

Novel Probes for Biomedical Diagnostics.

Zygmunt (Karol) Gryczynski

*Department of Physics and Astronomy, Texas Christian University, Fort Worth
Center for Fluorescence Technologies and Nanomedicine, UNTHSC, Fort Worth*

Detecting and monitoring activities of bio-molecules has been a central element of biomedical diagnostics from detecting diseases, pathogens, biohazard exposure, to DNA sequencing. Analytical optical methods today reach ultimately low concentrations down to a single molecule but in physiological conditions we reliably detect molecules of interest only at much higher microgram to nanogram level. The biggest hurdle is large level of background (autofluorescence) associated with any biological system that completely mask many physiologically important markers occurring at nanogram, picogram or even lower levels. Ultimately the background signal becomes a crucial factor limiting sensitivity for any diagnostic technology. There are two general approaches employed to enhance signal-to-background ratio; developments of new enhanced probes and developments of new approaches based on nanotechnology and photonics.

We will discuss three groups of probes that are developed in our laboratory and are most promising for practical applications.

- (1) Long-lived fluorescent dyes based on Azadioxatriangulenium structures. These are first organic dyes that offer red shifted emission and fluorescence lifetime of 20 ns.
- (2) Fluorescent nanodiamonds. These are first fluorescent nanoparticles that offer some excellent fluorescent properties and good biocompatibility. In contrast to semiconductor quantum dots this particles may enable practical applications in-vivo in cells, tissue, and organs.
- (3) Noble metal clusters. These are new organic-inorganic composites that offer excellent optical properties and microsecond emissive (fluorescence) lifetimes that may open the way for many practical applications.

Availability of such probes will have profound impact on molecular, cellular, and tissue imaging opening new technological possibilities for enhanced detection and FRET based applications.