Simultaneous Measurement of TCSPC Fluorescence Lifetime and RIPT Transient Absorption with an Oscilloscope-Based Single Instrument

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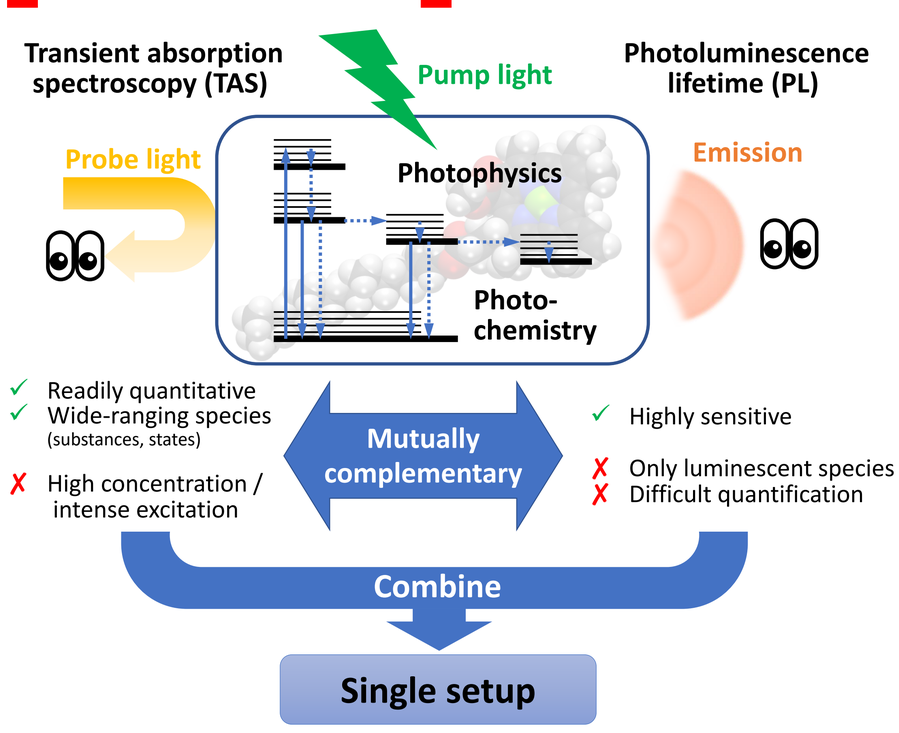
Abstract

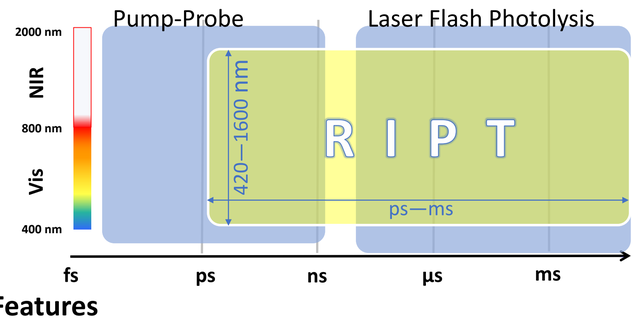
Transient absorption spectroscopy (TAS) and photoluminescence lifetime (PL) measurement are both powerful methodologies for elucidating dynamics of short-lived species in excited electronic states. While both methods could be utilized to observe the same targets and phenomena, they do not always substitute for one another in practice. In this study, recently developed our unique method for TAS, namely, randomly-interleaved pulse train (RIPT) method has been applied in combination with time-correlated single photon counting (TCSPC) method for the PL measurement by taking advantage of similarity in data processing of both methods. We have successfully developed the TAS-PL measurement system in a single instrument, and demonstrated its utility by measuring TAS and PL of photoexcited tris(2,2'-bipyridyl)ruthenium(II) complex and zinc(II) tetraphenylporphyrin.

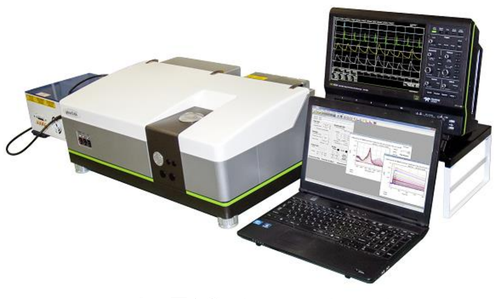
Motivation



What's RIPT?

