



第282回 OPERA研究交流セミナー
第273回 ISITマテリアルズ・オープン・ラボセミナー
第340回 未来化学創造センターセミナー



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Impurities in Organic Semiconductors Induce Persistent Afterglow

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Several recent reports suggest that arylboronic esters can exhibit room temperature phosphorescence (RTP), an optical property that is desirable for applications in security printing, oxygen sensing, and bioimaging. These findings challenged the fundamental notion that heavy elements or changes in orbital symmetry were required for intersystem crossing to occur in organic compounds. As we had not observed long afterglow in the many arylboronic esters we had synthesized over many years, we suspected that the RTP observed in these systems had a simpler explanation: the materials reported were impure. Herein, we synthesized numerous arylboronic esters that were previously reported to show RTP, and carefully purified them by column chromatography, recrystallization, and sublimation. We re-examined their photophysical properties alongside single-crystal X-ray diffraction analysis and detailed theoretical studies. While several of these compounds showed long afterglows as crude products, none of them showed persistent RTP after careful purification. We also successfully isolated the impurity 4-amino-3,5-bis(pinacolatoboryl)benzonitrile (2), identifying it as the impurity responsible for inducing delayed fluorescence in 3,5-bis(pinacolatoboryl)benzonitrile (1). Doping 1 with 1.0 mol % 2 led to a persistent afterglow with a lifetime of 67 ms, which is mediated by a dimer charge transfer state. Our findings call for a re-examination of previous studies reporting RTP from arylboronic esters, highlight the importance of careful purification in photophysical research, and provide a practical strategy for designing organic materials with a long afterglow.

References:

Hudson et al., *Angew. Chem. Int. Ed.* 2026, 65, e24578
Hudson et al., *J. Am. Chem. Soc.* 2024, 146, 31507–31517
Hudson et al., *Angew. Chem. Int. Ed.* 2024, 63, e202319089

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