Biocompatible fluorescent probes emitting in the visible, near-infrared region, and beyond: From small molecules to supramolecular assemblies

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A new class of instruments for the quick detection and imaging of biological processes was made possible by the technical revolution of instrumentalism in molecular biology. Fluorescence is the most common technique for detecting the unique characteristics of deoxyribonucleic acid and ribonucleic acid sequences. The primary reason is the extensive wavelength range (400–900 nm) that this approach covers. The class of cyanines are among the most extensively used fluorescent dyes. Unbound, they generally look nonfluorescent in aqueous media. Energy loss owing to free rotation around the methine link between the two chromophores is a reasonable explanation for this phenomenon. When the aromatic system in the structure of the dye becomes planar and so fixed within the target binding sites, the probe acquires a strong fluorescence signal (Fig.1).

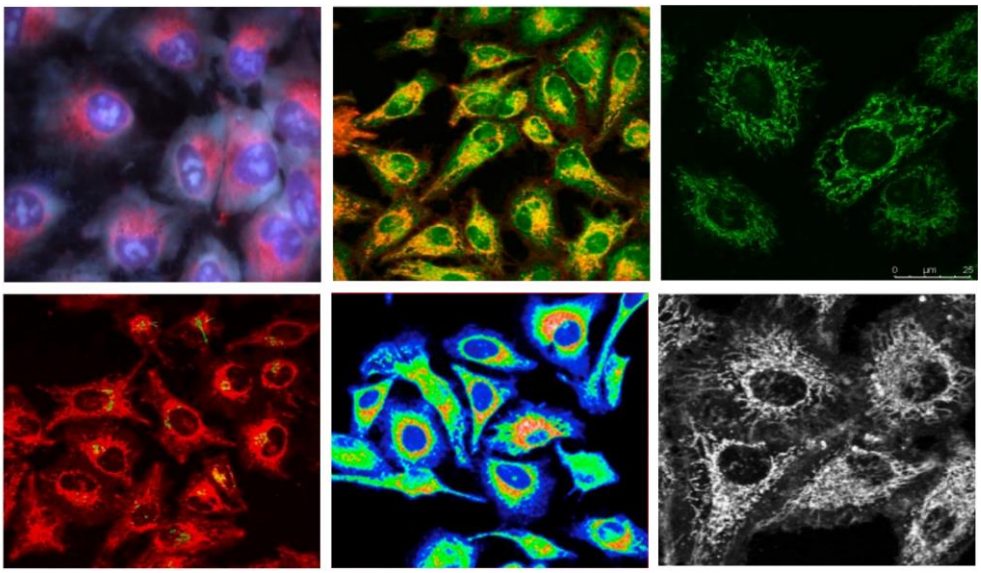

Figure 1. Fluorescence imaging on cells employing new generation of cyanine chromophores

Due to their great efficiency, selectivity, and reproducibility, as well as their safety, high-speed detection, and lack of radiation, fluorescence-based techniques are frequently utilized. In addition to the high fluorescence response, emerging fluorogenic substrates should possess a number of key properties, such as robust binding to biological components and minimum spectrum overlap with the target bio-objects. Other essential qualities involving binding selectivity, high molar extinction coefficients, good photobleaching stability, and low cytotoxicity are significant design criteria for such kind of compounds. Last but not least, the cost-effective manufacture of fluorescent probes is a significant characteristic.

Fluorescent imaging by means of flow cytometry and confocal microscopy is directly associated with one of the most important and hence rapidly increasing topics in biological research. Whether for diagnostic reasons, innovative medication development, quick detection techniques, or the tracking and imaging of biological objects and processes, these technologies are indispensable. Flow cytometers and confocal microscopes of the current generation provide the distinction and monitoring of different cellular populations and subpopulations, as well as cell sorting and purification. In order to evaluate their full potential, it is necessary to design innovative advanced fluorophores with enhanced performance and distinct spectra.

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