Randomly-Interleaved Pulse Train method, a novel and unique technique for TAS from Unisoku Co., Ltd





picoTAS, the RIPT-based TAS system released from Unisoku Co., Ltd., Japan.

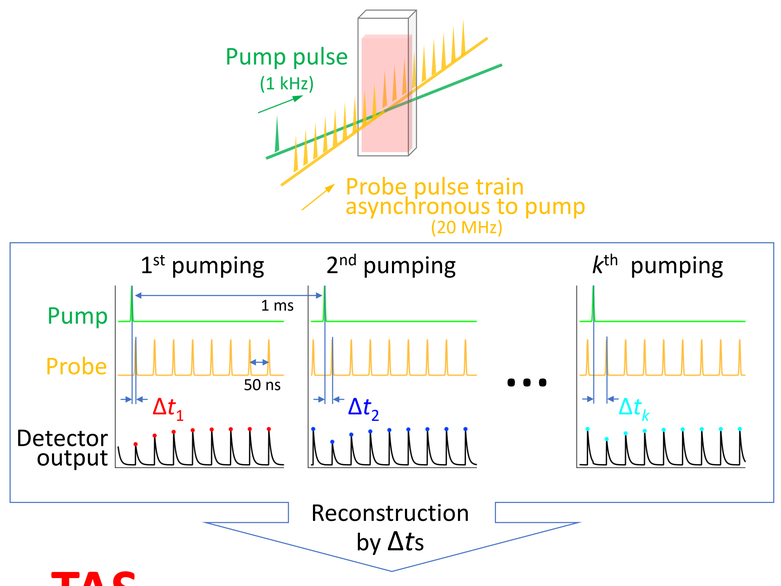
Features

✓ Extensive and seamless coverage of spectral and temporal regions
✓ Excellent emission-background elimination

