McCRONE ASSOCIATES, INC.

60 YEARS 1956 – 2016

ACCREDITED Certificate #3631.01

The CURSE of the Light Microscope

Wayne D. Niemeyer

Senior Research Scientist

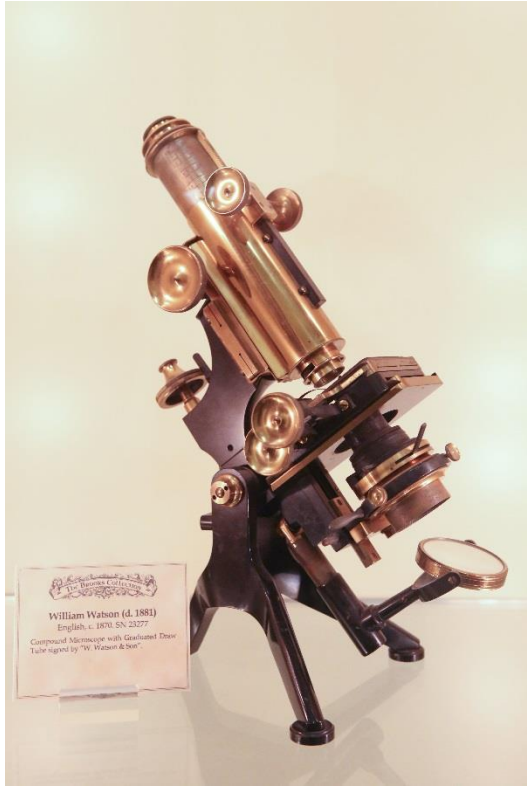
Historical Development of the Compound Microscope

- ca. 1590 Hans and Zacharias Janssen combine two simple microscopes to form a compound microscope.
- ca. 1665 Robert Hooke devised a compound microscope to observe opaque objects.
- ca. 1681 Christian Huygens invented an ocular for the telescope which was later adopted universally for the compound microscope
- ca. 1800 Thomas Young corrected lenses for astigmatism.
- ca. 1873 Ernst Abbe designed a chromatic substage condenser which is still furnished with many of today's microscopes.
- ca. 1886 Abbe, Schott, and Zeiss collaborated to perfect apochromatic objective lenses.
- ca. 1900 The compound microscope had essentially evolved to its present form.

- Ref: Needham, George Herbert, The Practical Use of the Microscope Including Photomicrography, Thomas Books, ©1958

Microscope Museum at The McCrone Group (The Brooks Collection)

- Approximately 200 microscopes on display and another 200-300 in storage. Earliest microscope in the collection is ca. 1680.
- Includes approximately 2,500 volumes of books on microscopy and optics dating back to 1630.



ca. 1870

ca. mid 1700's

The CURSE Begins and Intensifies:

