Plasmonic biosensors advanced by functional hydrogels

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Abstract: Rapid and sensitive detection of biomarkers is of a key interest in the field of medical diagnostics. The paper will present current advances in optical biosensors for the analysis of trace amounts of biomolecules that combine plasmonic metallic nanostructures and hydrogel materials. When post-modified with ligands for the specific capture of target analyte, these materials can serve as a matrix for specific capture of target analyte on the surface with good resistance to unspecific sorption of other molecules present in complex samples. The capture of target analyte in the hydrogel matrix can be probed by evanescent field of guided waves. Depending on the thickness of the hydrogel matrix (from around hundred nanometers to several micrometers in swollen state), it can be probed by surface plasmons with probing depth adjusted from around hundred nanometers (regular surface plasmons) to about micrometer (long range surface plasmons) or even above (by waveguide modes supported by hydrogel layer itself) [1, 2]. In addition, matrices prepared from hydrogels that are responsive to external stimulus can be advantageous for plasmonic sensors relying on surface plasmons with highly confined field distribution as they can be collapsed after the capture of the analyte into the plasmonic hotspot where the maximum field strength occurs. Examples of the implementation of hydrogel materials for the direct refractometric detection of small molecules by using antibody and molecularly imprinted polymer nanoparticles will be discussed based on spectroscopy of guided waves [3, 4]. In addition, surface plasmon-enhanced fluorescence spectroscopy biosensors that take advantage of responsive hydrogel binding matrices will be presented with the limit of detection at low femtomolar concentrations [5].

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References:

[1] A. Aulasevichet al, *Macromolecular Rapid Communications,* vol. 30, pp. 872-877, 2009.
[2] J. Dostalek et al., *Plasmonics,* vol. 2, pp. 97-106, 2007.
[3] N. Sharma et al., *Macromolecular Chemistry and Physics,* in press, 2014.
[4] Q. Zhang et al., *Talanta,* vol. 104, pp. 149-154, 2013.
[5] Y. Wanget al., *Analytical Chemistry,* vol. 81, pp. 9625-9632, 2009.