B43 Colorimetric Analysis of Glass Fragments

Paul Martin, PhD, CRAIC Technologies, 948 North Amelia Avenue, San Dimas, CA 91773; and Mike Eyring, MS, Micro Forensics, Ltd., 1141 West Glenrosa, Phoenix, AZ 85013*

After attending this presentation, attendees will learn a technique to accurately quantify color information of microscopic glass fragments and allow for simple comparison of known and questioned glass samples.

This presentation will impact the forensic community and/or humanity by introducing a new technique that will allow the criminalist to obtain objective color information on microscopic glass fragments.

Historical evidence shows that mankind started making glass approximately 5500 years ago and chiefly used it as glazes on pottery. The earliest finds of manmade glass objects were fragments of vases dating back to 1600 BC and were found in Mesopotamia. Glassblowing techniques were first developed in Syria approximately 2000 years ago and the Romans spread the techniques throughout their empire. In the 11th century, sheet glass was first developed in Germany and plate glass was originally made in France in 1688. With the advent of the industrial revolution, glass production increased and prices dropped. Glass was cheap and easily available. Because of its unique properties and low cost, many uses were found for this material.

Glass fragments are commonly found at crime scenes and can be from a number of different sources. At the scene of a car accident, these may include windshields, mirrors, and headlamps. At a burglary, the evidence may include broken windows and containers. At a homicide, the evidence may encompass eyeglasses, windows, bottles and other containers. In recent years, plastics have supplanted glass, as they tend to be more resistant to breakage. However, under energetic conditions (an automotive accident for example), plastics shatter just as easily as glass and yield similar types of microscopic evidence. While they can be readily differentiated from glass, they are more difficult to separate from one another and as such represent important evidence.

Due to the multitude of uses found for this type of material, glass is formed in many different ways and in many different colors. And because it shatters so easily, it is commonly found as microscopic shards at the crime scene and as such can be very difficult to obtain accurate colorimetric information. This is because the randomness of the shape of the glass fragments leads to refraction and diffraction of light passing through it. These optical effects can make the glass evidence appear to be one color when observed from one angle and change colors as it is rotated. When analyzed with a UV-visible range microspectro- photometer using standard techniques, refraction and diffraction cause spectral artifacts to appear. These artifacts appear in a number of different forms and include peak shifting, reshaping of peaks and dramatic changes in intensity. To date, it has been very difficult to get accurate and quantifiable color data on microscopic glass fragments because of these effects.

The purpose of this paper is to describe a technique that eliminates the spectral artifacts and allows for the microspectroscopic analysis of glass and plastic trace evidence. These techniques include sample preparation, methods of spectral data acquisition and, of course, spectral analysis, and interpretation. Sample preparation is especially critical. In this step, the refractive phenomena of the glass are eliminated by immersing the fragments in a liquid of matching refractive index. Several commonly available fluids are examined in order to find those that have the broadest spectral range, durability under high energy illumination and the closest refractive index match to a broad spectrum of glass samples. A reusable sampling cell, designed for use with upright microscopes or microspectrophotometers, is also described.

This presentation will also review the data from a number of glass samples in order to provide the examiners with representative data to aid them with their casework. This includes microscopic samples of glasses of different colors and from a multitude of sources. Micro-spectra have been acquired and are compared and contrasted in order to educate the audience on the pertinent features of the spectra.

Glass, Microspectroscopy, Colorimetry

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