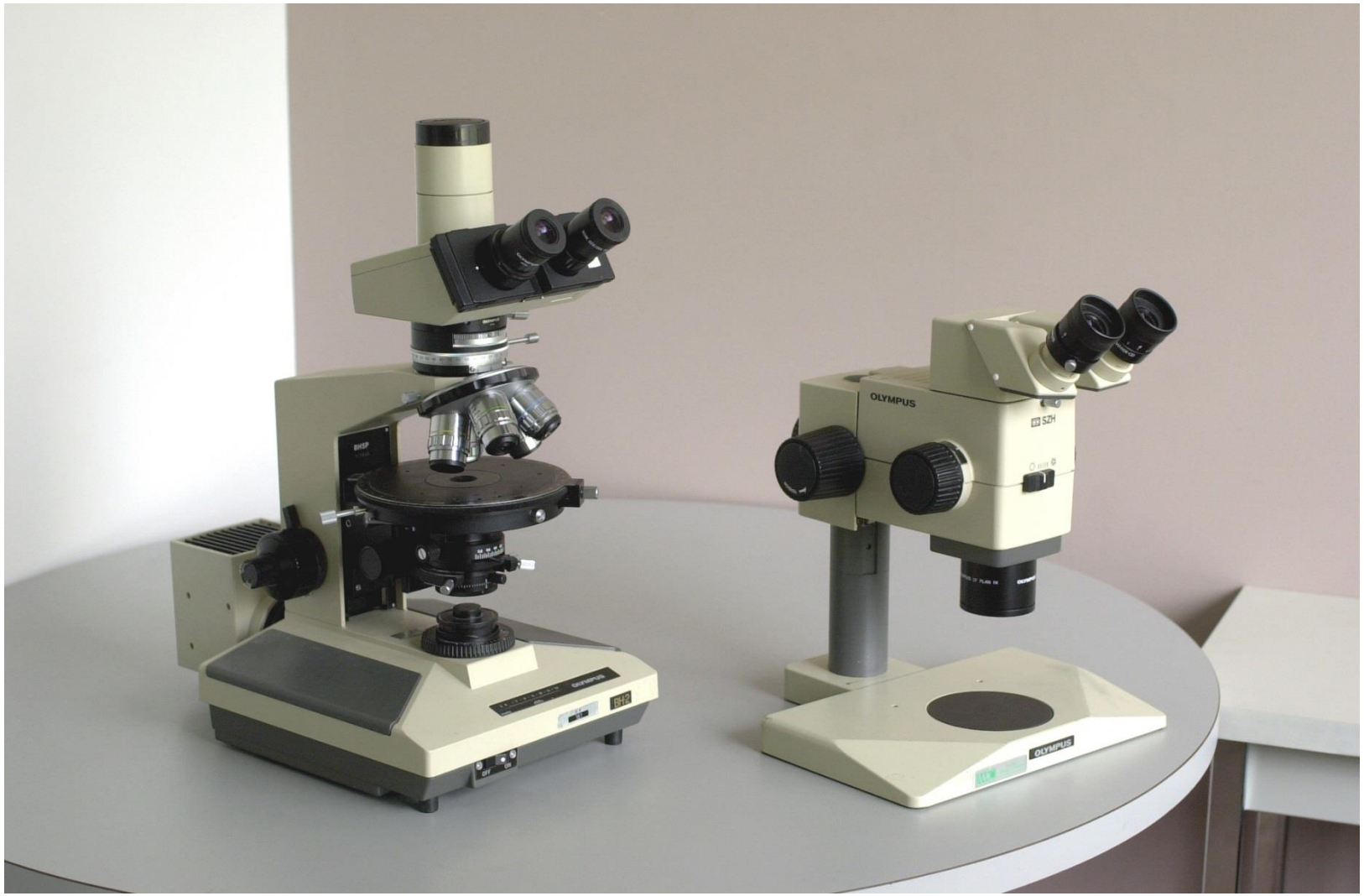
- When you buy (or inherit) any microscope
- As you start using it to examine objects
- As you learn more about microscopy through:
  - "brute force" experience
  - reading microscopy literature
  - participate in formal training classes
  - attend microscopy conferences/seminars/webinars

What is the CURSE ?

It is *LIGHTING*!!!!

Basic Compound and Stereo Microscopes

(ca. late 1980s)



Stereo Microscope and Lighting Accessories

Compound Microscope and Lighting Accessories

“Fully” Equipped Compound and Stereo Microscopes

Examples from the Stereo Microscope

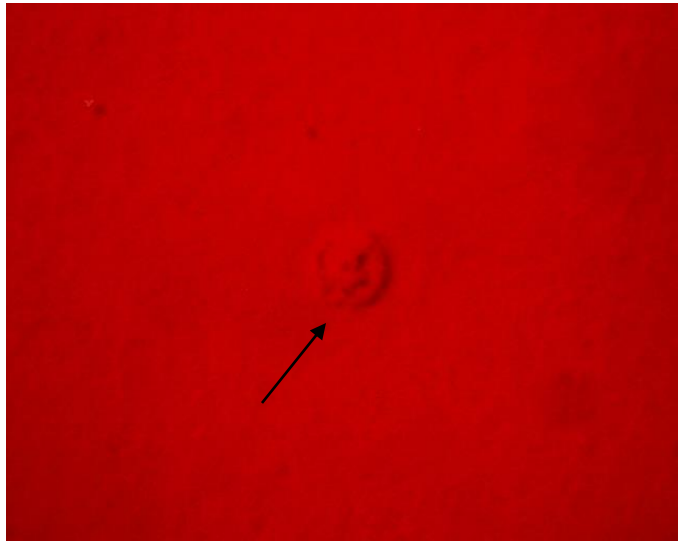
Illumination Systems* for the Stereo Microscope

