## Abstract

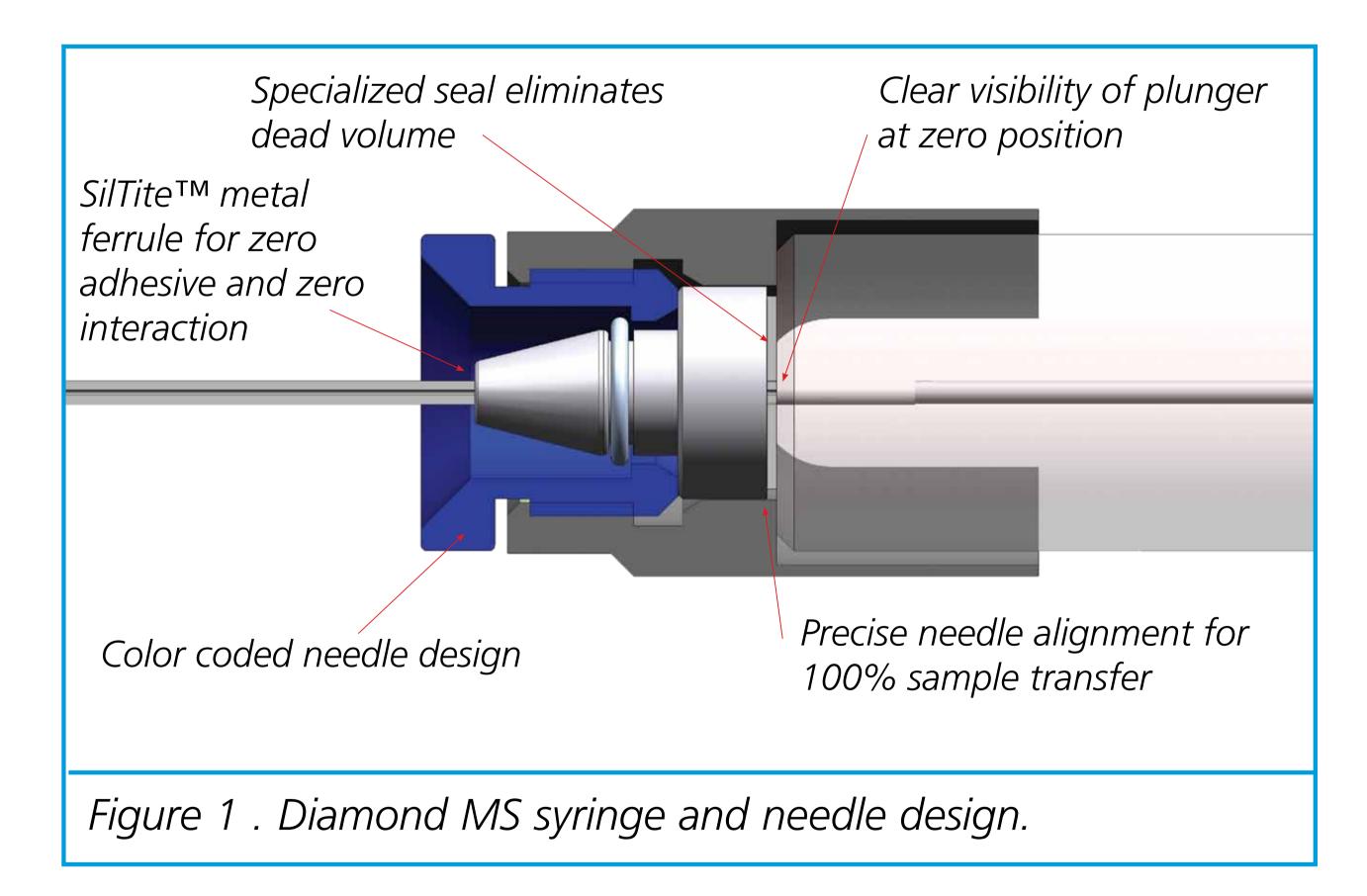
As instrumentation becomes more sensitive and able to detect ever-smaller concentrations of sample, cleanliness and reactivity of the analysis system becomes increasingly important. This issue has been addressed in most part by the instrumentation manufacturers using shorter, smaller diameter transfer lines and materials with very low reactivity. There have been no significant gains in the sample introduction phase of the analysis system, namely the syringe, for some time.

A new range of syringes has been specifically designed, drawing on over 50 years of knowledge in the analytical chemistry field, to address this issue. With increasing sensitivity of detectors any sample carryover or any interaction of the syringe materials with the sample can negate the analysis. This new range of syringes is customizable; the user can select the most suitable syringe components for the analysis and be assured they will have minimal effect on the analysis. These syringes also take advantage of technology that dramatically improves syringe lifetime and stability.

