Electrodeposition of Ag Nanoparticles Using SP1 Nanopore as Template

Dorit Levy[1], Efrat Gdor[2], Daniel Mandler[2] and Oded Shoseyov[1]

[1]*Institute of Biochemistry, Food Science and Nutrition, The Robert H. Smith Faculty of Agriculture, Food and Environmet, The Hebrew University of Jerusalem*
[2]*Institute of Chemistry, The Hebrew University of Jerusalem*

Plasmonics is an emerging sub-field of nanophontonics, which has recently attracted increasing attention due to its potential applications in controlling and manipulating light at nanoscale dimensions. Plasmonic metal nanoparticles (NPs) have great potential for chemical and biological sensor applications, owing to their sensitive response to the local environment and ease of monitoring the light or absorbance by the NPs.

The crystal structure of ring-like stable protein 1 (SP1) reveals a ring diameter of 11 nm, an inner pore of 2–3 nm and a width of 4–5 nm. This protein, which is highly stable to boiling and protease resistant, was recently proposed as a new self-assembled molecular scaffold for nano-biotechnology and biomaterials applications. SP1 and its derivatives exhibit unique properties, such as the ability to generate a hydrophilic nanochannel in the plasma membrane of living cells and non-covalent adsorption to various surfaces.

In this study, we have channeled silver (Ag) NPs onto self-assembled SP1 on gold (Au) surfaces by electrodeposition. We have used L81C SP1 variant which presents cysteine (Cys) residues on its outer rim thus enabling its adsorption onto the Au electrodes. Electrochemical silanization was carried out by (3-mercaptopropyl) trimethoxysilane (MPTMS), creating an insulating layer on the electrode. The electrodes were characterized by cyclic voltammetry (CV) of ferrocenemethanol prior and post modifications.

We demonstrate that the SP1 coated electrode exhibit a behavior similar to a microelectrode, limited only by the diffusion rate of the redox couple, without the oxidation/reduction peak currents, suggesting the formation of SP1 pores within the MPTMS matrix. This was further supported by XHR-SEM imaging and EDS analysis after the electrodeposition of Ag, which revealed the formation of Ag nanoclusters on the SP1 coated electrode.