

Surface Characterization of Antibacterial Coated Sutures using Cold Stage TOF-SIMS and XPS

Antibacterial coated sutures have been developed to reduce the occurrence of surgical site infections. Triclosan has been used in coatings on poliglecaprone based sutures. Understanding the surfaces of suture coatings is important for failure analysis and quality control. Analysis of the triclosan itself is difficult because of its volatility in the UHV vacuum systems used for instruments sampling the top few angstroms of a surface, such as Time-of-Flight Secondary Ion Mass Spectrometry (TOF-SIMS) and X-ray Photoelectron Spectroscopy (XPS).

Cold stage analysis has been shown to be effective for samples that are not solids at room temperature or that have components that are volatile in a vacuum system - such as the sutures. Samples are cooled to near liquid nitrogen temperatures outside the vacuum system and then pumped down to UHV pressures for analysis. Cold stage options are available for TOF-SIMS and XPS at EAG Laboratories.

Negative ion TOF-SIMS images of a single suture filament are displayed in Figure 1. This analysis was done using a cold stage at -80 °C. The images show the distribution of triclosan – both as the molecular ion ($C_{12}H_6Cl_3O_2$) and as Cl fragmented from the parent molecule. The molecular ion is the most specific for triclosan. The antibiotic is found predominantly on the upper part of the suture filament as oriented. The lower part of the filament has more signal from the base poliglecaprone material. Species related to surface lubricants were also detected: silicone and stearate.

TOF-SIMS analysis of a similar suture at room temperature without cold stage (at room temperature) shows dramatic reduction in the triclosan signal (Figure 2) and a higher signal from poliglecaprone. The triclosan has been lost to the vacuum system of the instrument at approximately 10B Torr.

In the cold stage XPS analysis of the suture, Cl from the triclosan was detected. The spectra were compared to a suture having no triclosan coating. While the levels are low, the Cl 2p doublet is clearly present - best illustrated in the high resolution spectra. XPS provides a semi-quantitative measurement of the triclosan while TOF-SIMS is only relatively quantitative but is more chemically specific. These techniques are often combined for a fuller understanding of the chemistry of a sample surface.

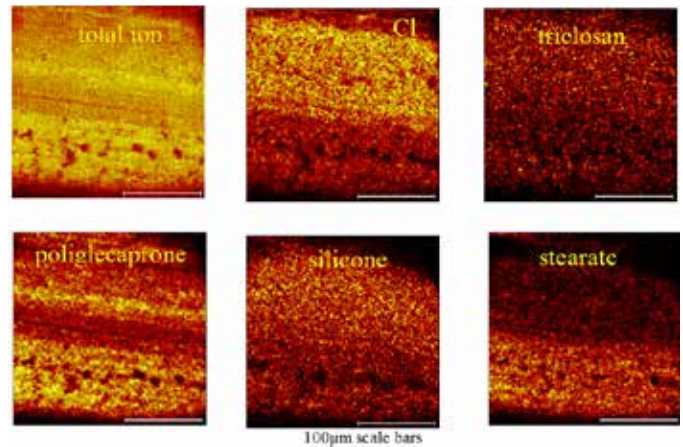


Fig. 1: TOF-SIMS images of a triclosan coated suture using cold stage.

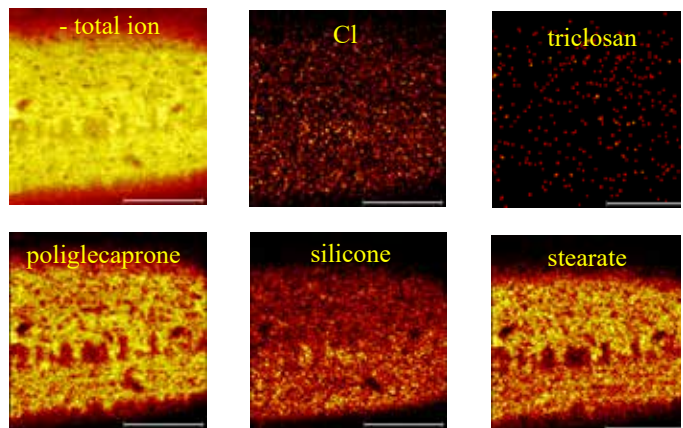


Fig. 2: TOF-SIMS images of a triclosan coated suture without cold stage.

Suture	C	N	O	Si	Cl
Triclosan	72	0.4	23	4.5	0.1
No Triclosan	64	0.4	32	2.9	-

Atomic Concentrations (in atomic %)

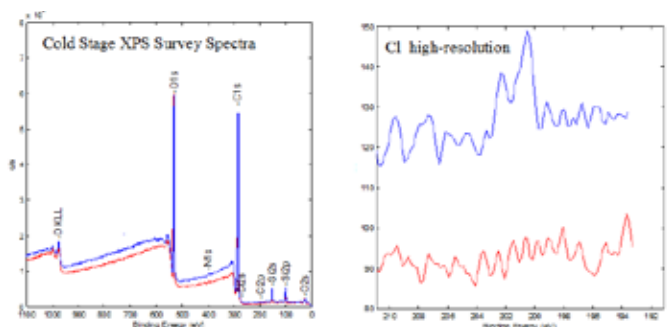


Figure 3. XPS detected triclosan from the coating on the suture with the help of the cold stage. The spectrum is compared to an uncoated suture.