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Real-time molecular detection using a nanoscale porous silicon waveguide biosensor XING WEI, JEREMY MARES, SHARON WEISS, Vanderbilt University — A grating-coupled porous silicon waveguide with an integrated PDMS flow cell is demonstrated as a platform for real-time detection of chemical and biological molecules. This sensor platform not only allows for quantification of molecular binding events, but also provides a means to improve understanding of diffusion and binding mechanisms in constricted nanoscale geometries. The large internal surface area of porous silicon enables the capture of molecules inside the waveguide, which causes a large perturbation of the guided mode field and improves detection sensitivity by more than one order of magnitude as compared to evanescent wave-based detection methods. Molecular binding events in the waveguide are monitored by real-time angle-resolved reflectance measurements. Diffusion, adsorption and desorption coefficients of different sized chemical linker and nucleic acid molecules are determined based on the rate of change of the measured resonance angle. Both the magnitude of the waveguide resonance angle shift and kinetic parameters are observed to depend on molecule size. Experimental results are shown to be in good agreement with calculations based on rigorous coupled wave analysis and finite element simulation.

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