- Oblique
- Reflected Coaxial
- Ring Light
- Transmitted Brightfield/Darkfield

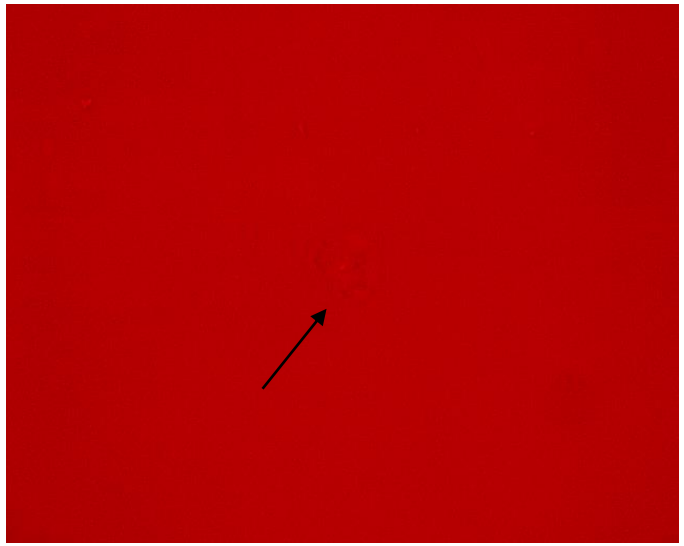
* Suggested minimum requirements

Crater Defect in Paint

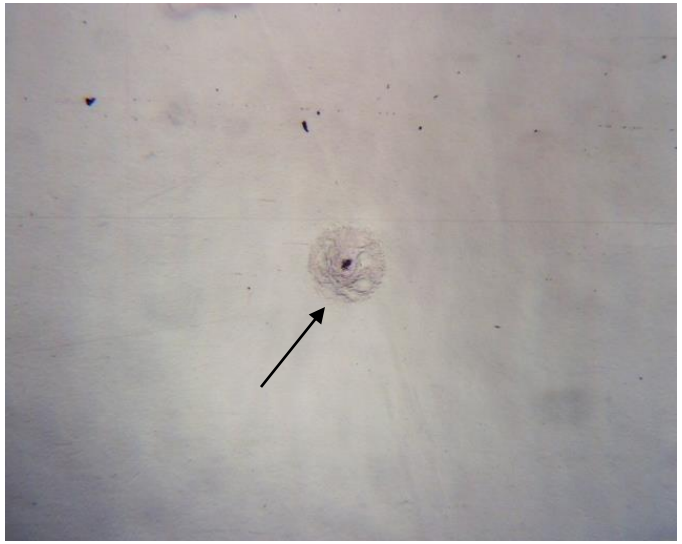
(Original Magnification: X64)



