Body fluid traces can be automatically detected in situ regardless of the substrate using Raman hyperspectroscopy

Universal detection of body fluid traces in situ with Raman hyperspectroscopy for forensic purposes: Evaluation of a new detection algorithm (HAMAND) using semen samples

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Background

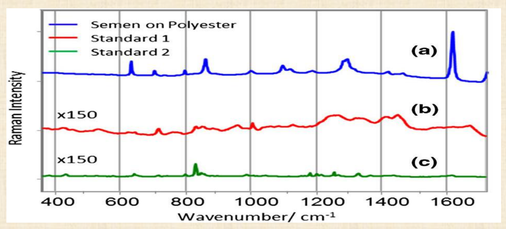
- Biological stains recovered at a crime scene play a significant role in reconstructing the event and providing *DNA* material. As ultrasensitive DNA techniques are
- Raman spectroscopy is highly amenable to the forensic community as this methodology is nondestructive, noncontact, and identifications are generally considered confirmatory.
- A possible new approach is reported here for the detection and identification of biological stains on strongly interfering substrates using *Raman hyperspectroscopy* combined with a newly developed (*HAMAND*) software.

Methods

- Spectra were obtained with Renishaw inVia spectrometer and Leica confocal microscope.
- Raman mapping was performed for points on stain and neat substrate.
- A dataset of 49 reference spectra of dried semen on aluminum foil was used from donors.
- Simulated evidence was prepared with trained *HAMAND* program that was applied to the samples on glass and blue dyed 100% polyester.

Results

- Glass is a problematic substrate due to high fluorescence: the fluid contribution is cryptic;
- The Raman spectrum of semen on blue polyester displays several prominent Raman bands throughout the fingerprint region atop a nearly flat baseline;
- Neat portions of both glass and blue polyester show a zero magnitude of the extracted standards

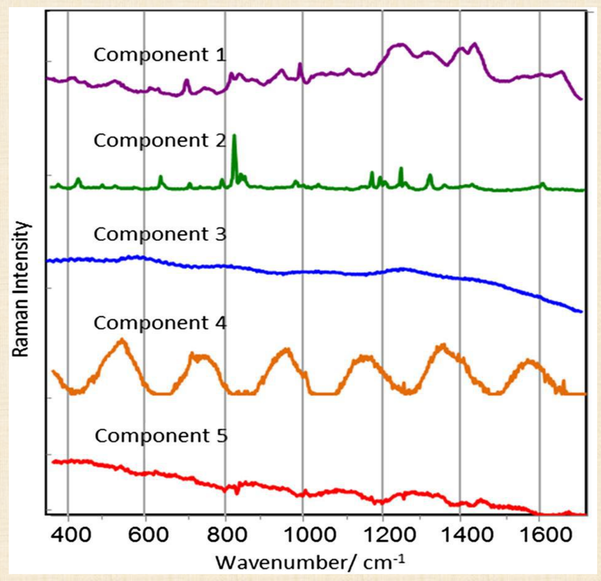


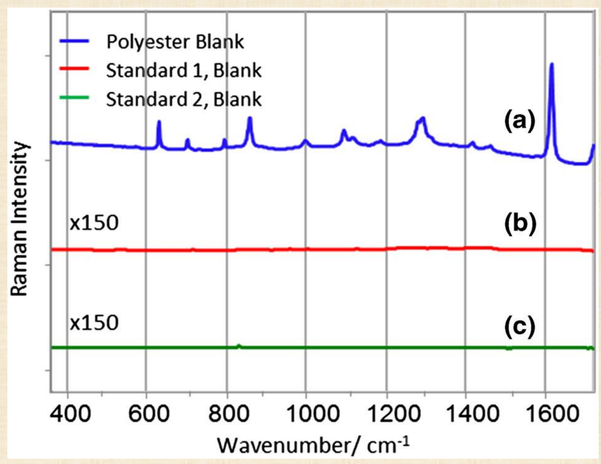
Fabric substrates suppresses organic Raman bands from semen

Discussion

- The spectrum of neat glass and semen show no commonalities;
- Polyester and semen share several common spectral bands;
- The developed algorithm preserves the selectivity of the Raman approach;
- For any individual-component-based identification method, there is a risk of specificity being compromised.

Analysis of the neat semen dataset extracted several components representative of baseline features and two spectral components, referred to Components 1 and 2). They capture the signature vibrational bands of semen suitable for identification. These spectral components have been attributed to contributions from tyrosine, general protein content, and spermine phosphate hexahydrate, respectively.





Algorithm preserves the selectivity of the Raman approach

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