metal emitters and deuterated materials in next-generation OLEDs for displays, solid-state lighting, and emerging applications in flexible and wearable electronics.

References:

[1] L.K. Li, M.-C. Tang, S.L. Lai, M. Ng, W.K. Kwok, M.Y. Chan, V.W.W. Yam, *Strategies towards rational design of gold(III) complexes for high-performance organic light-emitting devices*, Nature Photonics **2019**, 13, 185-191, https://doi.org/10.1038/s41566-018-0332-z.

[2] M.-C. Tang, M.Y. Leung, S. Lai, M. Ng, M.Y. Chan, V.W.W. Yam, *Realization of Thermally Stimulated Delayed Phosphorescence in Arylgold(III) Complexes and Efficient Gold(III) Based Blue-Emitting Organic Light-Emitting Devices*, J. Am. Chem. Soc. **2018**, 140, 13115-13124, https://doi.org/10.1021/jacs.8b09205.

[3] S. Jung, W.L. Cheung, S. Li, M. Wang, W. Li, C. Wang, X. Song, G. Wei, Q. Song, M. Ng, S.S. Chen, M.-C. Tang, *Enhancing operational stability of OLEDs based on subatomic modified thermally activated delayed fluorescence compounds*, Nature Communications **2023**, 14, 6481, https://doi.org/10.1038/s41467-023-42019-6.

[4] L. Xing, J. Wang, W.C. Chen, B. Liu, G. Chen, X. Wang, J.H. Tan, S.S. Chen, J.X. Chen, S.M. Ji, Z.J. Zhao, M.-C. Tang, Y.P. Huo, *Highly efficient pure-blue organic light-emitting diodes based on rationally designed heterocyclic phenophosphazinine-containing emitters*, Nature Communications **2024**, 15, 6175, https://doi.org/10.1038/s41467-024-50370-5.

[5] W. Yuan, T. Huang, J. Zhou, M.-C. Tang, D. Zhang, L. Duan, *High-efficiency and long-lifetime deep-blue phosphorescent OLEDs using deuterated exciplex-forming host*, Nature Communications 2025, 16 (1), 1-10, https://doi.org/10.1038/s41467-025-59583-8.