J7 The Discrimination of Less Frequently Encountered Colored Pen Inks Based on Their Optical Properties

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After attending this presentation, attendees will better understand the most discriminating optical properties of less commonly encountered colored pen inks.

This presentation will impact the forensic science community by providing guidance on the most efficient use of optical techniques to the differentiations of ink samples, given the ink type and color.

Commercially available writing instruments include a wide variety of body styles, ink delivery systems, ink types, and colors. An extensive body of research has been dedicated to investigating multiple methods of ink analyses and differentiation of inks. However, the majority of these studies have focused on the more popular black and blue inks. Less data are available to questioned documents examiners when confronted with less frequently encountered colored inks, such as red, purple, green, turquoise, pink, orange, and maroon. Therefore, this study explored the properties of inks of less common colors of frequently encountered writing instruments such as ballpoint, rollerball, porous-tips, and gel pens. Initially, this study considered the optical properties of the ink samples because these are the first features that questioned document examiners inspect, especially in the context of comparative examinations between unknown specimens and inks from known sources. The goal of this study was to determine the most discriminating conditions for a given set of ink type and color. This was achieved by spanning different illumination techniques that are commonly utilized during questioned document examinations, such as sample exposure to filtered colored light, infrared reflectance, infrared luminescence, and fluorescence by ultraviolet excitation.

A total of 163 colored ink samples of popular brands such as BIC, Zebra, Pentel, Schneider, and Cello were collected from large retailers in the US. They were divided in groups based on their ink type and on their visually perceived colors. The groups consisted of 26 red ballpoints, 6 red rollerballs, 22 red gels, 5 red porous, 23 green ballpoints, 5 green rollerballs, 16 green gels, 5 green porous-tips, 16 purple ballpoints, 4 purple rollerballs, 17 purple gels, 3 purple porous-tips, 2 maroon gels, 2 orange gels, 5 pink ballpoints, 5 pink gels, and 1 pink porous.

Spectral comparisons were carried out to discriminate ink samples within each category. Each sample was observed using an examination matrix where the techniques and filters were selected in the Video Spectral Comparator system including: flood visible light and infrared (IR) reflectance from 530-1000nm; IR fluorescence; and, ultraviolet for 365, 312, and 254nm.

For red ballpoints, 303 of the 325 pairs were differentiated and 189 of the 231 red gel pairs, all ten pairs of the porous pairs, and 3 of the 15 roller ball pairs were also differentiated. The most discriminating illumination type for red pens was absorption starting at 417, 431, 446, 492, or 507 and reflectance up to 612 or 627nm with the IR reflectance band pass filters.

For green ink types, all 253 ballpoints pairs, 120 gel pairs, 10 porous pairs, and 10 rollerball pairs were differentiated. The most discriminating illumination type for green pens was absorption starting at 431, 446, 462, 507, or 522nm, and reflectance up to 702, 732, 717, or 837nm with the IR reflectance band pass filters.

For purple porous pens and rollerballs, all pairs could be differentiated, with the most discriminating illumination type being absorption from 476/482nm, and reflectance up to 732/792nm for purple porous pens using the IR reflectance band pass filters. The most discriminating illumination type for rollerballs was absorption from 462/492nm and reflectance from up to 642/732/792nm. For purple ballpoints and gel pens, all pairs were discriminated; the most discriminating illumination type for both was absorption starting from 431/507nm, and reflectance up to 642 or 792nm using the IR absorption band pass filters.

For pink ballpoints, pink gels, and orange gels no differentiations were observed. However, differentiation of the pair of maroon gels was possible with the most discriminating illumination type being absorption up to 665nm for IR fluorescence filters 485-590 and 485-610nm, and fluorescence up to 725nm using the 515-640nm IR fluorescence filter.

Inks, Spectral Comparisons, Discriminations