Oblique Illumination



Ring Light Illumination

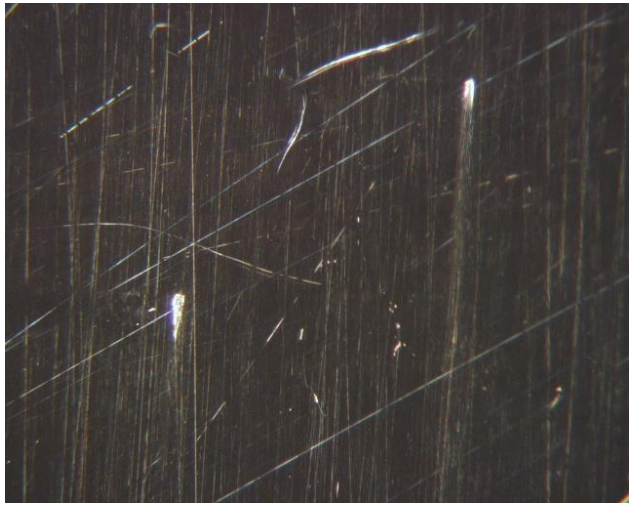


Coaxial Illumination

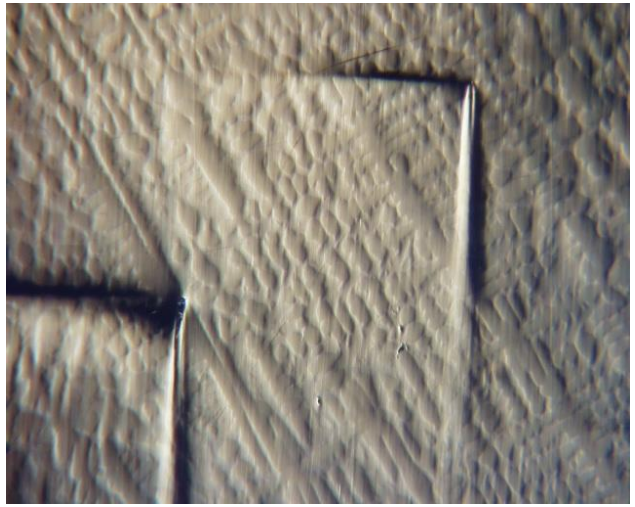
“Comet” Defects on Polished Brass

(Original Magnification: X50)

Oblique Illumination



Ring Light Illumination



Coaxial Illumination

Deposit on Polished Beryllium Plate

(Original Magnification: X64)

Coaxial Illumination

Coaxial Illumination with ¼ λ plate rotated for “extinction”

Burned Circuit Board

(Original Magnification: X35)

Oblique illumination from left

Ring Light illumination

Examples from the Compound Microscope

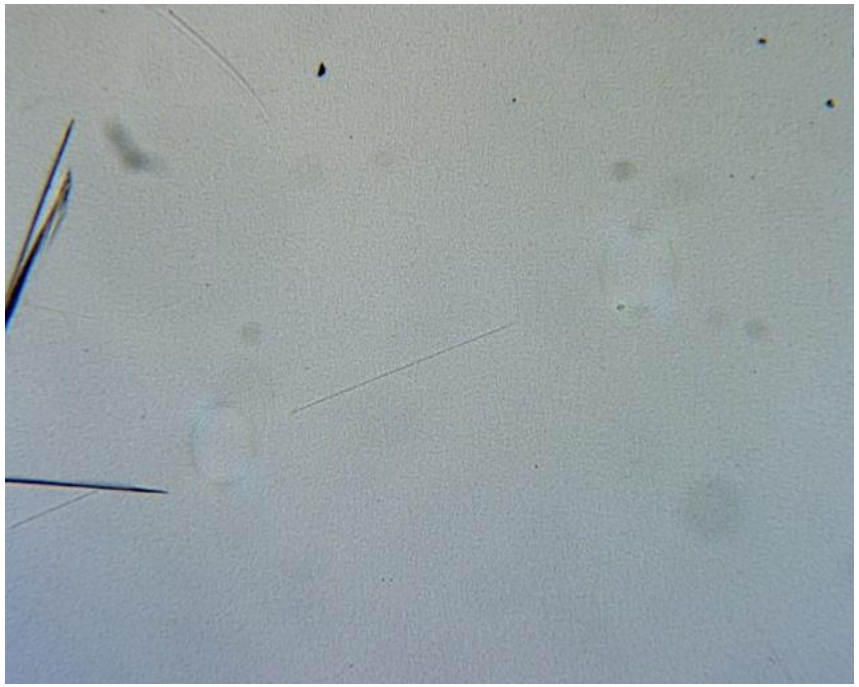
Illumination Systems* for the Compound Microscope

- Polarized Light -Transmitted and Reflected
- Reflected Brightfield/Darkfield
- Interference Contrast
- Fluorescence

