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Incorporation of Ag Nanoparticles into Membrane Mimetic Systems Composed by Phospholipid Layer-by-Layer (LbL) Films to Achieve Surface-enhanced Raman Scattering as a Tool in Drug Interaction Studies

P. H. B. Aoki[(1)*], P. Alessio[(1,2)], J. A. De Saja Saez[(2)], C. J. L. Constantino[(1)]

(1) Departamento de Física, Química e Biologia, Faculdade de Ciências e Tecnologia, UNESP, 19060-900 Presidente Prudente, SP, Brazil, email: pedro.aoki@terra.com.br
(2) Cellular Materials Laboratory (CellMat), Condensed Matter Physics Department, Faculty of Science, University of Valladolid, 47011 Valladolid, Spain.

Abstract –Both DPPG and AgNP were combined in LbL films, which were further investigated in the presence of MB. The surface-enhanced phenomenon was applied to investigate these films taking the advantage of the strong SERRS signal presented by MB. The results showed that the LbL films can be grown in a controlled way with the surface morphology susceptible to both AgNP and MB. The AgNP played a key role achieving the MB SERRS signal and working as an analytical tool since the MB resonance Raman scattering spectrum was not observed for the MB concentrations used to prepare the LbL films.

The synergistic effect produced by nanoparticles when incorporated to different systems used as analytical tools represents a growing research field nowadays. On the other hand, the study of interactions involving pharmacological drugs and biological membranes using phospholipids as mimetic systems is a research field already well established. In a previous work, we have used the electrostatic layer-by-layer (LbL) technique as a new approach to produce multilayered thin films containing biological phospholipids applied as transducers in electronic tongue systems [1]. Here, we combine both phospholipid and Ag nanoparticles (AgNP) to form LbL multilayered films, which were further investigated in the presence of a phenothiazine compound (methylene blue - MB). The LbL films containing the anionic phospholipid DPPG ([1,2-dipalmitoyl-*sn*-3-glycero-[phosphor-rac-(1-glycerol), negatively charged AgNP, cationic MB drug, and the cationic polymer PAH (poly(allylamine hydrochloride)) as the supporting polyelectrolyte were prepared. The molecular architecture of the LbL films in terms of controlled growth, morphology with micro and nanometer spatial resolutions, and dispersion of both AgNP and MB within the DPPG matrix was determined combining UV-Vis absorption spectroscopy, micro-Raman spectroscopy, scanning electron microscopy (SEM), and atomic force microscopy (AFM). The results showed that the LbL films can be grown in a controlled way at nanometer thickness scale with the surface morphology susceptible to the presence of both AgNP and MB, as shown in Figure 1(a,b). The surface-enhanced phenomenon was applied to investigate the LbL films taking the advantage of the strong surface-enhanced resonance Raman scattering (SERRS) signal presented by the MB molecules (Figure 1b). Besides, since MB is a pharmacological drug of interest, its molecular arrangements when dispersed in LbL films containing DPPG, which is the biological membrane mimetic system here, were investigated. In this case, the AgNP played a key role achieving the MB SERRS signal and working as an analytical tool since the MB resonance Raman scattering (RRS) spectrum was not observed for the MB concentrations used to prepare the LbL films.

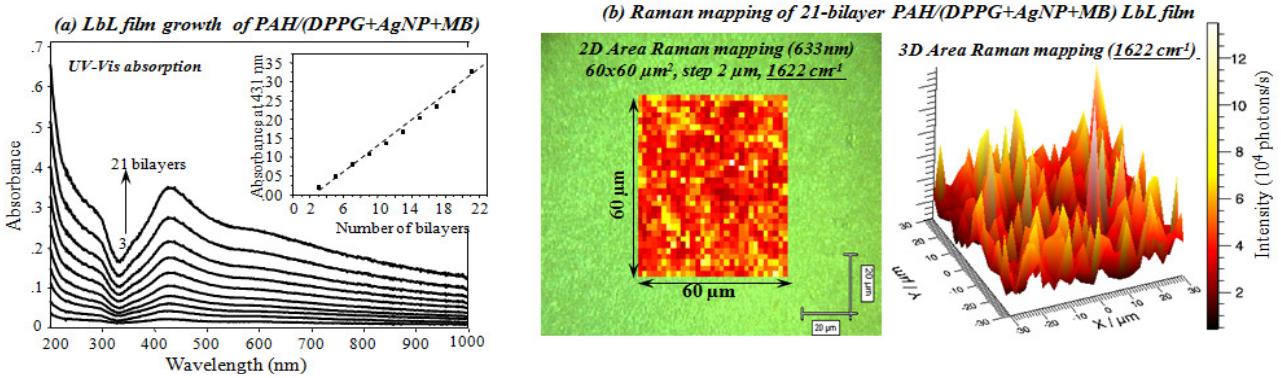

Figure 1. a) UV-Vis absorption spectra for LbL films of PAH/(AgNP+DPPG+MB) containing different numbers of bilayers. The inset shows the linear dependence of the absorbance at 431 nm as a function of deposited bilayers. **b)** SERRS mapping, exhibited in 2 and 3 dimensions carried out for 21-bilayer LbL film of PAH/(DPPG+AgNP+MB).

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References

[1] P. H. B. Aoki, D. Volpati, A. Riul, Jr., W. Caetano and C. J. L. Constantino, Langmuir 25 (2009) 2331-2338.