B37 Evaluation of Microscopy and Vibrational Spectroscopy for the Discrimination of Purple and Blue Nail Polishes

Brianna Kroon, 4333 Wells Curtice Road, Canandaigua, NY 14424; Elaine M. Pagliaro, JD, University of New Haven, Lee Institute of Forensic Science, 300 Boston Post Road, West Haven, CT 06516; and Brooke W. Kammrath, PhD, University of New Haven, Forensic Science Dept, 300 Boston Post Road, West Haven, CT 06516*

After attending this presentation, attendees will understand the discriminating power of microscopic and spectroscopic analytical methods for the analysis of blue and purple nail polishes.

This presentation will impact the forensic science community by evaluating the discriminating potential of microscopic and spectroscopic methods for the analysis of blue and purple nail polishes.

Nail polish is a common and popular quick-drying lacquer that is painted on fingernails or toenails for aesthetic purposes. Nail polish falls under the category of cosmetic evidence and limited research has been performed regarding the evaluation of microscopy (stereomicroscopy, brightfield, and polarized light) and spectroscopy (infrared and Raman) as these techniques relate to nail polish as cosmetic evidence. Although identification and discrimination of nail polish is not commonly practiced by forensic scientists, cosmetic evidence and, more specifically, nail polish has played a key role in criminal cases. Most infamously, nail polish was valuable forensic evidence in the "Wood Chipper Murder Case" in Connecticut. Nail polish is either a transparent or colored lacquer that contains the following basic components: film forming agent, resins or plasticizers, solvents, and coloring agents. Each component has a different purpose: the film-forming agent creates a protective layer over the polish; the plasticizer or resin improves flexibility of the nail polish and makes the nail polish more resistant to water and soap; the volatile solvents hold the mixture of materials and colorings until the polish is applied; and the coloring agent, which is comprised of organic dyes or inorganic pigments, contributes to the overall color of the nail polish.

Nail care is a large part of the cosmetic industry, with global sales in 2014 estimated to be nearly $1.2 billion. Nail art not only follows trends but is also viewed as a form of personal expression, which is why there is a plethora of available colors. This study focused on blue and purple nail polishes, which have not yet been studied by the forensic science community.

The discrimination power of microscopic and spectroscopic methods was evaluated in this research. Seven different brands of nail polish with seven different shades of purple and blue per brand of nail polish were analyzed. The shade of blue and purple were chosen to be as similar as possible between the brands, and a variety of brands were chosen to represent a selection of salon-quality polishes as well as polishes intended for at-home use. A total of 49 different polishes were analyzed using three types of microscopy (stereomicroscopy, brightfield, and polarized light microscopy) and two types of spectroscopy (Raman and attenuated total reflection Fourier Transform infrared microspectroscopy) in order to determine whether these methods could provide discrimination between the 49 bottles of blue and purple nail polish and/or brand identification.

All 49 bottles of nail polish were able to be discriminated microscopically, based on various pigment characteristics (i.e., size, dispersion, density, color, etc.), as were the presence of distinct effect pigments in some of the samples. Raman spectroscopy was successful in identifying some pigments in the polishes, specifically Pigment White 6 (anatase) and Pigment Blue 27; however, there was fluorescence in several samples that prevented pigmentation identification for every blue and purple polish. Infrared spectroscopy was used for brand identification, with Principal Component Analysis/Canonical Variate Analysis (PCA/CVA) hold-one-out cross validation proving to have a 1.9% error rate. The results from this research provide valuable information about cosmetic evidence that criminalists can use in investigations and adjudications.

Nail Polish, Microscopy, Spectroscopy

Copyright 2016 by the AAFS. Unless stated otherwise, noncommercial *photocopying* of editorial published in this periodical is permitted by AAFS. Permission to reprint, publish, or otherwise reproduce such material in any form other than photocopying must be obtained by AAFS.

*Presenting Author