Micromachined Endovascularly-Implantable Wireless Medical Microsystems

Micromachining is a manufacturing technology that uses microfabrication techniques typically used to create integrated circuits, augmented by some specialized microfabrication tools, to also create mechanical structures and devices. Such microelectromechanical systems (MEMS) have the capability for small size, high functionality, and batch fabrication manufacturing economics. After a review of some current MEMS projects in our laboratory at Georgia Tech, this talk will discuss the history, design, fabrication, development, clinical testing, and commercialization of permanently-implantable, wireless silica MEMS sensors for measurement of pressure within blood vessels of the human body. These sensors have no internal power supply or circuitry and wirelessly communicate their measured pressure to an external reader.

The design and fabrication, as well as medical use, of these sensors will be discussed. The first medical application of these sensors is as monitors of pressure within the excluded portion of endovascularly-repaired abdominal aortic aneurysms. For this application, the devices must be permanently implanted deep within the electrically lossy medium of the body and be functional for the remainder of the patient's life. Micromachining enables sensors with sizes and form factors suitable for endovascular delivery and permanent implantation. The sensors are interrogated with an external measurement antenna and a real-time waveform of the pressure environment is extracted. These devices are now commercially available in the United States. The second application for these devices involves measurement of pressure in the pulmonary artery for monitoring and control of congestive heart failure. Sensors are implanted in the patient and home readings are used to communicate vessel pressure through the Internet to physicians, who can then adjust medication to keep the patients from decompensation and hospitalization. The results of a successfully completed 550-patient clinical trial in the US will be presented.