Nanosensors: Exploring Molecular Processes in a Single Living Cell

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ABSTRACT

This presentation describes the area of research related to the development of nanosensors and nanoprobes for *in vivo* analysis of a single cell. We have developed nanosensors for *in situ* intracellular measurements of single cells using antibody-based and enzyme-based nanosensors. In this work, we describe the development of nano-biosensors for *in situ* monitoring of single cells using biosensors having nanoprobes having 50-nm diameter (Figure 1).

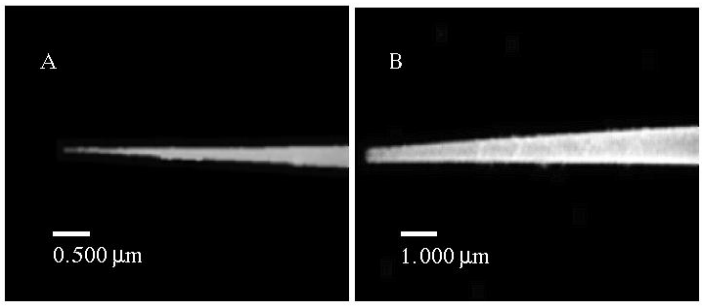

Figure 1 Photograph of an Antibody-based Nanoprobe. (The small size of the probe (200-nm diameter) allows manipulation of the nanoprobe at specific locations within single cells).

Figure 2 Photograph of Single Cell Sensing Using the Nano-Biosensor

Figure 2 shows a photograph of an antibody-based nanoprobe used to measure the presence of benzopyrene tetrol (a marker for DNA damage) inside a single cell. The small size of the nanoprobe allowed it to be manipulated to specific locations within the Clone 9 cells. We have recently performed measurements to investigate the application and utility of nanosensors for monitoring the onset of the mitochondrial pathway of apoptosis in a single living cell by detecting enzymatic activities of caspase-9. The nanosensors use probe based on a caspase-9 specific substrate, tetrapeptide Leucine-GlutamicAcid-Histidine-AsparticAcid (LEHD), bound to a fluorescent molecule 7-amino-4-methyl coumarin (AMC). Minimally invasive analysis of single live MCF-7 cells for caspase-9 activity was demonstrated using the optical nanosensor which employed a modification of a bioassay format based on LEHD-AMC.

These studies demonstrate unique application of nanosensors for measurements of chemical and biological species inside a single cell. Such nanosensors open new horizons to a host of applications in biotechnology, molecular biology research and medical diagnostics. These nanodevices could also be used to develop advanced biosensing systems in order to study *in situ* intracellular signaling processes and to study gene expression and molecular processes within sub-compartments inside individual living cells.

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