This poster demonstrates the improved results seen when using new Diamond MS syringes designed for higher sensitivity analyses.

#### Background

Sample introduction into any analytical instrument must be consistent from sample to sample to ensure reproducibility and the ability to directly compare analysis results. Any inter-sample variation causes inconsistencies in results and difficulties in interpretation of those results. The potential for sample to sample variation is reduced when particular focus is given to a number of key syringe design elements.



The optimal syringe needle connection should have zero dead volume and be free of contaminants such as adhesives. With this in mind, a design to perfectly align the syringeneedle connection was developed, reducing dead-volume to zero and completely removing adhesives from the flowpath. This is achieved by incorporating features from SGE's metalferrule SilTite<sup>™</sup> range and provides the additional benefit of the needles being replaceable. Having replaceable needles prevents the need to replace an entire premium syringe if the needle has been bent, blocked or damaged in some way and provides needle options for users as discussed later in this poster.

# A New Syringe Line for Highly Sensitive Applications

Ultra Smooth Needle Bore: A polishing technique to dramatically improve the finish of the internal needle surface providing a number of benefits has been developed.

- I. The ultra smooth surface of the needle allows the sample to more easily flow and then be washed from the syringe. The smoothing of imperfections and reduced number of pockets and pocket depth allows the washing liquid to easily clean residual sample from the internal surface of the needle. This ensures unwanted interactions and carryover do not occur from one sample to the next.
- 2. The ultra smooth surface inside the needle reduces overall needle restriction; samples are more easily aspirated and dispensed with reduced risk of cavitation or pressure build-up.

Choice of Needle Surface Chemistry: A range of needle surface chemistries have been developed. Depending on the sample and analysis, significant improvements in sensitivity are possible by using one of three options:

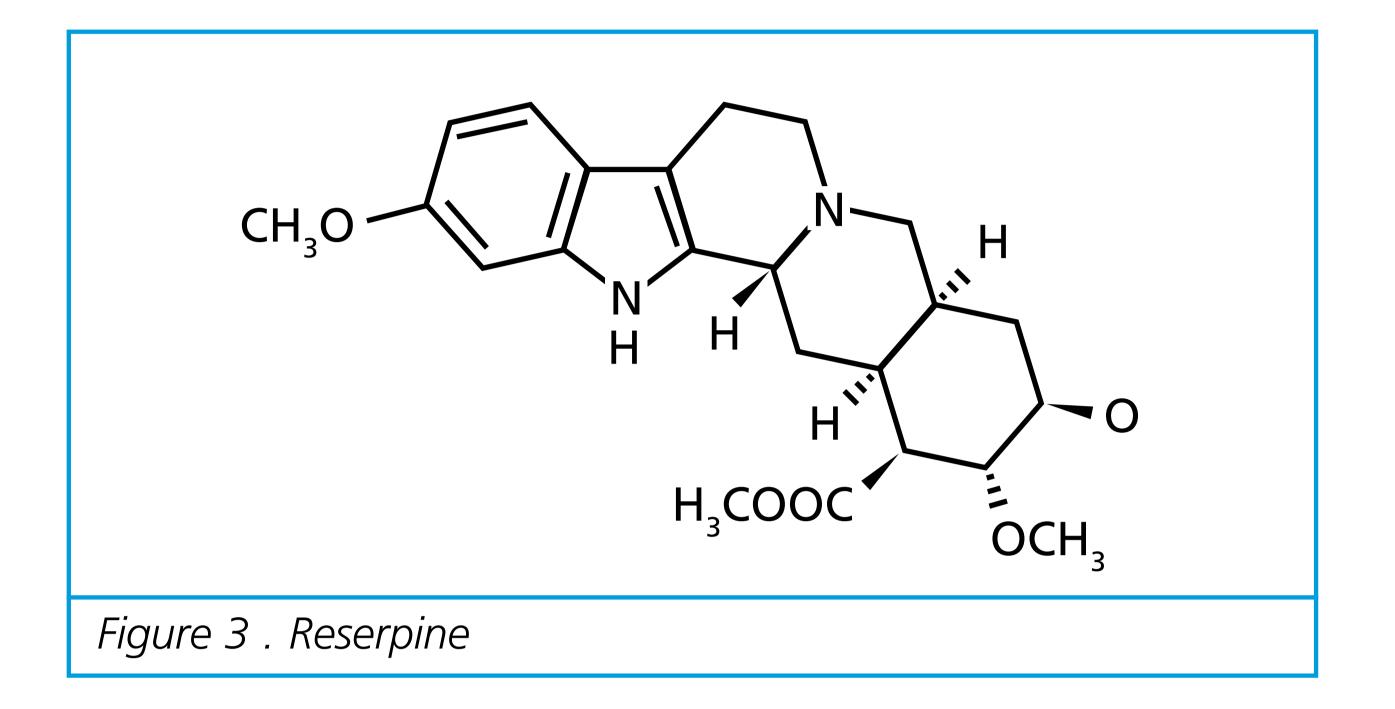
- . Ultra Smooth surface with Hydrophobic needle coating this coating reduces the surface energy of the needle and allows hydrophilic samples to be more easily washed out of the needle.
- 2. Ultra Smooth surface with Hydrophilic needle treatment the treatment applied increases the surface energy of the needle and allows hydrophobic samples to be more easily washed out of the needle.
- 3. Ultra Smooth surface with no coating or treatment this uncoated needle has the same needle finishing process applied as the hydrophilic and hydrophobic needles. This needle offers a dramatic improvement in sample recovery when compared with a conventional needle syringe.

