Implantable and Wearable Wireless Medical Sensors

Recent advances in micro- and nano-technologies provide unique interfacing functionalities to human tissues, with features of miniaturization and low power consumption. Interfaces between biological objects and electronics allow quantitative measurement and documentation of physiological and biochemical parameters, and even behaviors. The interfaces also provide direct modification of cells, tissues, or organs by electrical stimulation making it possible to manage chronic diseases with a closed loop between body and portable computer. Wireless communication and power transfer in the implantable systems enable in-situ sensing for freely-behaving animals or patients without constrains. Wireless networking also allows ubiquitous access to physiological information for treating complex problems in body.

This lecture focuses on our research progress in wireless micro sensors for clinical and neurobiological applications. The systems are based on integrated platforms such as wireless energy transfer for batteryless implants, miniature and flexible electrochemical sensors, nanoparticle modified surfaces, microelectromechanical system devices, and wireless communication. Several implantable, wireless diagnosis and therapeutic systems targeting management of pain and gastric disorders will be discussed with emphases on the sensor technologies. These technologies empower new personalized medicines to improve human welfare and assist better living. Sensor device designs, fabrication, characterization, system integration and clinical experiments will be presented.