

Nano-sphere lithography fabrication of large-area ordered arrays plasmonic nanostructures for high-sensitivity biosensors

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Introduction

In this work, highly ordered array of plasmonic nanostructures have been fabricated developing a simple and reproducible approach based on nano-sphere lithography (NSL). This cost-effective method is based on the self-assembling of close-packed polystyrene (PS) particles at air/water interface, and enables the fabrication of colloidal mask characterized by a high quality crystal structure. Periodic array of metal nanostructures can be easily prepared on large-area by exploiting the interstitial geometry of this cheap lithographic mask. In particular, highly ordered array of gold nano-triangles distributed in hexagonal lattice have been fabricated on different kind of substrates. In this work, an optical biosensor based on localized surface plasmon resonance has been developed for the sensitive detection of lipopolysaccharides (LPS). Gold nano-triangles have been realized, used as optical transducers, functionalized with specific antibodies as sensing elements for the detection of LPS. After a proper functionalization step of the nanostructured transducers, Protein A was immobilized which, contains an Fc antibody-binding specific domain allowing an oriented immobilization of antibodies. Each functionalization step has been monitored by optical characterization by measuring the shift of the resonance peak. A good linear relationship between peak shifts and the LPS concentration has been demonstrated with detection limits down to 10 ng/ml. Further applications are in quality control of pharmaceutical preparations and medical devices.

Recent Publications:

1. MG Manera, A Colombelli, A Taurino, AG Martin and R Rella (2018) Magneto-Optical properties of noble-metal nanostructures: functional nanomaterials for bio sensing. *Scientific Reports* 8(1):12640.
2. Silvia Rizzato, Elisabetta Primiceri, Anna Grazia Monteduro, Adriano

Colombelli, Angelo Leo, Maria Grazia Manera, Roberto Rella and Giuseppe Maruccio (2018) Interaction-tailored organization of large-area colloidal assemblies. *Beilstein Journal of Nanotechnology* 9:1582-1593.

3. M G Manera, G Pellegrini, P Lupo, Valentina Bello, C de Julian Fernandez, F Casoli, S Rella, C Malitesta, F Albertini, G Mattei and R Rella (2017) Functional magneto-plasmonic biosensors transducers: Modelling and nanoscale analysis. *Sensors and Actuators B: Chemical* 239:100-112.

Biography

Roberto Rella is the Senior Researcher at the National Research Council, the Microelectronics and Microsystems Institute (IMM-CNR). The research activity is connected with the optimization of prototypes of new devices for optoelectronic sensing and biosensing applications. Optics and optochemical sensors with new organic and inorganic materials, systems like metal oxide semiconductors, organic macrocycles, conjugated polymers, dots and rods of metal oxide semiconductor, gold nanoparticles, and organic/inorganic multilayer systems. The emphasis of this work is on the fabrication of electronic devices incorporating these layers in the realization of chemical (gas, vapour and liquid) sensors, self-organized structures and nanoscale devices. Analysis of the sensing performances and optimization of the sensing parameters. Development and application of surface-sensitive spectroscopic techniques such as surface plasmon resonance (SPR) imaging, magneto-plasmonic SPR, localized SPR. Chemical modification of metal surfaces for adsorption-based biosensors.

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