

Near-infrared thermally activated delayed fluorescence and heavy-atom effect in organic exciplexes

Radosław Rogowski¹, Illia E. Serdiuk¹, Michał Mońka¹, Daria Grzywacz^{1,2},
Beata Liberek², Piotr Bojarski¹

¹Faculty of Mathematics, Physics and Informatics, University of Gdańsk,
Wita Stwosza 57, 80-308 Gdańsk, Poland

² Faculty of Chemistry, University of Gdańsk, Wita Stwosza 63, 80-308 Gdańsk, Poland

The described research concerns the spectral studies of novel exciplex emitters for near-infrared (NIR) OLED (Organic Light Emitting Diode). Through the mechanism of thermally activated delayed fluorescence (TADF) emitters can effectively utilize both singlet and triplet excitons formed in a 1:3 ratio due to the spin statistics during electrical excitation. Exciplex TADF systems offer higher stability and efficiency, but their examples with high quantum yields in NIR range are very scarce. Even more challenging is to achieve high reverse intersystem crossing rate (rISC) in this range, which is the key to fast TADF and high OLED stability.

The aim of this research is to explore the photophysical properties of an exciplex system comprising DBP fluorophore as a donor and dicyanophenazine-based TADF emitter as an acceptor (Figure 1). In our previous studies we have shown that rISC in such a TADF emitter can be finely enhanced by the heavy atom effect. Therefore, we further explore the effect of bromine substitution on the discovered exciplexes.

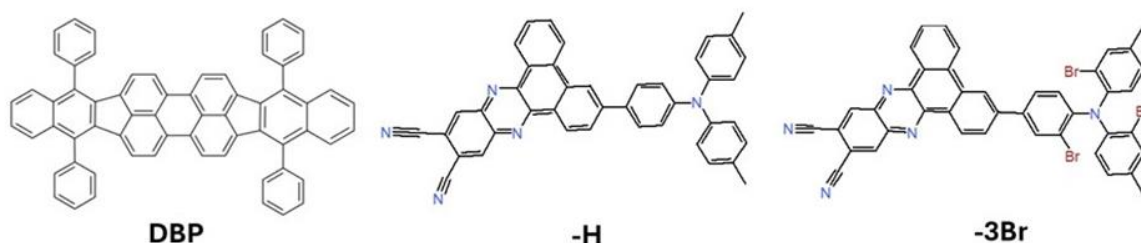


Figure 1. Structures of DBP and TADF emitters -H and -3Br.

Our results provide experimental and theoretical (via DFT calculations) proof of the exciplex formation. Studied systems show emission maximum in the 704 nm range with the PLQY of 25%. Both systems show TADF in the 10-1000 μ s time region. The studied photophysical constants and the emission characteristics of the exciplexes aim to determine their good potential for OLED applications, whilst DFT predicted electronic features shed the light on the TADF mechanism.

Acknowledgements: Financial support from the National Centre for Research and Development (NCBR) within the LIDER XI grant LIDER/47/0190/L-11/19/NCBR/2020 is gratefully acknowledged. Quantum chemical calculations were performed on the computers of the Wrocław Centre for Networking and Supercomputing (WCSS), Poland.

corresponding author: r.rogowski.765@studms.ug.edu.pl