SL24

Advanced Bioimaging Research

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It is desirable that seeing into the body and cells is accomplished by using less-invansive techniques, without cutting into the body or isolating of cellular constituents. Therefore, techniques to visualize physiological or pathophysiological changes in the body and cells become increasingly important in biomedical sciences.

Compared to other technologies such as radioisotope labeling, MRI, ESR and electrochemical detection, fluorescence imaging has many advantages for this purpose, as it enables highly sensitive, less-invansive and safe detection using readily available instruments. Another advantage of fluorescence imaging we should emphasize here is that the fluorescence signal of a molecule can be drastically modulated, so that probes relying on “activation”, not just accumulation, can be utilized. Fluorescent probes based on small organic molecules have become indispensable tools in modern biology because they provide dynamic information concerning the localization and quantity of the molecules of interest, without the need of genetic engineering of the sample. Until the 1980s, however, fluorescence imaging was mainly applied to fixed samples owing to the lack of fluorescent chemosensors or probes, suitable for imaging in living cells. In this Annual Meeting, “fluorescent probes” are defined as molecules that react specifically with biological components such as Ca^{2+}, ROS, enzymes and receptors to induce a concomitant change of their photochemical properties (fluorescence intensity, excitation/emission wavelength, and so forth). Today, several design strategies for fluorescent probes, including photoinduced electron transfer (PeT), fluorescence resonance energy transfer (FRET), intramolecular charge transfer (ICT), and spirocyclization, are well established and have been applied to many probes. Some of them were developed in our laboratory. On the basis of these design principles, we have already developed so far above forty bioimaging probes, of which thirteen probes are now commercially available.

Thus, biofunctional species-reactive fluorescent probes which allow bioimaging with high spatial and temporal resolution in conjunction with fluorescence microscopy are useful for elucidation of biological functions. At the Meeting I will introduce molecular design of bioimaging probes, of which most are applicable to cellular or *in vivo* imaging.