3 Ultra Smooth needles available for you to choose based on your sample properties:	
Ultra Smooth with Hydrophobic Coating	
Ultra Smooth with Hydrophilic Coating	
Ultra Smooth	
Figure 2 . Diamond MS needle options	

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# **Testing Methodology / Procedure**

Extensive tests were conducted with Diamond MS Syringes using known 'sticky' substances such as Reserpine and a series of syringe cleanliness tests were performed.



#### Sample preparation

Cleanliness Testing: A series of syringes were prepared with each type of needle treatment and a comparative sample of conventional syringes taken. The syringes were individually removed from their packaging and tested immediately. Each syringe was used to first aspirate Methanol and then dispense into a "Mass Spec Certified" vial. The vial was then loaded into an autosampler sample tray. Six consecutive washes were collected and loaded into the sample tray in the same fashion. This was repeated for each syringe in the sample set.

Reserpine Washability Testing: A series of syringes were prepared with each type of needle treatment and a comparative sample of conventional and competitive syringes taken. Each syringe was intentionally contaminated by aspirating and dispensing 10 uL of Reserpine. Methanol (10  $\mu$ L) was then aspirated into the syringe, dispensed into a "Mass Spec Certified" vial and loaded into an autosampler tray. This washing step was repeated with samples collected after 2, 3, 4, 5, 10 and 20 washes and loaded into the autosampler tray in the same fashion. This was repeated for each syringe in the sample set.

#### **Sample Injection**

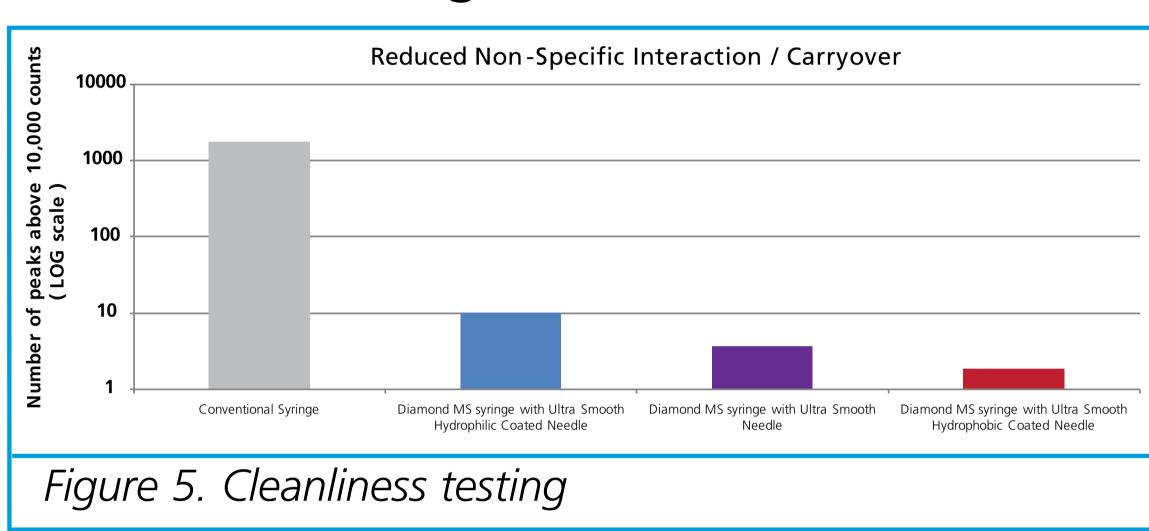
The samples were injected via an Eksigent Tempo LC system. The loading pump (50 % Methanol/0.1 % Formic acid/Water) was used to infuse (initial flow of 2  $\mu$ L/min then reduced to 0.5 µL/min for analysis) via a nanospray III ion source into an AB Sciex QTRAP 5500. Spectra were collected for a positive EMS scan of 100-1000 amu.

