

# Stimulated Raman Scattering microscopy for the evaluation of silicone content in breast implant capsules

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Silicone breast implants are generally considered to be safe, with implant rupture being the predominant concern. Macroscopic implant rupture can easily be diagnosed by Magnetic Resonance Imaging. However, investigating the shedding of smaller particles, so called 'bleeding', remains challenging due to the lack of specific histopathological techniques that allow the detection of small silicone particles. Stimulated Raman Scattering microscopy (SRS) has emerged as a potential tool for high-resolution chemical imaging.

Three periprosthetic capsules surrounding silicone implants were obtained after explantation due to implant rupture. Samples were processed per standard histological treatment and stained with hematoxylin and eosin. Subsequently, the samples were imaged with SRS at two wavenumbers corresponding to the silicone Raman peak and the protein peak at the CH stretch region of the Raman spectrum. The Images were combined, revealing the distribution of the silicone inclusions through the tissue, and co-registered with a color histology image by using the cell nuclei positions for position registration. Regions of interest were scanned again to investigate and confirm small silicone inclusions down to 0.5  $\mu\text{m}$  size.

For the first time, to the best of our knowledge, silicone bleeding into breast tissue from breast implants was shown and verified spectrally on histology slides. All tissues studied showed ample amounts of silicone inclusions down to sub-micron size. Inclusions were found as far as 700  $\mu\text{m}$  into the tissue from the tissue-implant interface. Inflammatory response indicated by the distribution of cell nuclei was additionally observed.

SRS is a robust tool for the evaluation of silicone content in periprosthetic breast tissue. The analysis on H&E stained histology slides makes this a particularly useful technique. This protocol is currently used for the evaluation of silicone gel bleeding from non-ruptured breast implants, to correlate patients complains and scarring (Baker score) to silicone bleeding into the tissue.

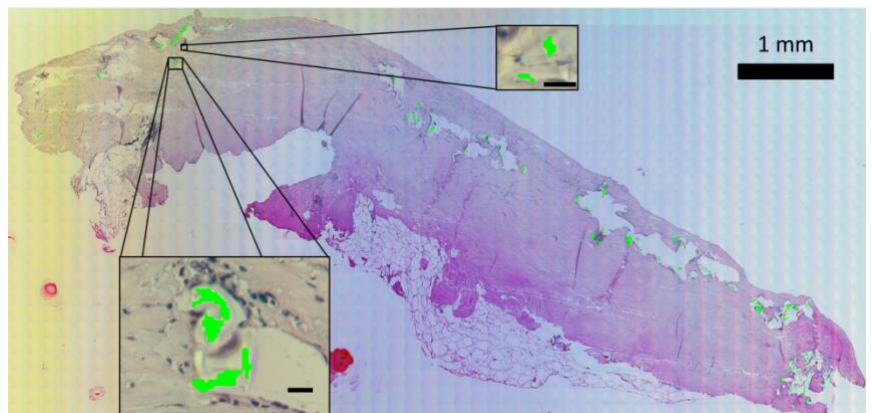


Figure: Silicone bleeding distribution in breast tissue. The breast tissue was H&E stained. Silicone distribution image (green) was overlaid on the histology image. The insets show small particles with 10  $\mu\text{m}$  scale bar. The bottom inset shows high density of nuclei typically found around a silicone inclusion.