# Lipid Nano Carriers, COVID-19 and Hyperspectral Microscopy

For over a decade, nano-drug delivery has slowly evolved out of the research laboratory and into the commercial market with a small number of regulatory approvals. Between 2017 and 2019 there were only three FDA approved nano-drug delivery constructs.[1] However, there is now a large and ever-growing number of nano-drug delivery applications in the regulatory approval pipeline.

None of these is more high profile than the Moderna COVID-19 vaccine. This vaccine, which has been submitted for immediate approval by the FDA, utilizes lipid nanoparticles as the vector for its mRNA construct. It is expected that this nanoparticle delivered mRNA vaccine will soon impact the lives of hundreds of millions of people world-wide. As such, this development is expected to provide a much needed boost to the nano-drug delivery market, proving that nanoparticles can be utilized at scale as a drug delivery vector in a safe and effective manner.

Development of lipid nanoparticle therapies such as the Moderna vaccine requires the ability to validate proper uptake of drug therapies or other nanoscale elements within, or onto, the lipids. Additionally, it is important to demonstrate how these lipid carriers interact with cells and tissue. CytoViva's Enhanced Darkfield Hyperspectral Microscopy can be an effective tool for both of these tasks.

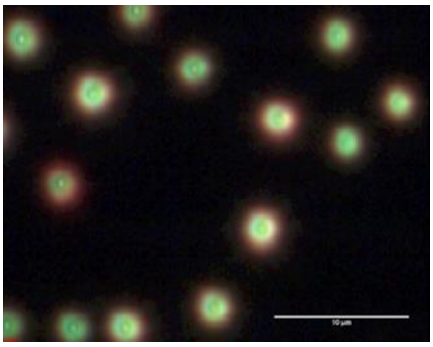

Figure 1: Liposomes with AuNP Loaded Bilayer.

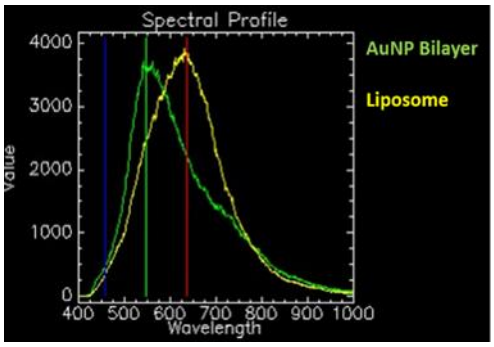


Figure 2: Spectral Response of Liposome Area (**yellow**) and Liposome Bilayer Area with AuNPs (**green**).

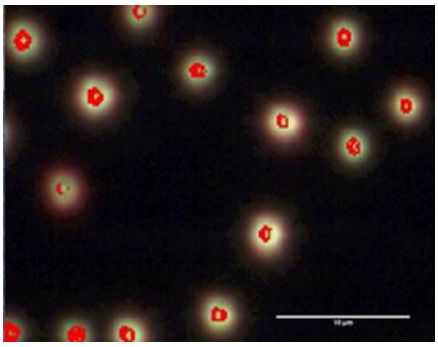

Figure 3: Mapping (**red**) of AuNPs in the Liposome Bilayer

Figure 1 above illustrates an enhanced darkfield hyperspectral image of liposomes loaded with AuNPs (gold nanoparticles) in the bilayer. The AuNPs cause a shift in the spectral response in areas where they are present in the liposome. This spectral shift is illustrated in Figure 2, with the hyperspectral mapping of the AuNPs in the liposome bilayer illustrated in Figure 3 (in red).

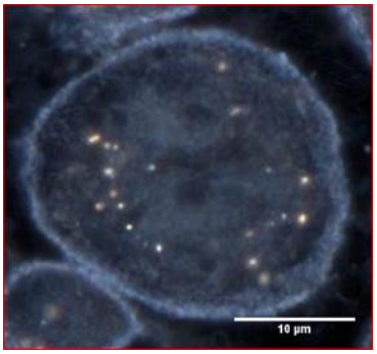


Figure 4: LDL Encapsulated AuNPs in Macrophage Cell.

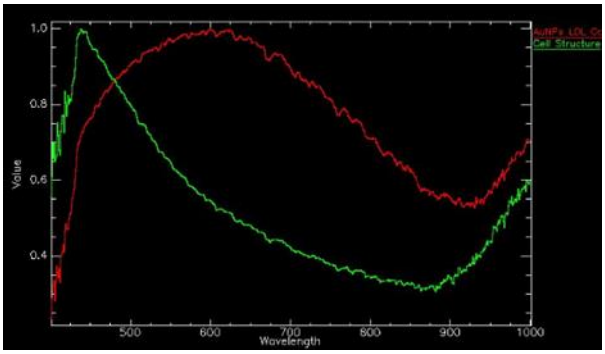


Figure 5: Spectral Response of LDL Encapsulated AuNPs (**red**) and Cell Structure (**green**).

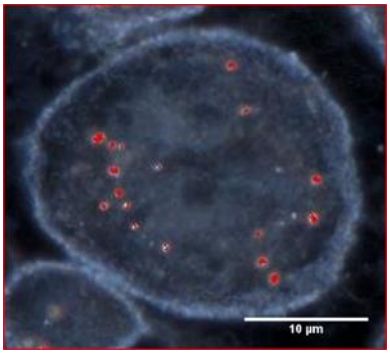


Figure 6: Mapping (**red**) of LDL Encapsulated AuNPs.

Figure 4 above illustrates an enhanced darkfield hyperspectral image of LDL encapsulated AuNPs in macrophage cells*. The unique spectral response of the LDL encapsulated AuNPs versus the cell structure is illustrated in Figure 5. The hyperspectral mapping of the LDL encapsulated AuNPs is illustrated in Figure 6 (in red).

The ability to observe and spectrally confirm the nanoscale cargo within the lipid or the uptake of these lipid constructs into cells is critical for effective development and deployment of these therapies. CytoViva's Enhanced Darkfield Hyperspectral Microscopy is proven to be an effective method for supporting these applications.

[1]Anselmo AC, Mitragotri S. Nanoparticles in the clinic: An update. Bioeng Transl Med. 2019;4:e10143 10.1002/btm2.10143

Contact CytoViva info@cytoviva.com to learn more about enhanced darkfield hyperspectral microscopy or to schedule a demonstration of the system with your samples.