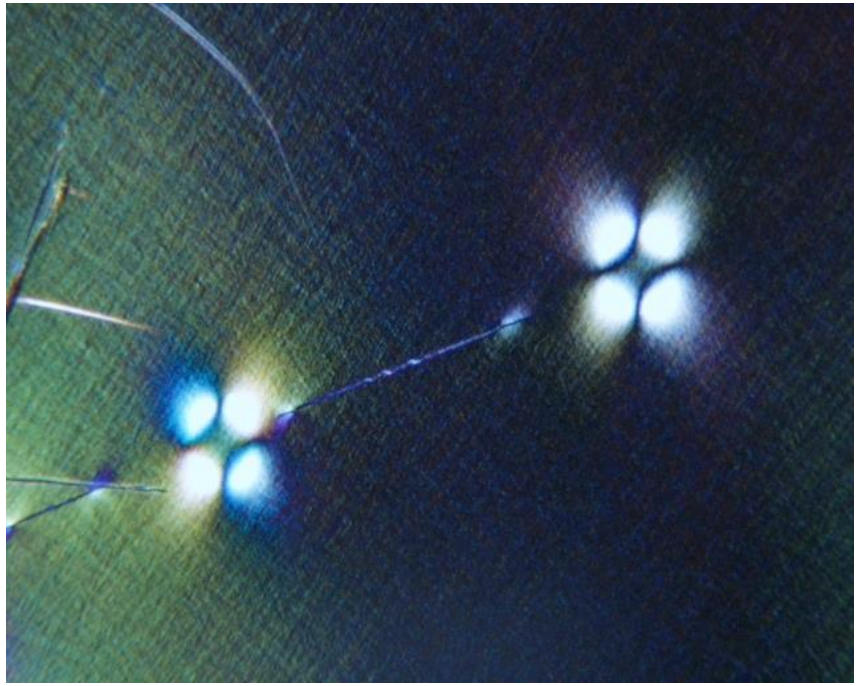
* Suggested minimum requirements

Foreign Material Embedded in Polyethylene Film

(Original Magnification: X50)

