

BioMEMS and Nanoparticles for Cancer Detection and Treatment

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Venue: Blk EA, #02-11 (Seminar Executive Room),
Faculty of Engineering.

Date: Thursday, 05 January 2006

Time: 2.30pm - 3.30pm



Abstract:

This paper presents the results of recent studies involving the use of BioMEMS and nanoparticles for cancer detection and treatment. The design of biocompatible implantable bio-micro-electro-mechanical systems (bioMEMS) is discussed in the first half of the paper. This includes the use of nanoscale titanium and gold coatings, and alkane phosphoric acid – RGD (AP-RGD) complexes that increase the adhesion of cells to the biomedical surfaces. The adhesion is quantified using shear assay techniques. These show that the adhesion is improved by the use of biocompatible coatings and AP-RGD complexes. The biological origins of increased adhesion are also explored before discussing possible bioMEMS approaches to cancer detection and treatment. In the second half of the paper, we explore the use of chemically functionalized magnetic nanoparticles in the specific detection and treatment of breast and prostate cancer. LHRH-coated magnetic nanoparticles are shown to result in specific attachment to breast and prostate cancer sites. The sizes and distributions of the super-paramagnetic iron oxide nanoparticles (SPIONS) are characterized in transmission electron microscopy images of the organs of mice injected with the SPIONS. These reveal the formation of clusters of nanoparticles in the case of LHRH-coated SPIONS. The implications of such clusters are discussed for the detection of cancer with magnetic resonance imaging (MRI) techniques. The paper concludes with a final section in which we explore the possible use of magnetic forces in the treatment of cancer.

Biography:

Wolé Soboyejo received his PhD in materials science and metallurgy from Cambridge University in 1988. He then worked as a research scientist for McDonnell Douglas Research Labs from 1988 until 1992. In 1992, he joined the department of materials science and engineering at The Ohio State University as an Assistant Professor. He received tenure, and was promoted to Associate Professor in 1996. From 1997 to 1998, he was a Visiting Martin Luther King Professor in the departments of mechanical engineering and materials science and engineering at MIT. He was appointed as a Full Professor at Princeton University in 1999. Professor Soboyejo teaches materials at the department of mechanical and aerospace engineering, and The Princeton Institute of Science and Technology of Materials (PRISM). He is the Director of the PRISM Undergraduate Program and is also the Director of the NSF – funded US/Africa Materials Institute. Prof. Soboyejo is the recipient of two National Young Investigator Awards (NSF and ONR). He is also a recipient of the ASM Bradley Stoughton Award for Excellence in the teaching of materials science. He has published over 250 papers in journals and proceedings. He is also the author of a recent textbook on the mechanical properties of engineered materials.