Controlling Molecular Orientation to Improve Photon Upconversion Efficiency

([1]*Center of Molecular Systems, Kyushu University*) ○Catherine Helenna Mulyadi,[1] Masanori Uji,[1] Nobuhiro Yanai,[1]

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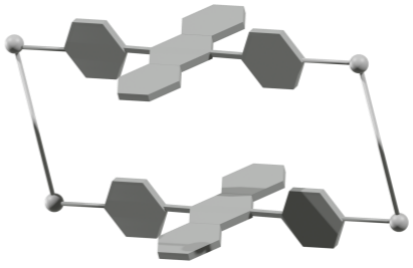
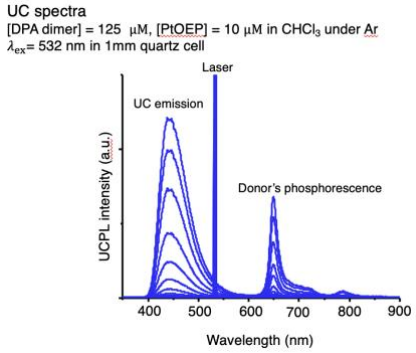
Triplet-triplet annihilation photon upconversion (TTA-UC) is a promising research field for various photonic applications due to tunable spectral range and non-coherent light source utilization. Recent research has been aiming to enhance TTA-UC performance, such as the UC efficiency (η_{UC}), which is crucial especially in energy-harvesting related applications. The UC efficiency is comprised of spin statistical factor (f) and quantum yield of energy transfer processes (Φ_{ISC}, Φ_{TTET}, Φ_{TTA}) and fluorescence (Φ_{FL}), as described in the equation below:

$$\eta_{\mathrm{UC}} = f\Phi_{\mathrm{ISC}}\Phi_{\mathrm{TTET}}\Phi_{\mathrm{TTA}}\Phi_{\mathrm{FL}}$$

According to the research by Bossanyi et al., the spin statistical factor, the probability of singlet state acceptor formation after TTA process, can be improved by fixating parallel orientation of the acceptor molecules.[1] With this molecular design, the f value can increase significantly from 40% to 66.7% in solution system. Therefore, this research tries to prove this theory by synthesizing a parallel-oriented dimer of a widely known acceptor molecule (9,10-diphenylanthracene, DPA) with Schiff-base linker then observing its optical properties. The DPA dimer is successfully synthesized, and its optical properties resemble those of the single DPA molecule. In addition, the upconverted fluorescence of DPA dimer was observed at 446 nm using PtOEP as the donor molecule. We'll report the detailed UC parameters in this presentation.





1) David G. Bossanyi, Yoichi Sasaki, Shuangqing Wang, Dimitri Chekulaev, Nobuo Kimizuka, Nobuhiro Yanai, and Jenny Clark, *JACS Au* **2021** *1* (12), 2188-2201.