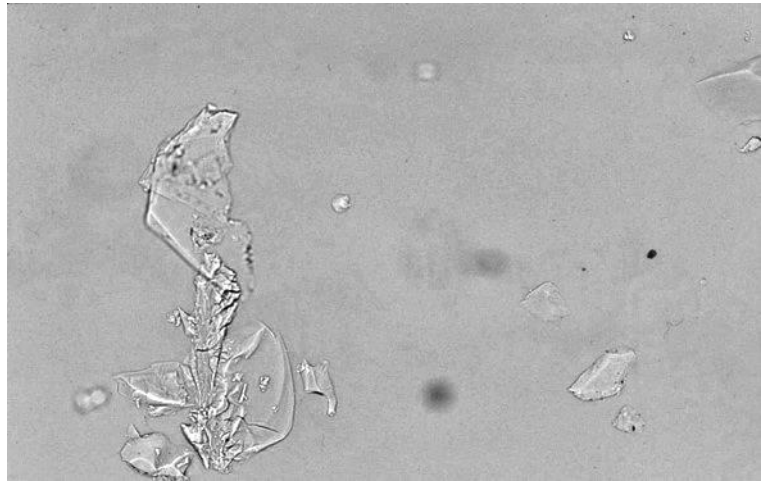


Plane polarized transmitted light - Brightfield

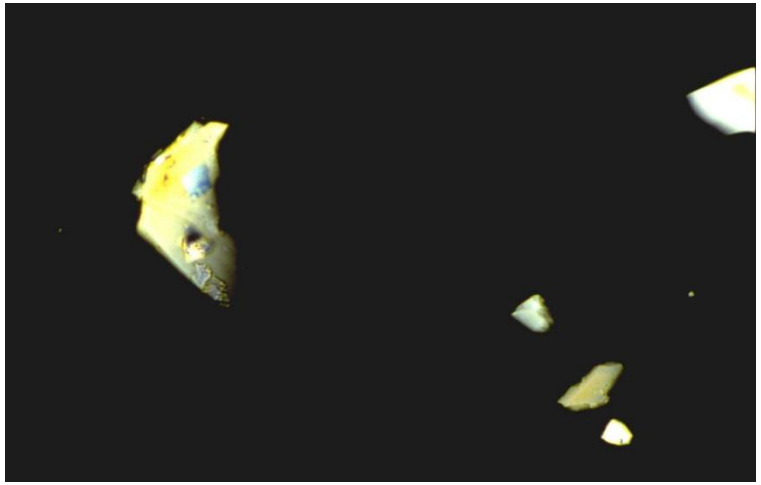


Transmitted light - Crossed Polarizers

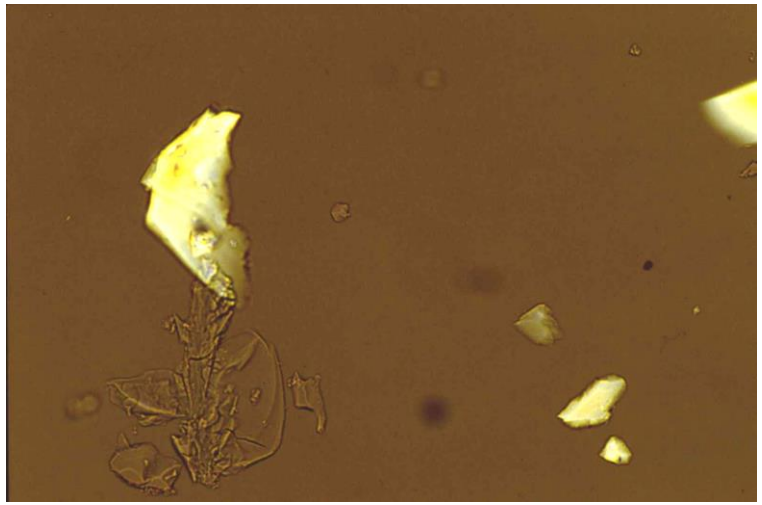
PLM Glass and Quartz



