

## James & Esther King Biomedical Research Program

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*NanoScience Technology Center  
University of Central Florida*

*2007 Program  
New Investigator (3-year project)*

**Project Title:** Nanocolumn-Supported Nanoparticle Array for Early Detection of Lung Cancer Biomarkers

**Project Summary:** The early detection and screening of lung cancers are believed to be the most effective approaches (other than to quit smoking) to enhance the lung cancer survival rate. Although irreplaceable in obtaining spatial distributions of cancer, most of the current diagnostic techniques such as x-ray scans, computer tomography, and bronchoscopy have low sensitivities and cannot detect small cancers. Traditional molecular biology techniques such as polymerase chain reaction depend upon extensive analyses in a comprehensive laboratory and cannot be widely deployed for routine screening due to the high cost. In addition, the detection of lung cancer biomarkers is difficult due to low concentration and specificity of biomarkers. On the other hand, the highly sensitive and integrated devices that can detect cancer biomarkers at a very early stage have been the targets of much research. Ideally, such a device should be able to detect multiple, low concentration, genetic biomarkers within a small volume of sample both economically and efficiently. Recent progress in nanotechnology shows great promise in achieving this goal. Specially nanostructured materials with controlled properties open up new possibilities for the early detection of cancer prior to conversion into acute syndromes. The interaction of electromagnetic waves (i.e., light) with metal nanoparticles will generate a unique phenomenon called surface plasmon resonance. Upon the adsorption of molecules, the plasmonic peak of nanoparticles will shift due to the changes in the local dielectric environment. In principal, if the nanoparticles were arranged into an ordered array with controlled geometry, a sharp plasmonic peak will occur. The shift of the peak strongly depends upon the concentration of adsorbed molecules, thus enabling the highly sensitive detection of the molecules. However, current material patterning and lithographic techniques cannot make such a nanoparticle array for various reasons including array size, nanoparticle size, structural uniformity, and manufacturing efficiency. We have developed a method to make well-controlled glass microcolumn arrays by combining fiber drawing and chemical etching. We will use such column array as a platform to make surface plasmon resonance sensors for the early detection of genetic lung cancer biomarkers. The sensitivity will be greatly enhanced as the result of structural uniformity; the signal-to-noise ratio will be improved due to the large array size; the specificity will be improved by the detection of multiple biomarkers; and the single basepair mismatch can be detected using stringency washing or electrical field-induced de-hybridization. Furthermore, an integrated device that consists of DNA microarray and microfluidic channels will be fabricated for the low-cost, label-free, and real-time biomarker sensing. The PI (Ming Su) will independently develop this novel technique. The development of such a biosensing system will reflect the state of Florida's commitment to improve the lives of its citizens, benefit the State's economy, and solidify its role in the technological community. The project also fits in the long-term goals of the James and Esther King Biomedical Research Program.