

Summary of the doctoral dissertation:

Author: Krzysztof Niciński, MSc

Title: Plasmonic nanostructures for bacteria and cancer cells analysis
by Surface Enhanced Raman Spectroscopy

Institute of Physical Chemistry, Polish Academy of Sciences
Kasprzaka 44/52, 01-224 Warsaw

Supervisor: Agnieszka Michota-Kamińska, PhD DSc, Assoc Prof. IPC PAS

Warsaw, 21.12.2022

This work consists of chapters containing a theoretical introduction, a description of the aim of the work, a description of the experiments and their results, as well as a summary and conclusions. The research presented in this dissertation concerns the practical application of surface-enhanced Raman spectroscopy (SERS). As a part of the described research, techniques for the production of solid SERS substrates based on fragments of photovoltaic panels and silicon, as well as magnetic nanoparticles with plasmonic properties were presented. The research was extended to determine the optimal way of preparing biological samples for measurement and the conditions in which these measurements should take place. In addition, principal component analysis (PCA) was applied to analyse the obtained spectra. It allowed for the identification of a wide range of bacteria, as well as different types of cancer cells and human body fluids. A considerable success in the field of the SERS spectroscopy application is the use of a mobile Raman spectrometer in a large part of the research. Miniaturization and lower cost of equipment additionally increase the attractiveness of the developed solutions.

The obtained results proved that the main thesis of the dissertation was correct and its individual objectives were achieved. The conclusions drawn from the presented results indicate that SERS spectroscopy is an effective, sensitive and universal technique for the analysis of a wide range of biological samples. Combining this technique with chemometric statistical analysis of PCA creates a useful and powerful analytical tool called SERS-PCA.

The vast majority of the results presented in the dissertation have been published in seven scientific publications and have been claimed in the form of four patent applications, two

of which are already intellectual property protected by law. The list of these studies and the other six publications, for which research was conducted in parallel to those described in this dissertation, is included in the part of the work after the final conclusions and results.

Information cited and presented data come from scientific articles, books and verified websites and can be found in the last chapter of this work.