Methodologies

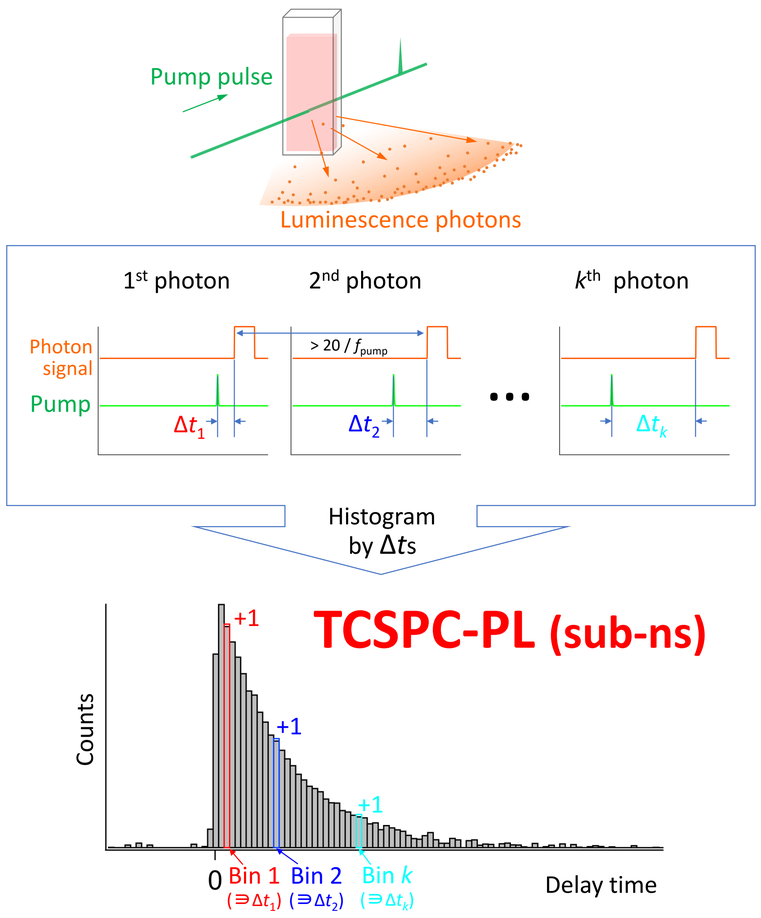
RIPT

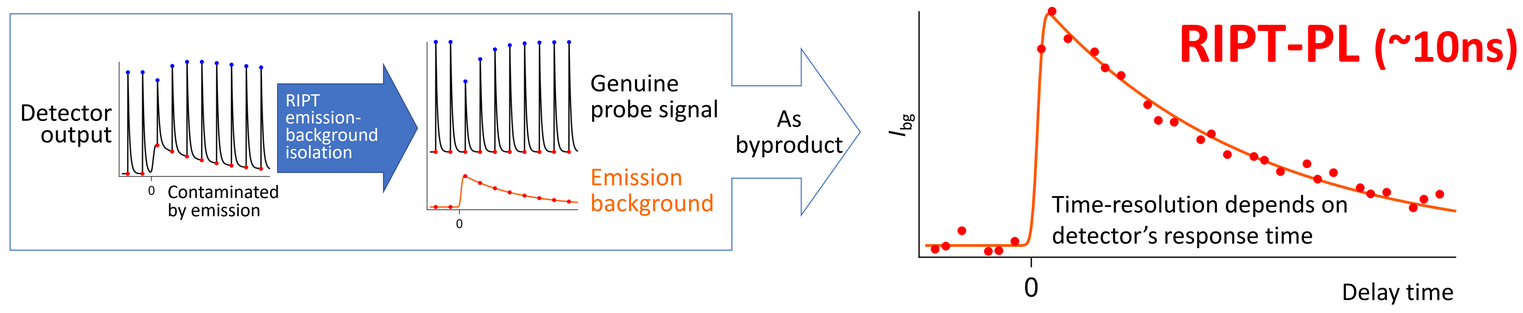
Randomly-Interleaved Pulse Train method



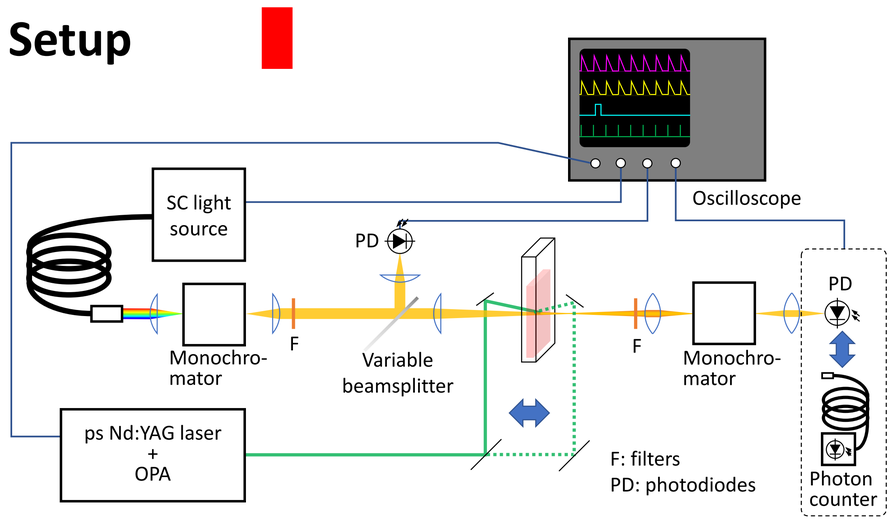
TCSPC

Time-Correlated Single-Photon Counting method



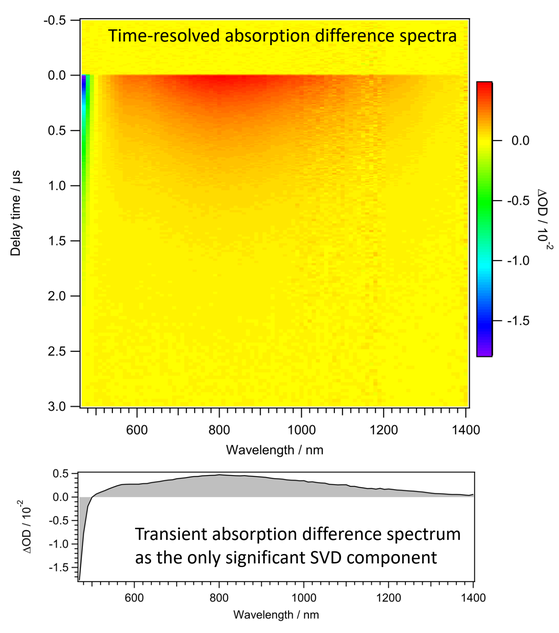


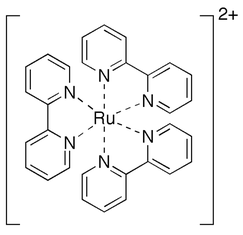
Setup

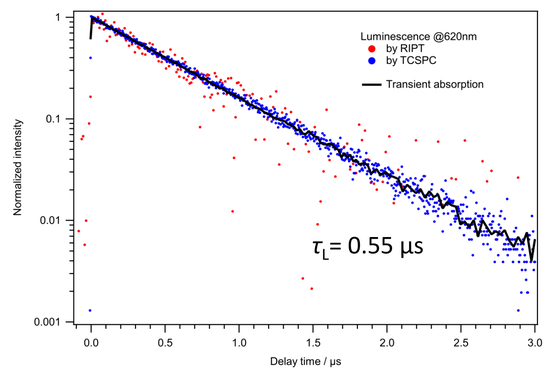


Results & Discussion

Sample: Aqueous solution of tris(2,2'-bipyridyl)ruthenium(II) chloride
Molecular oxygen is purged by argon gas bubbling.
Excitation: 460 nm

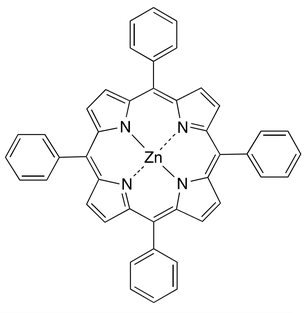


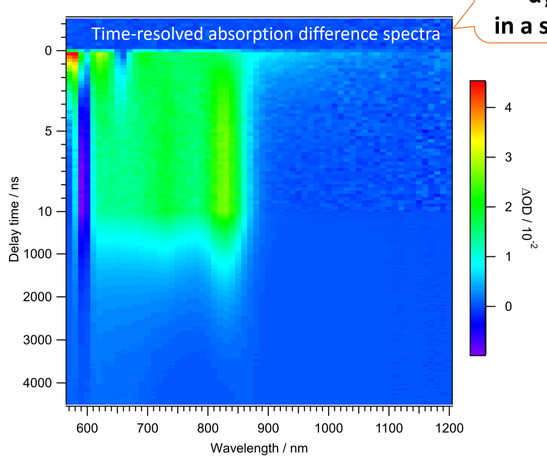


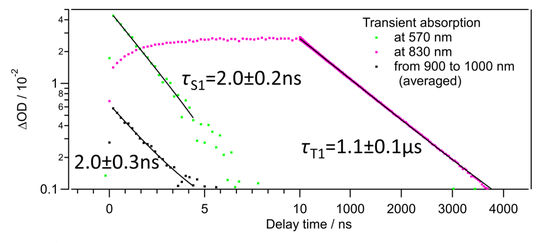


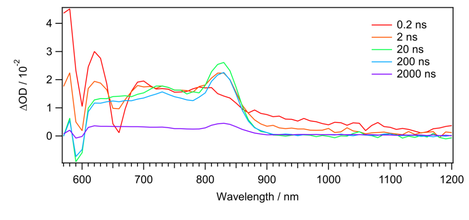
Sample: Zinc(II) tetraphenylporphyrin in acetonitrile
Molecular oxygen is purged by argon gas bubbling.
Excitation: 560 nm

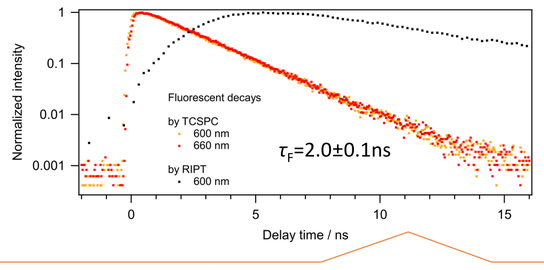
Excited singlet and triplet dynamics obtained in a single measurement!











RIPT-PL measurement does not resolve the fast dynamics.
TCSPC-PL has made fast luminescent dynamics accessible!

Conclusion

✓ TCSPC-based sub-ns photoluminescence lifetime measurement functionality was implemented in RIPT-based TAS apparatus by just adding a photon counter.

✓ It has been confirmed that the lifetimes of transient species obtained by transient absorption by RIPT, luminescence lifetime by RIPT and TCSPC are all consistent.

Acknowledgement

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