Plane Polarized Transmitted Light



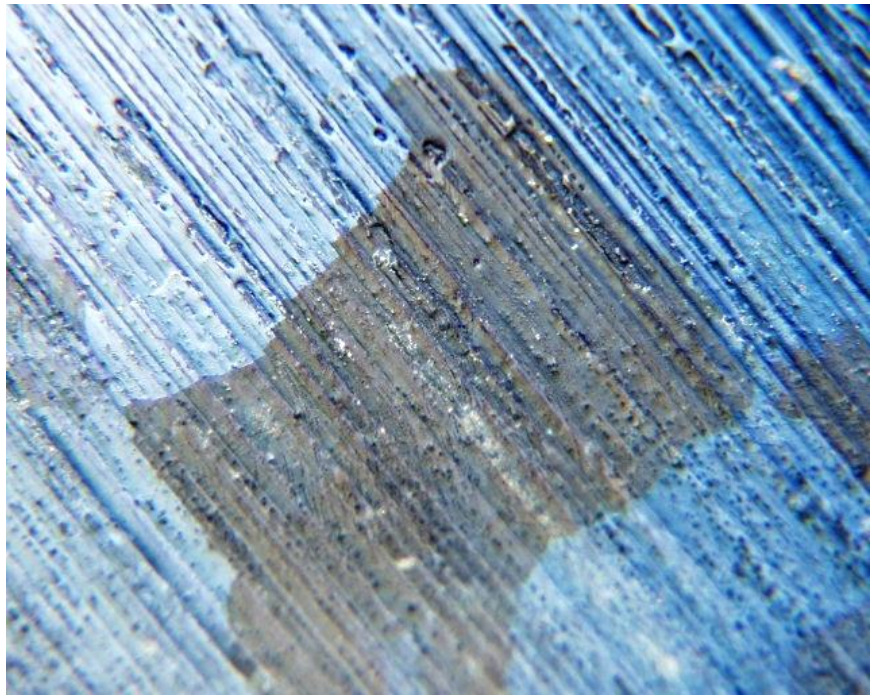
Crossed Polarizers



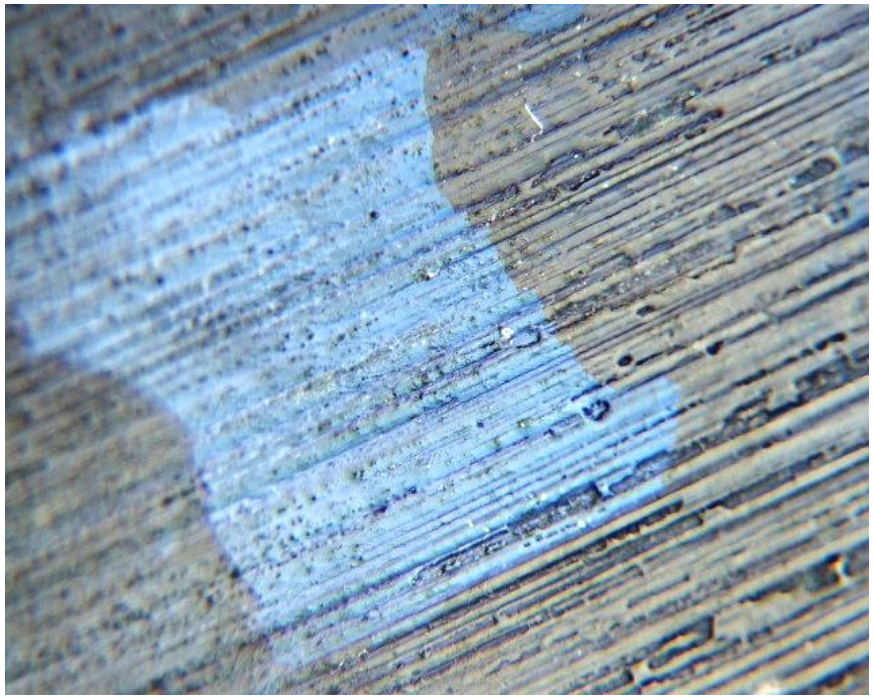
Slightly Uncrossed Polarizers

Electrolytic Tin Plated Steel

(Original Magnification: X100)

