INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: **DESIGN AND DEVELOPMENT OF AGGREGATION-INDUCED EMISSION BASED PROBES**

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SHORT ABSTRACT

Traditional organic fluorescent materials have a planar structure, in the dilute solution state, they have strong emission but show weak or no emission at a higher concentration, aggregated and in the solid-state. Decreasing fluorescence due to higher concentration is called concentration quenching (CQ), and this phenomenon is also referred to as aggregation-caused quenching (ACQ). Mostly, all traditional organic compounds have suffered from the notorious ACQ effect.

Recently a new type of non-planar and rotatable aromatic material has been reported, and they have precisely opposite emission properties to traditional materials. Non-planar organic compounds have extensively bright fluorescence in the aggregated state due to the prevention of π-π stacking, this phenomenon is termed as aggregation-induced emission (AIE). In the individual (soluble) state, the non-planar molecules were weakly emissive or non-emissive due to the intramolecular rotation or vibration. (IR or IV).

Pyrene is well known classical ACQ material, its emission quenches in the solid and aggregated state. In our first work, we generated AIE material from pyrene by incorporating different rotor groups and further these pyrene derivatives used as multi-responsive probes and in photodynamic therapy.

After that, we designed and synthesized AIEE active polymer from AIEE active monomer. Conjugated polymer PFTPBZ is used for receptor-free sensing of PA and TNT. AIEE state (LOD 0.47 μM) showed the lowest limit of detection compared to soluble or ACQ state (LOD 53.74 μM) for PA sensing. Therefore from our work, we have demonstrated that the AIEE state is more favourable than ACQ state for sensing applications.

In the next work, we reported that all non-planar molecules are not AIE active. For designing the AIE system, TICT effect should keep in mind because it also plays a crucial role. TICT active materials also can be used in stimuli sensors and secret ink. We successfully demonstrated a fluorometric probe for Nerve agent mimic.

Finally, we have synthesized three AIE materials PNH, PNM and PNB. Using synthesized AIE materials, we demonstrated wash-free imaging of pathogens. By judicially tuning organic materials, we reported selectively imaging and killing of bacteria (gram-positive and gram-negative) and fungus.