RamanFest 2023 Paris FRANCE

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Topical drug delivery: challenges and opportunities

Stimulated Raman scattering (SRS) microscopy is increasingly utilised within the pharmaceutical industry for its capability of performing fast, non-invasive, label-free imaging. This technique provides a signal intensity that is linear with concentration, allowing elucidation of quantitative information. SRS microscopy can also be correlated with other optical imaging modalities which can offer simultaneous visualisation of the connective tissues. Consequently, it is an ideal tool for investigating drug uptake and pharmacokinetics within skin tissues. There are various quantitative approaches that can be used in analysing samples with SRS [1]. Nevertheless, when it comes to analysing skin samples, several challenges must be overcome. These challenges include i) addressing signal attenuation with increasing depth; ii) detection and removal of parasitic signals (such as two-photon absorption processes); iii) detecting and quantifying the target signal amidst spectrally complex backgrounds; iv) correcting for optical and physical changes to the sample caused by the application of the formulations (optical clearing, dehydration etc). Addressing these challenges will enable SRS to reach its full potential as a new tool for supporting innovation in pharmaceutical product design and regulation.

References

[1] Manifold, B., & Fu, D., Annual Review of Analytical Chemistry (2022), Vol 15:269-289

[2] Tsikritsis, D., Legge, E.& Belsey, N. Analyst (2022),147,4642-4656

Figures

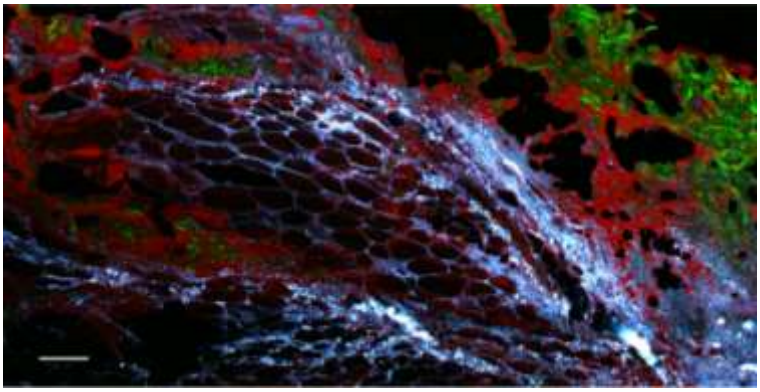

Figure 1: SRS and Second harmonic generation (SHG) microscopy composite image of a rat skin section containing metallic particles. SRS contrast for CH_2 stretching at 2850 cm^{-1} is shown in red, and off-resonance signals at 2770 cm^{-1} are overlaid in cyan hot, revealing the distribution of the metal particles based on their strong signals due to absorption and photothermal lensing. Collagen (green) is visualised using SHG. The scale bar represents 100 µm.