Cost-effective gold platform for SERS spectroscopy of macromolecules and biopolymers.

G.Dovbeshko[1,2], P. Wiewiorsky[3], O.Ivanov[3], W.Strek[3], F.Naeimaeirouhani[2], O.Skorokhod[2], G.Gilardi[2]

1-Institute of Physics, Nat. Acad. of Sci. of Ukraine. Prospect Nauky, 46, UA-03028, Kyiv, Ukraine

2-Department of Life Sciences and Systems Biology, University of Turin, Via Accademia Albertina, 13, 10123, Torino, Italy

3-Institute of Low Temperature and Structure Research Polish Academy of Sciences, Okólna 2, Wrocław, 50-422, Poland

Presenting author e-mail: matinelli@gmail.com

It is known that optical signals from biopolymers and macromolecules in Raman surface-enhanced spectroscopy (SERS) and surface enhanced infra-red absorption (SEIRA) spectroscopy is not easy to get due to many cites of interaction of the molecules with a substrate. Mechanism of SERS enhancement is usually explained by local fields near metal or graphite-type surface (electromagnetic mechanism) and increasing of polarizability of the molecules deposited on the surface (chemical mechanism). Recently appeared another types of mechanism connected with optical-mechanical coupling description for molecules at the substrate type of resonator cavities [1].

As SERS substrate we proposed to use a thin gold foil deposited on glass cover by special way to clear up the protein structure after its post-translational modification and compare with traditional SERS and Raman substrate. A droplet of 1 µl of 5 µM protein (human enzyme CYP4F11 before and under modification by 4-hydroxynonenal, toxic lipoperoxidation product) was used in our experiment. Previously it was impossible to register a signal from the same amount of protein on any other substrates. In the experiment we estimated the signal increase by 10 times or slightly more in comparison with quartz substrate. The surface of the foil–appears to be quite heterogeneous (sharp protrusions, cavities and holes). Therefore, all three mechanisms possible contribute to the spectrum enhancement. A more accurate assessment of their contribution requires special research.

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[1] Mikołaj K. Schmidt, Ruben Esteban, Felix Benz, Jeremy J. Baumberg and Javier Aizpurua, Faraday Discuss., 2017, 205, 31