

Referee report
for the extraordinary session of the PAC for Condensed Matter Physics
on the project “Raman microspectroscopy in biomedical study” (Biophotonics)

Theme: 1133, Leaders: G.M. Arzumanyan, N. Kucerka, Terms: 2021-2023

The main objective of the project “Biophotonics” (2021-2023) is aimed at the application of modern Raman scattering methods which are known to be highly valuable to biomedical research. The frequency-shifted Raman lines, directly give a basic information about the possible excitations in the system and provide information about the dynamics and chemical bonds which are the fundamental units in all molecules.

From the material presented by the project leaders, it is clear that the “CARS” microspectrometer, as well as the optical infrastructure developed around it, is not just a modern device, but also a very competitive instrument at the world level. The team of the Raman Spectroscopy Sector has made significant contributions in hardware in recent years. Among others, I’d like to emphasize (i) on the implementation of two amplifying modalities of the Raman signal known as SECARS, and (ii) the successful start of the development of low-frequency Raman, **which allows recording Raman shifts starting from 10 cm⁻¹, which is really extremely important for those tasks within the framework of the presented project.**

The Sector of Raman spectroscopy constantly expands its international cooperation, first of all, with the JINR Member countries. Over the past few years, this division has become particularly attractive to Slovak Republic, Poland, Romania, Bulgaria. This interest is reflected, among the others, in the support of grants and cooperation programs from the Plenipotentiary Representatives of these Member-State countries. Also, very large cooperation has been established with a number of research organizations in Belarus Republic. Starting this year, closer cooperation is also planned with Armenia, Mongolia and Uzbekistan as well.

I am also satisfied with both the quality and quantity of recently published papers in peer-reviewed journals. The list of the team's participation in international conferences also looks prestigious, **among which there are several keynote talks given by the one of the leaders of the project.**

The project “Biophotonics” comprises fundamental and applied parts. As for the basic research, the activities will be aimed at identifying and understanding the mechanisms of the anomalous ratio of intensities of the antiStokes/Stokes components in the spectrum of surface-enhanced Raman scattering. This will allow to formulate the conditions for obtaining reproducible SERS spectra during the development of biosensors. The development of biosensing techniques to achieve reliable detection, identification, and structural study of diverse bioorganic molecules at ultralow

concentrations is still an urgent objective of specialists in many spheres including medicine, biology, forensics, ecology, pharmaceuticals and so on.

Applied tasks are related to (i) spectroscopic and immunofluorescence studies of the programmed cell death NETosis, in particular, to search for Raman markers of this phenomenon, as well as to determine the mechanisms triggering the sterile activation of NETosis under the influence of UV radiation which currently very poor studied, and, (ii) lipid-protein interaction using modern membrane mimetic – lipodiscs, nanodiscs, and liposomes. As for the Group size, composition and budget I consider them optimal and realistic.

The project has just begun, and we very much hope for its successful implementation. In general, the goals of the project look harmonious, interconnected and quite ambitious. I would especially like to note for our members of the PAC and the FLNP Directorate that this is a good start for additional research on individual problems using the methods of Raman spectroscopy and neutron scattering.

My evaluation of the project “Biophotonics” and recommendation on the category:

I recommend its implementation in 2021–2023 with ranking Category “A”: excellent project.



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