Rational Design and Paradigm Synthesis of Fluorescent Dyes for Reactive Carbon Species (RCS) and pH Imaging

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Optical imaging-based diseases diagnosis using molecular probes is recognized as an efficient, cost effective, advanced technology for next-generation diagnostic tools. Fluorescent imaging has recently taking a significant role in biomedical research. Examples include diagnosis of endoscopic tissue samples, minimally invasive image guided surgery and treatment planning. The abnormal level of important biomolecules including reactive carbon species and pH are related to several disease state including neurodegenerative diseases, diabetic, chronic hepatitis and cancer. Thus, to detect this abnormality in cells, imaging agents are the crucial. Monitoring the dysregulations of analytes by applying contrast agents leading to disease diagnosis.[1] To develop these agents, functional dyes have been considered a modern tool. Among several imaging agents reported to date for RCS and pH imaging, major contrast agents with low detection limit, poor biocompatibility, low resolution in imaging, high cost for synthesis and nonspecific targeting to sub-cellular level make them majorly unfit for fluorescent markers.

Among reactive carbon species, formaldehyde (FA) is one of the crucial bioanalyte as it is a reactive signaling bioactive small molecule that continuously produces through a number of different enzymatic pathways in the living cells[2]. Especially, elevated levels of FA are associated with several diseases ranging from neurodegenerative disorders, asthma and cancer[3]. Here, we target for specific sensing of endogenous FA in cancer cells with a single benzene or naphthalene ring based efficient "Turn-On" fluorescent probe resulting to eliminate the carcinogenic byproducts such as acroline and 3-buten -1-amine during Aza-cope based sensing strategy.[4] In addition, a novel synthetic route was adopted to render Pyrylium functional dye with high quantum yield in aqueous solution. This pH probe shows an exceptional turn-on pH response in the window of biological relevance both in solution state and live cells. It can monitor minute change of pH in cells during the treatment of chemo drugs or apoptotic agents in real time.

References

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