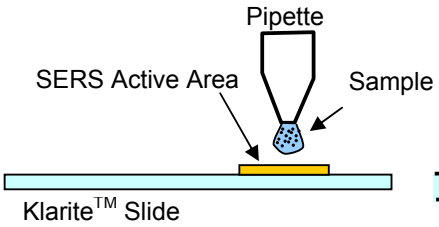
The 3 Step Sample Preparation for Klarite™ SERS Chips

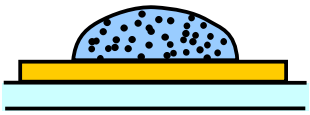
Application Note 001

Klarite™'s substrate reproducibility and high enhancement factors allow materials to be deposited in small quantities without expensive surface chemistry or high laser power. The enhancement factors allow detection of physiological concentrations [1-100µ M]. The reproducibility across the chip allows spatial and compositional imaging of the sample down to sub-monolayers or quantitative analysis without requiring high laser power. This makes SERS extremely attractive for fast and cost effective applications.
Preparation of the Klarite SERS chip is done in the three steps described below. This application requires a Raman Instrument with a CCD detector as well as an instrument equipped with a microscope for imaging. This method can be applied to different organic or inorganic analytes in solution.

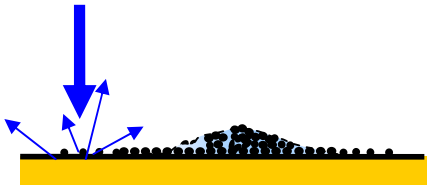
1. Deposition



2. Evaporation



3. Measurement



Step 1.

A liquid sample of typically 4 µL is deposited onto the Klarite chip using a pipette. If the drop does not detach from the pipette, carefully let the drop touch the substrate and then transfer the drop onto the substrate. Avoid touching the chip with the tip of the pipette. A scratch to the gold surface on the chip will ruin the active area and adversely affect the measurement results.
The solution used in this example has been obtained by diluting 7.5mg of L-Alanine (Sigma-Aldrich A7469) in 15mL of ultra-filtered water (Sigma-Aldrich 95289).

Step 2.

In general the evaporation process of any liquid on a surface produces one of three main types of patches: coffee rings[1,2], crystalline capillaries or spot-like stains. The evaporation result depends on the interplay of adhesive forces of the substrate and cohesive forces of the fluid. The L-Alanine used in this example was left at room temperature in a clean lab environment for about 30 minutes for the solvents to evaporate.

Step 3.

Once the sample is dry, SERS measurement can be carried out across the patch. The patch will appear formed by many concentric rings of different colours. Crystalline islands can also form inside the patch for concentration typically > 1µM. In general, size and characteristics of the film patch and crystalline islands depend on the concentration of the solution, the purity of the solvent and polar nature of both the analytes and the solution. In this case, a spot like stain is formed. A typical spot like stain is shown in Fig. 1 on page 2.

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Figure 1.

Spot like evaporated drop of a 5mM L-Alanine on Klarite™ substrate. The picture has been acquired with a 5x microscope objective

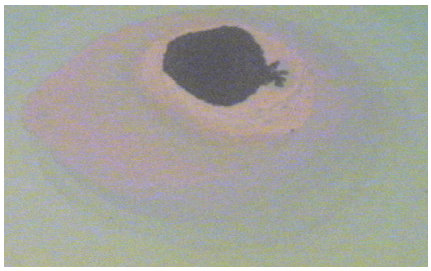
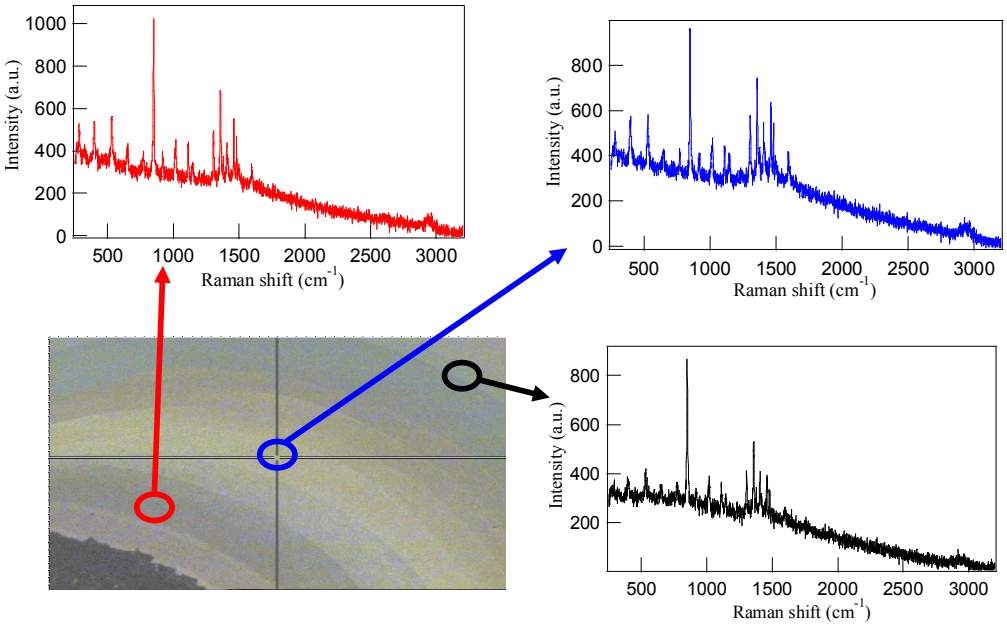


Figure 2.

SERS spectra acquired on L-Alanine dried film (56.1 mM) deposited on Klarite with 15mW at 785nm.



Typical spectra of L-Alanine across the film patch are shown in Fig. 2. The spectra have been acquired in 10 sec of CCD exposure time with 15mW laser power at 785nm excitation. No normalization and baseline subtraction has been performed for the spectra. Quantitative data on film composition and molecular interaction can be obtained by probing the Raman features across the patch.

Further applications notes and experimental data is available on www.mesophotonics.com

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[1] *Raman Detection of Proteomic Analytes* Dongmao Zhang, Yong Xie, Melissa F., Mrozek, Corasi Ortiz, V. Jo Davisson, and Dor Ben-Amotz. Anal Chem. Anal. Chem. **75** 5703-5709 2003.

[2] *Capillary flow as the cause of ring stains from dried liquid drops*, R.D. Deegan, O.Bakajin, T.F. Dupont, G. Huber, S.R.Nagel, and T.A.Witten, Nature **389**, 827-829 (1997)