



ENS – IISER Network / BIOSANTEXC Project

Internship Proposal Form France to India

(Discipline/Field name)

Chemistry

Internship title: Probing interorganelle communication using organic long-lived emissive probes through time-resolved imaging

Keywords related with the subject (minimum 3): Spectroscopy, Delayed fluorescence, Intracellular dynamics, Time-resolved imaging

Name of the laboratory(ies): Functional Materials Laboratory

Name of the internship supervisor(s): Prof. Abhijit Patra

Email(s) of the supervisor(s): abhijit@iiserb.ac.in

Prerequisites for the internship: Interest in spectroscopy, imaging, cell culture; Hands-on experience in fluorescence measurements, organic synthesis and cell culture could be advantageous but not mandatory.

Requested level: (For IISER Bhopal, it could be French Student M1/M2 level): (For French Student M1/M2 level)

Foreseen internship dates: May 2025

Internship type (refer to page 1):

☒ 3–6-month internship ☐ Research stays ☐ 6+6 months internship

For 3 to 6 months internships, please indicate the desired duration: 3 months

For 6+6 months internships, please also fill in:

- **Name of the internship co-supervisor:**
- **Name of the co-supervisor's laboratory/entity:**
- **Email of the co-supervisor:**

Internship proposal (description and expected training outcomes / half page min, 1 page max) (mandatory):

Luminescence imaging is one of the most potent and non-invasive analytical tools for visualizing intracellular organelles, their dynamic motions, microenvironmental changes, and monitoring the specific levels of various bioanalytes.¹ All organic thermally activated delayed fluorescent (TADF) and room temperature phosphorescent (RTP) materials have emerged as potential candidates for timeresolved luminescence imaging (TRLI) for autofluorescence-free bioimaging at the micro-millisecond timescale.² In this context, the introduction of donor-acceptor (D-A) architecture with facile intramolecular charge transfer (ICT) has been employed to reduce the singlet-triplet energy gap (ΔE_{ST}), resulting in a stable triplet state under ambient conditions.^{1a,2} We have developed D-A-type long-lived emissive probes, using the rigid acceptor core of coumarin, substituted with nonplanar aromatic donors like diphenylamine, and triphenylamine, respectively (Fig. 1). The presence of multiple substitutional sites in the coumarin unit makes it suitable for functionalization with different organelle targeting units. During this internship program, we aim to characterize the long-lived emission properties of the materials through steady-state and time-resolved spectroscopy. The cytocompatible probe(s) will be used for specific organelle-targeting using fluorescence and timeresolved luminescence imaging. The organelle dynamics and their subsequent microenvironmental changes will also be probed through TRLI. The proposed project is likely to provide hands-on experience on developing new fluorescent probes for intracellular imaging, fluorescence spectroscopic measurements, cell culture, and time-resolved imaging for the elucidation of the structure-property relationship of long-lived emissive probes for intracellular dynamics.

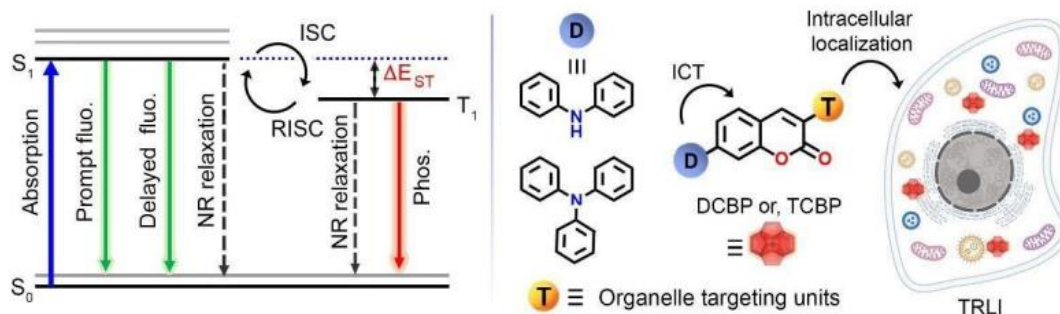


Fig. 1: Schematic representation of simplified Jablonski diagram and the design principle of the coumarin-based donor-acceptor (D-A) probes and their potential application for intracellular bioimaging using time-resolved luminescence imaging (TRLI) are indicated.

Learning outcomes

- (i) Steady-state and time-resolved spectroscopic characterizations such as UV- Vis, fluorescence spectroscopy, and time-correlated single photon counting (TCSPC)
- (ii) Basics of cell culture and cell imaging; fluorescence and time-resolved imaging
- (iii) Probing the organelle dynamics using TRLI

References

1. (a) Jaiswal, S.; Das, S.; Kundu, S.; Rawal, R.; Anand, P.; Patra, A. *J. Mater. Chem. C*, **2022**, *10*, 6141; (b) Kundu, S.; Das, S.; Jaiswal, S.; Patra, A. *ACS Appl. Bio Mater.* **2022**, *5*, 3623.
2. (a) Das, S.; Kundu, S.; Sk, B.; Sarkar, M.; Patra, A. *Org. Mater.*, **2021**, *3*, 477; (b) Kundu, S. ; Sk, B. ; Saha, N. ; Das, S. ; Dutta, T. K. ; Batra, A. ; Tomar, R. S. ; Patra, A. *ACS Materials Lett.*, **2023**, *5*, 27.

Internship conditions:

- monthly stipend of INR 15,000
- Accommodation will be provided on the IISER Bhopal campus
- cultural tour of nearby locations for ENS students during the stay.