Photonic crystal surface waves for sensor applications

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We present a new optical biosensor technique based on registration of dual optical s-polarized waves on a photonic crystal surface. The simultaneous registration of two optical modes, with different evanescent field depths permits to segregate the volume and the surface signals, while the absence of a metal damping permits to increase the propagation length of the optical surface waves and the sensitivity of the biosensor. The presented technique is tested with the binding of biotin molecules to a streptavidin monolayer that has been detected with S/N ratio of about 15 at 1 second signal accumulation time.

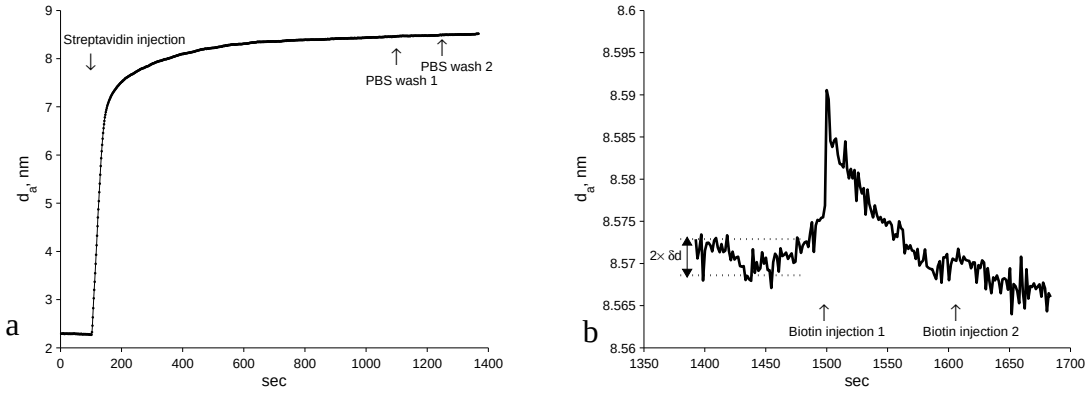

Fig. 1. Immobilization of streptavidin on a biotinylated surface (**a**) and free biotin binding to the streptavidin monolayer (**b**). The measurement time is 1 second per point (no posterior data averaging and smoothing).

Figure 1a shows the build-up of a monolayer from streptavidin molecules [molecular weight $\sim 60\,000$] on the biotinylated surface. Figure 1b presents the change of d_a during free biotin [molecular weight 244.31] binding to the streptavidin monolayer. From Figure 1b one can see that the streptavidin monolayer at first increases its thickness, but then contracts to a value slightly less than the initial one. So, during the time period 1500–1600 sec we observe the act of streptavidin conformation while biotin molecules penetrate into streptavidin molecules. The second biotin injection did not result in the same streptavidin conformation, because the most streptavidin subunits have already occupied by biotin molecules. The noise of the thickness measurement was $\delta d \simeq 1.3\ \mathrm{pm}/\sqrt{\mathrm{Hz}}$. The noise of the measurement of the external medium RI was $\delta n \simeq 5 \cdot 10^{-7}\ /\sqrt{\mathrm{Hz}}$.

References

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2. V.N. Konopsky and E.V. Alieva, "Photonic crystal surface waves for optical biosensors," in press.