Professor Serge Lemay
Professor, MESA+ Institute for Nanotechnology
University of Twente

Title:
Sensing with CMOS nanocapacitor arrays: from nanoparticles to living cells

Abstract:
Platforms that offer massively parallel, label free biosensing can, in principle, be created by combining all-electrical detection with low-cost integrated circuits. Examples of these include field-effect transistor (FET) arrays that are used for mapping neuronal signals and sequencing DNA. Despite these successes, however, bioelectronics has so far failed to deliver a broadly applicable biosensing platform. This is due, in part, to the fact that DC or low-frequency signals cannot be used to probe beyond the electrical double layer formed by screening salt ions, which means that under physiological conditions the sensing of a target analyte located even a short distance from the sensor (~1 nm) is severely hampered. Here we show that high-frequency impedance spectroscopy can be used to detect and image microparticles and living cells under physiological conditions. Our assay employs a large-scale, high-density array of nanoelectrodes integrated with CMOS electronics on a single chip; the sensor response depends on the electrical properties of the analyte, allowing impedance-based fingerprinting. We image the dynamic attachment and micromotion of several cancer cell lines in real time at sub-micrometre resolution, and demonstrate detection of both synthetic and virus nanoparticles.