Diagnostics of bacteria using Fabry-Perot interference in silicon nanostructures of various morphologies

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The most common optical sensors are based on the effects of light interference in thin layers of silicon nanostructures, such as porous silicon (PS) [1] or silicon nanowires (SNF) [2].

In this work three different nanostructures were studied: (i) porous silicon film (e-pSi) obtained by electrochemical (EC) etching of crystalline silicon substrate; (ii) sacrificial-etched porous silicon film (se-pSi) obtained by double electrochemical (EC) etching of a crystalline silicon substrate with the first e-pSi layer dissolved in NaOH solution; (iii) porous silicon nanowire layer (pSiNWs) obtained by metal-assisted chemical etching (MACE) of crystalline silicon substrate.

SEM micrographs of the obtained silicon nanostructures with various morphologies after adsorption of *E. coli*. Bacteria are presented in Figure 1.

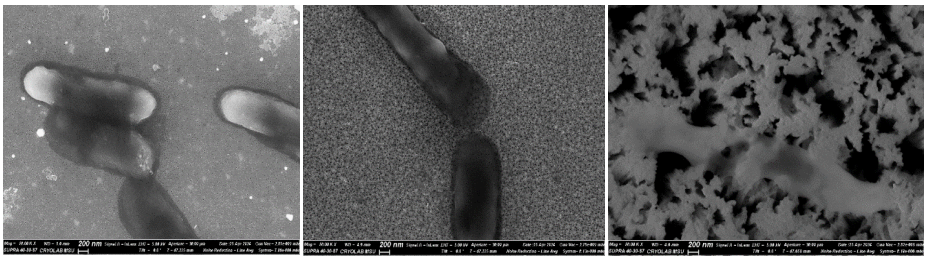

Fig. 1. SEM micrographs of silicon nanostructures with various morphologies after adsorption of *E. coli*.

IR reflectance spectra of the samples were measured without and with *E. Coli* at a concentration of 106 CFU/ml. Then, the change in the effective optical thickness of the nanostructures ($EOT = 2 \times L \times n_{eff}$) was determined using fast Fourier transform, and the adsorption efficiency of the bacteria was measured.

As a result, this work showed the possibility of diagnosing bacteria using Fabry-Perot interference in silicon nanostructures.

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[1] A. Jane, R. Dronov, A. Hodges, N.H. Voelcker, Porous silicon biosensors on the advance, Trends in biotech., vol. 27(4), pp. 230-239, (2009).
[2] K.A. Gonchar, S.N. Agafilushkina, D.V. Moiseev, I.V. Bozhev, A.A. Manykin, E.A. Kropotkina, A.S. Gambaryan, L.A. Osminkina, H1N1 influenza virus interaction with a porous layer of silicon nanowires, Mater. Res. Express, vol. 7, pp. 035002, (2020).