A186 Evaluation of Lip Cosmetics Using Raman Spectroscopy

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After attending this presentation, attendees will be informed about the possibility of using Raman spectroscopy in the analytical scheme for lip cosmetics.

This presentation will impact the forensic science community by suggesting a non-destructive, rapid method for evaluation of lip cosmetics that can provide significant discriminatory information for comparisons.

Because of the ease of transfer and prevalence of use, lip cosmetics are often encountered on crime scenes. The vast array of different manufacturers, product types, and colors make them a potentially powerful source of associative evidence. However, many current analytical schemes need components of lip cosmetics to be extracted and analyzed separately. For example, dye components may be extracted and analyzed with High Performance Liquid Chromatography (HPLC) or Thin Layer Chromatography (TLC), while oils and waxes may be analyzed using Gas Chromatograph/Mass Spectrometry (GC/MS). Raman spectroscopy can give a more complete look at chemical composition without need for extraction procedure, which reduces both handling time for the sample and risk of contamination.

In this study 80 lipsticks, 34 lip glosses, and 17 lip balms were obtained from donations and evaluated using Raman spectroscopy at an excitation of both 532 and 780nm. Pure samples were analyzed as smears on aluminum foil. Intra-product studies were first conducted to determine the effect of dye combinations when the base composition was unchanged. Four common colors, red, brown, purple, and purple-brown were selected from the lipsticks and grouped with ten similarly colored products from different manufacturers for comparison. Any two lipsticks outside these groupings with visually identical colors were also compared. The possibility of examining cosmetic samples directly from a substrate (such as cotton swabs, colored fabrics, and automobile panels) was also evaluated. For substrate studies, two identically colored lipsticks were selected and applied to the desired surface and examined without extraction. The ability to distinguish the lipstick from the substrate as well as the ability to differentiate between lipstick samples was assessed. Spectra were compared using visual overlays.

While fluorescence severely limited the analysis by the 532nm source, the 780nm source provided useful spectra from all analyzed samples. Within a brand, colors from the same product line could be distinguished from one another using Raman spectroscopy alone. This was true even for colors that were very close to one another, indicating that dye components contribute significantly to the Raman spectra. It was also possible to distinguish between the same colors from different products within the same manufacturer.

In inter-brand comparison of similarly colored samples, the lipstick samples could all be discriminated using only the Raman spectra. Many similarities were attributed to dyes used, but there was enough variation between dye formulations and other chemical components to provide unique spectra. Lip glosses and lip balms showed less variation within the same product, mostly likely due to less contribution from pigmentation. It was also possible to distinguish the lipstick signal from the substrates examined. However, there was detail lost from the pure spectra. Despite this, it was still possible to use the spectra as a source of discriminatory information.

Instances where spectra could not be differentiated were limited to lip glosses and lip balms of different colors from the same product type and manufacturer. No lip glosses or lip balms had the same spectra as a lipstick. Variation in chemical composition of lip cosmetics provides significant discriminatory power and opens the possibility of creating a database that catalogues Raman spectra of lip cosmetics.

Lip Cosmetics, Lipstick, Raman Spectroscopy

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