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Nanosensor for *in vivo* analysis of a living cell

Scientists in the ORNL's Advanced Biomedical Science and Technology Group have developed nanosensors for *in situ* measurements of single living cell using antibody-based nanoprobes

Technical Concept

The nanosensors have probes with antibody receptors targeted against the analyte of interest. In a recent study, benzopyrene tetrol (BPT) was selected the analyte model system because this species has been used as a biomarker of human exposure to benzo[a] pyrene, a polycyclic aromatic hydrocarbon of great environmental and toxicological interest because of its mutagenic/carcinogenic properties. Nanoscale fiber probes (with 50-nm diameter) are fabricated them by pulling larger silica optical fibers using a laser-based pulling device.

To demonstrate proof of concept of single-cell measurements with antibody-based nanoprobes, experiments were performed on animal and human normal and tumor cells. The cells were first incubated with BPT prior to measurements. Interrogation of single cells for the presence of BPT was then carried out using antibody nanoprobes for excitation and a photometric system for fluorescence signal detection. The figure shows a photograph of an antibody-based Nan probe used to measure the presence of BPT inside a single cell. The small size of the nanoprobe allowed it to be manipulated to specific locations within the cell.

Development Approach

Traditional cellular analysis approaches involve "fixing" of the sample before analysis; this fixing procedure often destroys cellular viability and may significantly alter intracellular architecture as compared to the living state. Nanosensors could provide unique tools to investigate important biological processes at the cellular level *in vivo*. Not only can antibodies be developed against specific epitopes, but also an array of antibodies can be established, so as to investigate the overall structural architecture of a given protein. Finally, the most significant advantage of the nanosensors for cell monitoring is the minimal invasiveness of the technique. The integration of these advances in biotechnology and nanotechnology could lead to a new generation of nanosystems with unprecedented sensitivity and selectivity to probe molecular machines in subcompartments of living cells at the molecular level.

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