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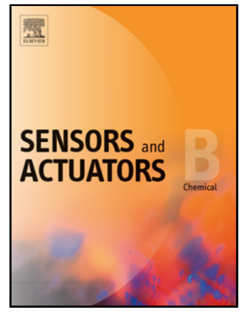

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Nano-Plate Biosensor Array Using Ultrafast Heat Transport through Proteins

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Abstract

A novel label-free biosensor array is proposed, which uses the ultrafast heat transport from a metallic nano-plate into surrounding solution across proteins captured on the nano-plate. Using electron-beam lithography, 2,500 gold nano-plates of 30 nm thick with $5 \times 5\ \mu\ \mathrm{m}^2$ area were fabricated on a fused silica substrate, on which receptor proteins were immobilized. Thermal phonons were induced on the back surface of a single nano-plate by focusing ultrafast light pulses from the substrate side, which propagated toward surrounding solution through surface proteins. Because the ultrafast heat-transport behavior, which is completed within $\sim$1 ns, is affected by existence of target proteins on the nano-plate, each nano-plate works as a single label-free biosensor. A theoretical calculation was made for predicting the cooling-down behavior of the nano-plate after an impulsive heating, and a pump-probe optics was developed for monitoring the ultrafast temperature change after excitation with a femtosecond fiber laser. We then confirm that each nano-plate acts as a single label-free biosensor by performing antigen-antibody binding reactions, indicating that a large scale number of multichannel measurement is made possible with this phenomenon.

Keywords: label-free biosensor, pump-probe laser measurement, thermoreflectance measurement, MEMS, multichannel

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