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A Novel Electronic Transduction Scheme with MOSFET-Embedded Microcantilevers for Bio-Chem Sensing

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Microcantilever-based molecular sensing is rapidly emerging as a label-free high-sensitivity platform for molecular binding studies. However, the current schemes to detect cantilever bending have several shortcomings, which make it difficult for multiplexing and wide deployment. As an alternative, we present a novel approach for detecting subtle bending of microcantilevers based on drain current change in classic MOSFET embedded underneath the microcantilevers. Our approach relies on differential drain current signal between reference and analyte microcantilevers, both of which have embedded field-effect-transistors, whose drain current characteristic are sensitive to microcantilever bending. Microcantilevers bending, as small as few nanometers, can be readily registered in this approach. Full-scale simulation and optimization of the microcantilevers have allowed us to position the MOSFET at the appropriate location to enhance the sensitivity and reduce the various noise components to a minimum. The presentation will cover the basic philosophy behind MOSFET-embedded microcantilevers, and demonstrate its effectiveness with several examples of biomolecular binding events, including: DNA hybridization, protein-protein binding, and antigen-antibody binding. It will be argued that MOSFET-embedded microcantilevers offer a unique approach of electronic transduction for molecular binding event, and enjoy numerous technical advantages for wide-spread deployment and ready for massively parallel diagnostic platform.