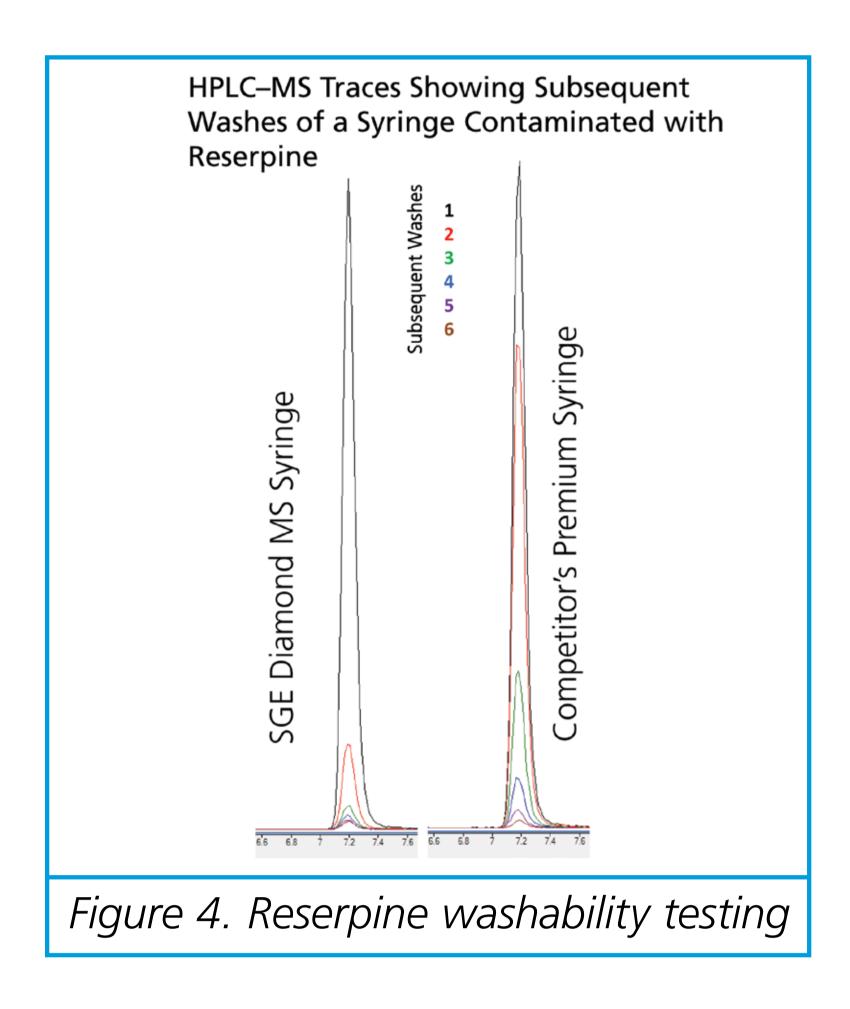
#### Results

#### **Reserpine Washability Testing:**

The Diamond MS syringe with ultra smooth needle cleans with fewer washes than a competitive premium syringe product.

#### **Cleanliness testing:**





The averaged non-specific interaction and carryover of washed syringes shows low level unspecified contamination and clearly demonstrates the significant impact needle treatment has on whether contamination is washed from the syringe. (Note the vertical axis uses a logarithmic scale.)

Where the contamination is of a hydrophilic nature, a low level of interaction was seen with the ultra smooth hydrophilic treatment, the contamination was easily washed from the un-treated ultra smooth needle and negligible interaction with the hydrophobic ultra smooth needle surface was recorded.

# Conclusion

Analyses performed on today's latest, most sensitive, mass spectrometry instrumentation will benefit from being coupled with the latest, most innovative, syringe technology. Diamond MS syringes demonstrate superior performance in reduction of carryover and non specific interactions when compared to conventional syringes and competitive premium syringe products.

The Diamond MS syringe range combines reduced non-specific sample interaction and extremely low levels of carryover with a choice of needle chemistries providing significant improvements to the reproducibility and sensitivity of mass spectrometer analyses.

### Acknowledgements

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