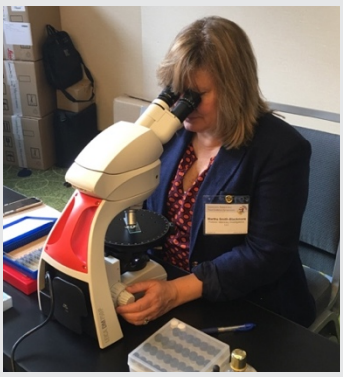
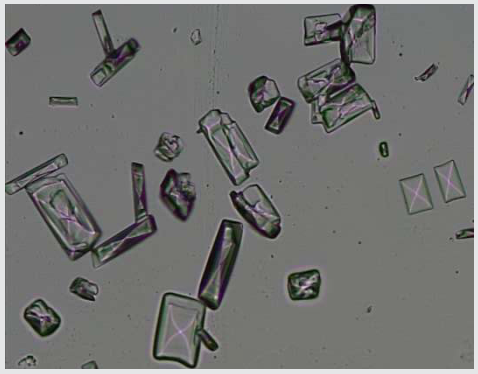
Forensic Technology
CENTER OF EXCELLENCE
A program of the National Institute of Justice

IN-BRIEF

IPTES 2018 Workshop: Applied Polarized Light Microscopy for Trace Evidence Examiners





"This workshop not only served as an excellent introductory course to polarized light microscopy for beginners, but also as great refresher course for experienced trace evidence examiners."

-Workshop Attendee

Introduction

The Forensic Technology Center of Excellence (FTCoE), led by RTI International, is supported through a cooperative agreement with the National Institute of Justice (NIJ), award 2016-MU-BX-K110. The FTCoE supports the implementation of new forensic technology and best practices by end users. One way the FTCoE bridges the gap between the scientific and justice communities is through hosting national meetings that bring together professionals spanning several areas of expertise.

The FTCoE hosted the Impression, Pattern and Trace Evidence Symposium (IPTES) on January 22-25, 2018 in Arlington, Virginia. This symposium brought together over 600 practitioners and researchers to enhance information-sharing and promote collaboration among the law enforcement, legal, and impression, pattern, and trace evidence communities. Participants were able to engage in a variety of content, including keynote addresses, panel discussions, and poster and scientific sessions.

Prior to these general plenary sessions, the FTCoE hosted 13 interactive workshops spanning several topics, including firearm and tool mark examinations, probabilities and likelihood ratios in pattern evidence, and applied polarized light microscopy. This in-brief report highlights the Applied Polarized Light Microscopy for Trace Evidence Examiners workshop, which provided an overview of the topic and guided participants through hands-on exercises.

Objectives

- Describe the basics of polarized light microscopy to attendees.
- Demonstrate the theory and application of polarized light microscopy.
- Investigate hands-on exercises designed to demonstrate the concepts illustrated in lecture.
- Establish the significance of the observations made with polarized light microscopy.

Overview

Purpose

Polarized light microscopy (PLM) is a technique commonly used in the field of forensic science. PLM characterizes and identifies trace evidence found at crime scenes, such as fibers, hairs, paints, and glass fragments. This 2-day course introduced attendees to the theory and applications of PLM utilizing a combination of lecture and laboratory activities. Topics included proper microscope setup, refractive index measurement, basic optical crystallography, retardation and birefringence, extinction characteristics, and compensators.

About the Instructors

This workshop was instructed by Andrew Bowen, a senior forensic chemist at the U.S. Postal Inspection Service, and Sebastian Sparenga, a senior research microscopist and instructor at McCrone Research Institute. These instructors are both actively involved in casework and research activities and have more than 30 years of combined experience in microscopy instruction.

Summary of Workshop Material

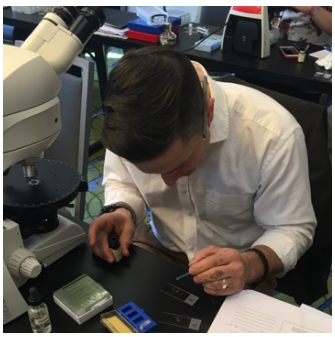
Microscope Optics and Setup

Proper microscope setup is critical to analyzing evidence in a forensic laboratory setting. Attendees first learned about image formation in a compound light microscope followed by the guidelines for proper microscope setup (Köhler Illumination). The benefits of setting a microscope up using Köhler Illumination include maximum control over the contrast, resolution, and depth of field as well as even illumination over the entire field of view.

Attendees completing a laboratory exercise during the workshop.

Refractive Index Measurement

Refractive indices were one of the next topics discussed during this workshop. The refractive index of a material is the relative measure of the speed of light through a material versus the speed of light in a vacuum. The refractive index of a material, such as a glass fragment, fiber, or other particle, can be determined by immersing the sample into liquids with different refractive index values and analyzing the optical properties of the unknown sample during immersion.



Attendee determining the refractive index of an unknown sample.

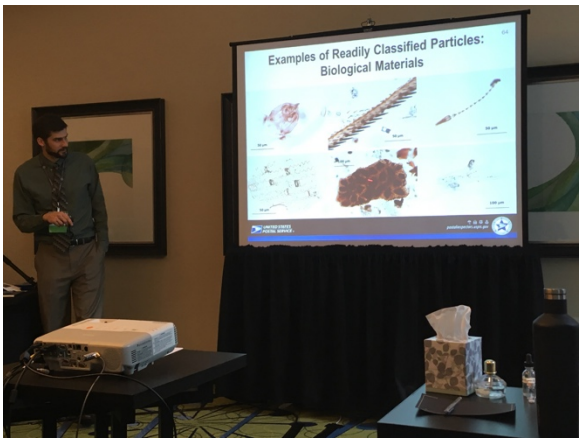
Crossed Polars

Crossed polars is a technique that can be used to determine additional properties to characterize and identify unknown samples. Crossed polars refers to the state in which the polarizer (located on the microscope below the sample) and the analyzer (located on the microscope above the sample) are perpendicular to each other. In this orientation, only light vibrating in a certain direction (referred to as the privileged direction) can pass through to the eye.

Using crossed polars, attendees were able to determine the birefringence of a substance which is another characteristic just like shape, size, or color. A substance with only one refractive index, referred to as isotropic, has no birefringence and remains dark under crossed polars. Substances with two or three refractive index values, considered anisotropic, remain bright in certain orientations under crossed polars. A birefringence value or number can be determined for these anisotropic substances that can be useful in comparing and identifying samples.

Forensic Significance

PLM is a technique that is very useful for the quick screening of materials, and based on the properties observed using PLM, unknown samples can be easily identified and compared to other materials. Additionally, microscopy can be paired with other types of instrumentation (e.g., Raman or Fourier transform infrared spectroscopy) to aid in the identification and comparison processes. This workshop provided participants with a foundation in PLM techniques and theories that can be applied to casework.



Instructor Andrew Bowen dicussing the roles of polarized light microscopy in trace evidence examinations.

Further Reading and More Information

The instructors recommend the following resources:

[1] Winchell, AN, Winchill, H. *The Microscopial Characters of Artificial Inorganic Solid Substances: Optical Properties of Artificial Materials.* McCrone Research Institute, Chicago, IL: 1989.

[2] Winchill, AN. *The Optical Properties of Organic Compounds.* 2nd ed. McCrone Research Institute, Chicago, IL: 1987.

For more information about the 2018 Impression, Pattern, and Trace Evidence Symposium, visit https://forensiccoe.org/workshop/18-iptes/.

Photo Credit (pages 1-3): RTI International Staff

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