Plasmonic Nanomembranes For Detection And Sensing

Zoran Jakšić[a], Jovan Matović[b], Marko Obradov[a], Dragan Tanasković[a], Filip Radovanović[a] and Olga Jakšić[a]

[a] *Centre of Microelectronic Technologies, Institute of Chemistry, Technology and Metallurgy, University of Belgrade, Serbia*
[b]*Institute Biosense, Novi Sad, Vojvodina, Serbia*

Abstract. Nanomembranes, freestanding quasi-2D structures with thickness of the order of tens of nm and smaller and a giant aspect ratio with lateral dimensions of the order of millimeters, even centimeters, represent an important building blocks in micro and nanosystems [1], corresponding to ubiquitous bilipid membranes in living cells [2]. In this contribution we present our results in theory, design and experimental fabrication of metallic and metal-dielectric nanomembranes with plasmonic properties, intended for the use in the field of sensing. We first consider different approaches to functionalization and nanostructuring of nanomembranes [3]. These include introduction of noble metal or transparent conductive oxides fillers directly into the nanomembrane, lamination (multilayering) and patterning by 2D arrays of subwavelength nanoholes. Within this context we describe our results on nanofabrication of 8 nm thick chromium-based composite nanomembranes. Biomimetic structures utilizing nanochannel-based pores are also considered. We further present our results related to the design of chemical and biological sensors based on nanomembranes with plasmonic metamaterial properties [4]. Such sensors function as refractometric devices utilizing evanescent near fields as optical concentrators and adsorption-desorption mechanism, which ensures their ultra-high sensitivity that reaches single molecule detection [5]. We present some results on chemical sensors utilizing nanomembranes exhibiting extraordinary optical transmission, as well as those based on double-fishnet structures. Finally we consider the enhancement of infrared detectors by nanomembranes [6] utilizing the designer plasmon mechanism [7].

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