Real-time monitoring of protein bioconjugate formation

Karolina Sulowska[1,2], Marcin Szalkowski[1], Ewa Roźniecka[3], Sebastian Maćkowski[1,2], Joanna Niedziółka-Jönsson[3]

[1] Institute of Physics, Nicolaus Copernicus University, Torun, Poland
[2] Baltic Institute of Technology, Gdynia, Poland
[3] Institute of Physical Chemistry, Polish Academy of Sciences, Warszawa, Poland

Plasmonic character of silver nanowires (AgNWs) together with their ability to efficiently propagate energy make these nanostructures suitable for controlling the optical properties of emitters, such as polymers, nanocrystals or biomolecules. The diameters of AgNWs in the range of 100 nm, are small enough to facilitate plasmonic effects over the broad spectral range, and at the same time their lengths of tens of micrometers make them visible using standard microscopy. Importantly, their surface properties can be modified with functional groups for sensing. In this work we demonstrate the real-time fluorescence imaging of a hybrid nanostructure based on silver nanowires and natural light-harvesting proteins. Biotin-modified silver nanowires were found to specifically interact with streptavidin tagged peridinin-chlorophyll-protein (PCP).

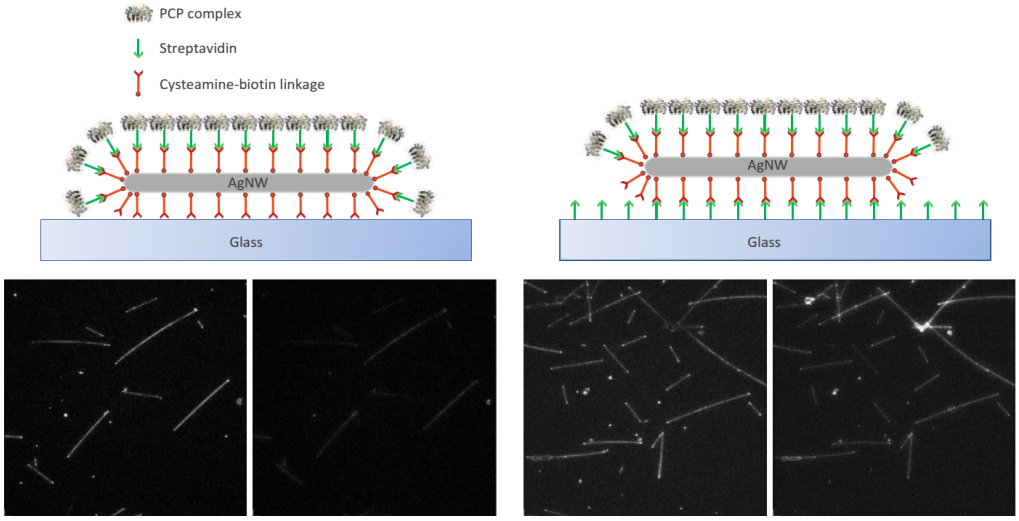

Figure 1. Schematic illustration of the structural differences between the two used substrates: bare glass and streptavidin-covered glass. The fluorescence maps collected at 12.5 s and at 300 s from the start of the measurement for bare glass substrate and the streptavidin-covered glass.

Using fluorescence imaging we find that bioconjugation between biotin-modified AgNWs and streptavidin-PCP in real-time is very efficient, as it takes place over a few seconds It is evidenced by fluorescence intensity patterns correlated with the positions of AgNWs. Further studies of two types of substrates show significant impact of the substrate functionalization on the efficiency of the conjugation process. The binding rate of the protein to AgNWs is substantially slower in the case of streptavidin coverage. Importantly, the strength of the observed plasmon fluorescence enhancement is independent of the substrate.

Research was partially financed by the project 3/DOT/2016 funded by the City of Gdynia, Poland, projects DEC-2013/10/E/ST3/00034, 2017/27/B/ST3/02457, DEC-2016/21/B/ST3/02276 funded by the National Science Centre Poland.

[1] M. Szalkowski et al., Sensors, 18 (2018), 290/1-9.