SARS-CoV-2 NUCLEOCAPSID PROTEIN IMMUNE COMPLEX INVESTIGATION BY COMBINED ACOUSTIC AND OPTICAL METHODS

Vincentas Mačiulis[1,2], Ieva Plikusienė[1,2], Silvija Juciutė[2], Arūnas Ramanavičius[1,2], Zigmas Balevičius[3], Rimantas Slibinskas[4], Indre Kučinskaite-Kodzė[4], Martynas Simanavičius[4], Saulius Balevičius[5], Almira Ramanavičienė[2]

[1]Center for Physical Sciences and Technology, Department of Nanotechnology
Saulėtekio av. 3, LT-10257 Vilnius, email: vincentas.maciulis@ftmc.lt

[2]NanoTechnas – Center of Nanotechnology and Materials Science, Faculty of Chemistry and Geosciences, Vilnius University, Naugarduko str. 24, 03225 Vilnius

[3]Center for Physical Sciences and Technology, Department of Laser Technologies
Saulėtekio av. 3, LT-10257 Vilnius

[4]Institute of Biotechnology, Life Sciences Center, Vilnius University
Sauletekio ave. 7, LT-10257 Vilnius

[5]Center for Physical Sciences and Technology, Department of Functional Materials and Electronics
Saulėtekio av. 3, LT-10257 Vilnius

SARS-CoV-2 virus and its' comprising proteins are of keen interest to the scientific community. Nucleocapsid protein (SCoV2-N) is widely used alongside the spike protein in COVID-19 rapid detection kits. The nucleocapsid proteins (SCoV2-N) are the earliest detectable diagnostic markers for COVID-19 infection, also a high count of anti-SCoV2-N can result in an increased risk of hospitalization and admission to intensive care on a subsequent infection of COVID-19 [1]. The investigation of SCoV2-N and its' interaction with anti-SCoV2-N require highly sensitive systems that can be used for real-time analysis.

To achieve high precision and accuracy, label-free, non-contact methods need to be applied. This work combines two highly sensitive methods, that are widely applied when examining reactions at the solid-liquid interface. One is the optical method of spectroscopic ellipsometry, it is a highly sensitive, non-destructive measurement method. It measures parameters; Ψ - light wave amplitude, and Δ - light wave phase shift. These parameters allow for the determination of layer thickness and refractive index of formed protein monolayers, these are then used for the evaluation of dry protein mass density (evaluation that calculates only the immobilized protein mass) [2]. Second method is quartz crystal microbalance with dissipation, which is a acoustic measurement method that measures; Δf - frequency change, and Δd - energy dissipation of a quartz crystal sensor. When the sensor is modified, has proteins immobilized or is affected in a way that adds material on the surface of the sensor - sensor's frequency lowers to compensate for the increased mass, this can be utilized to evaluate the wet surface mass density (evaluation that includes the material and surrounding liquid mass on the sensor), a change in energy dissipation can give information on the immobilized protein viscoelastic properties [3].

Both methods are good tools for biomolecule interaction analysis. A combined spectroscopic ellipsometry and quartz crystal with dissipation measurement method, allows the evaluation of hydration, dielectric and viscoelastic properties [4].

In this work, real time interaction of SCoV2-N and anti-SCoV2-N was recorded using spectroscopic ellipsometry and quartz crystal microbalance. Formed protein layers were analyzed, providing information on antibody flexibility and spatial arrangement in SCoV2-N/anti-SCoV2-N immune complex.

References

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