Referee report on the proposal for the extension of the theme "Modern Trends and Developments in Raman Microspectroscopy and Photoluminescence for Condensed Matter Studies" and opening of the new project "Biophotonics" for the years 2021-2023.

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The proposal to extent the current theme and the opening of the new project "Biophotonics" is undoubtedly based on the already achieved and a number of quite significant scientific results, and, thus, is aimed at solving new fundamental and practical problems in the field of Raman and upconversion luminescence. In this regard, it should be noted that the CARS microspectrometer, unique in its characteristics, is operated in the department of Raman Spectroscopy of the FLNP in a very efficient and targeted manner. This primarily refers to the CARS modality (coherent anti-Stokes Raman scattering), which was originally installed in the equipment and further improved by the team of employees of this subdivision. In addition, one more important achievement should be noted within the framework of the current theme: over the past years, not only the surface enhanced Raman scattering (SERS) technique has been mastered, but also new, modern approaches have been proposed to achieve very high sensitivity of the recorded spectra. All this allowed the team to publish works in the prestigious journals on SECARS (a combination of SERS and CARS), as well as to achieve an attomolar level of sensitivity when registering Raman spectra. The research on the synthesis of "core-shell" nanoparticles and their testing in upconversion luminescence with an eye to biomedical applications also deserve attention. Such nanoparticles are attractive due to the diversity of their chemical composition and structure, ensuring their multifunctionality, as well as high luminescence intensity. ***Thus, it seems to us that over the past three years, in the department of Raman spectroscopy of the FLNP has laid a modern research basis in this direction, which should be continued and developed.***

The new project "Biophotonics" involves the study of tasks of both fundamental and applied nature. However, in general, both are ultimately aimed at developments in the field of highly sensitive biosensorics by method of enhanced Raman spectroscopy and photoluminescence. Among the first, the authors suggest studying the features of Stokes and anti-Stokes components of SERS-spectra of analyte molecules on nanostructured surfaces of noble metals. It should be noted here that a number of studies have been devoted to solving this problem, but the bulk of the experiments were carried out using cw lasers. The use of picosecond lasers is very promising for solving this problem, since this duration corresponds to the time scale of flows and energy redistribution in nanostructured materials with attached molecules. ***There are very few such studies at present, but, in our opinion, they will allow us to better understand the physics and mechanisms of the formation of Raman signals in SERS-spectra with the possibility of their adequate interpretation.*** There is a spectral base for such studies in the department, however, it requires a certain retrofit.

As for the applied problems of the Biophotonics project, and, in particular, the problem of NETosis, the team is working ahead of the curve - I am familiar with their first published work in this direction, dedicated to the search for a spectral marker of NETosis at low wave numbers. ***In the paper it is emphasized the possibility of early diagnosis of NETosis by identifying the corresponding raman marker. According to our information, this is the first work in this direction of research NETOSis.***

Another applied task is the use of lipodiscs in studies of the structure of membrane proteins. Membrane proteins make up 20-30% of the human proteome. Knowledge of their structure helps the

advancement of medicine and pharmacology - among proteins that are targets of drugs, the proportion of membrane proteins is up to 50%. This project is devoted to the advancement of a method for stabilizing membrane proteins and studying their chemical structure by Raman spectroscopy using lipodiscs - fragments of the lipid membrane (membrane mimetic) bounded by amphiphilic polymers. Lipodiscs formed using styrene and maleic acid copolymer (SMA, XIRAN) have become the most popular. ***It is assumed that this will improve the existing procedures for isolating and studying the structure of membrane proteins using Raman spectroscopy, and to obtain new information about the structure of lipodiscs with membrane proteins.***

To sum up, we note that the relevance and scientific significance of the proposed project "Biophotonics" is not in doubt, and it is strongly proposed to extend the current theme for 2021-2023 with the inclusion of the above project.

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