

Manufacturing Electronic Label-Free Biosensing Assays

Nanoscale electronic devices have the potential to achieve exquisite sensitivity as sensors for the direct detection of molecular interactions, thereby decreasing diagnostics costs and enabling previously impossible sensing in disparate field environments. Semiconducting nanowire-field effect transistors (NW-FETs) hold particular promise, though contemporary NW approaches are inadequate for realistic applications and integrated assays. We present here an integrated nanodevice biosensor approach [1] that is compatible with CMOS technology, has achieved unprecedented sensitivity, and simultaneously facilitates system-scale integration of nanosensors. These approaches enable a wide range of label free biochemical and macromolecule sensing applications, such as specific protein and complementary DNA recognition assays, and specific macromolecule interactions at femtomolar concentrations.

Critical limitations of nanowire sensors are the Debye screening limitation [3], and the lack of internal calibration for analyte quantification, which has prevented their use in clinical applications and physiologically relevant solutions. We will present approaches that solve these longstanding problems, which demonstrates the detection at clinically important concentrations of biomarkers from whole blood samples [4], integrated assays of cancer biomarkers [5], and the use of these as a quantitative tool for drug design and discovery, including binding kinetics [6] and chirality detection [7].

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