

Carbene-metal amides: an emerging class of highly efficient OLED emitters

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Linear two-coordinate metalloorganic complexes composed of coinage metals (Cu, Ag, Au), as well as electron accepting carbene and electron donating amide ligands have recently attracted great attention as highly promising low-cost emitters for organic light emitting diodes (OLEDs). These so called carbene-metal-amides (CMAs) possess ability of triplet excited state harvesting, which are enabled by efficient thermally activated delayed fluorescence (TADF) mechanism. Unique structural properties of this emitter class allow attainment of near-unity photoluminescence quantum yields and sub microsecond emission lifetimes, making compounds highly suitable for electroluminescence applications [1].

Here we explore structural modifications of CMAs, by introducing novel carbene chemical fragments. Namely, thiazoline and imidazole ligands were used. The corresponding CMAs were synthesized using Cu or Au central metal and carbazole-based amide electron donors.

CMAs based on thiazoline ligands exhibit dual emission from monomer and excimer states. When incorporated in OLEDs, this results in efficient single-emissive-layer white electroluminescence [2]. In the case of imidazole ligands yet unprecedented photophysical behaviour was observed, when auxiliary electron acceptors were introduced at the periphery of carbene moiety. Specifically, through-space charge transfer process was enabled, substantially decreasing the singlet-triplet energy gap thus lowering thermal activation barrier for TADF process [3].

Our results expand theoretical understanding and practical application directions for CMA emitters.

References

1. Di et al., Science, 2017, 356, 159.
2. Ruduss et al., ACS Appl. Mater. Interfaces 2022, 14, 15478.
3. Ruduss et al., Inorg. Chem. 2022, 61, 2174.