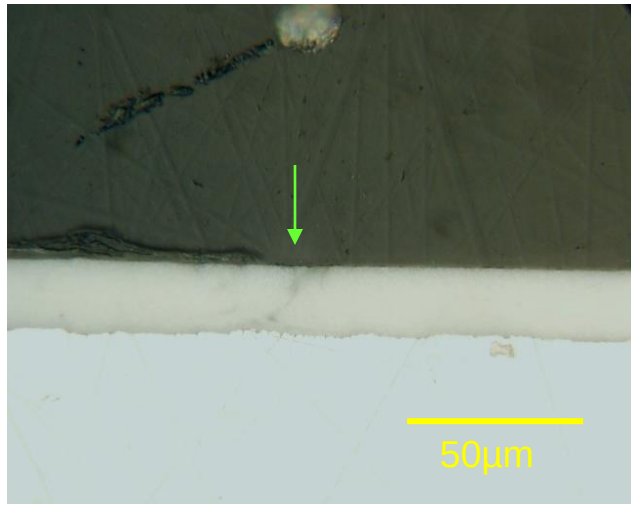


Reflected Light - Crossed Polarizers

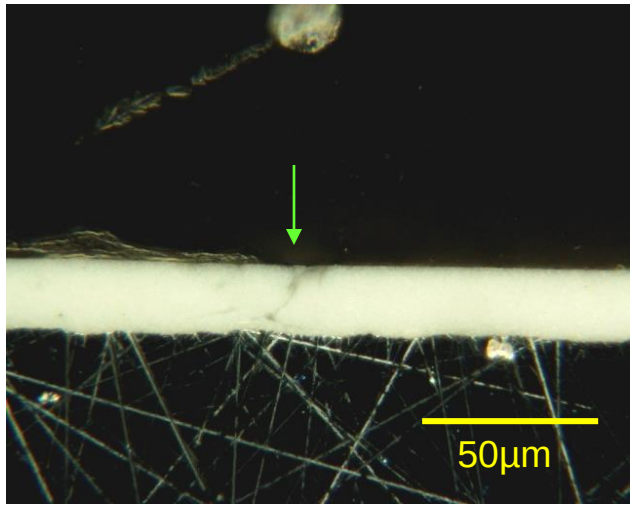


Rotated 90°

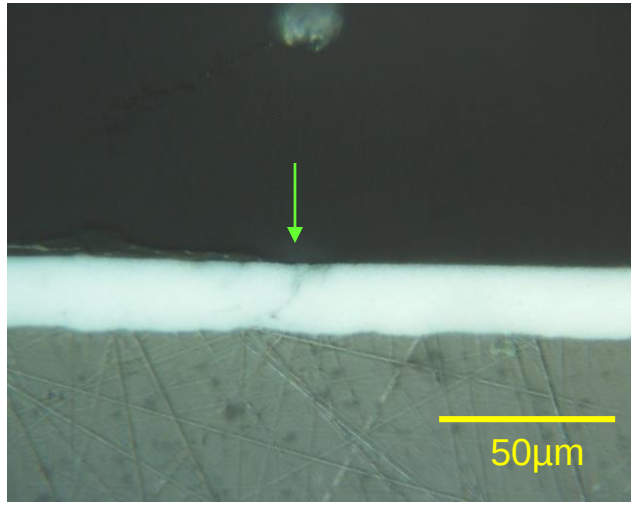
Painted Aluminum Panel - Polished Cross Section
(Original Magnification: X800)



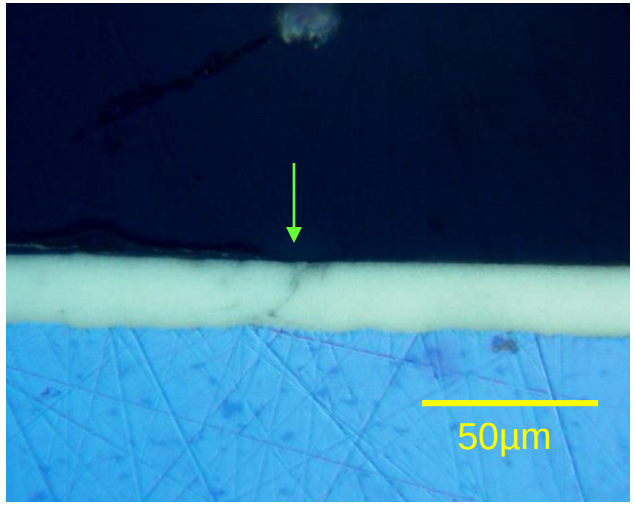
Reflected Light - Brightfield



Reflected Light - Darkfield

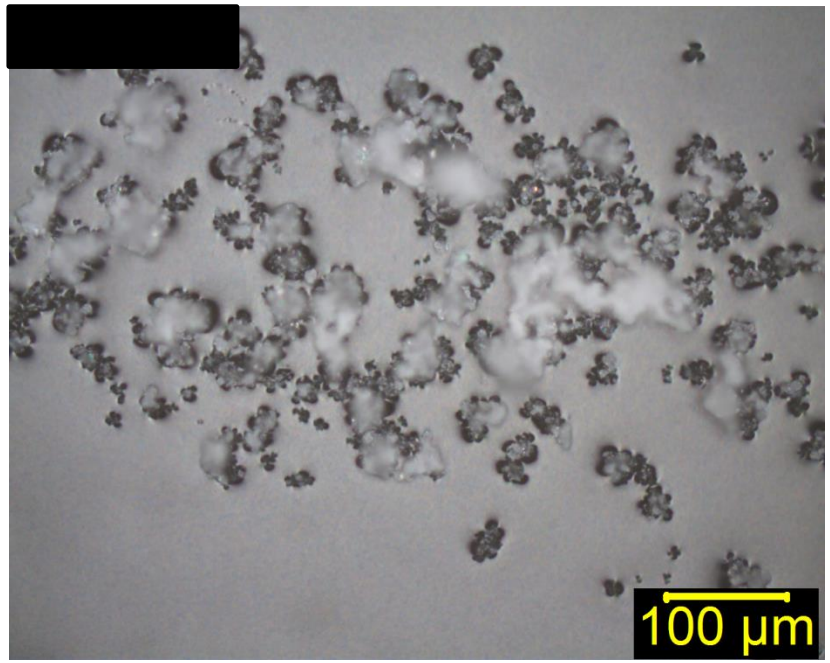


Reflected Light - Crossed Polarizers

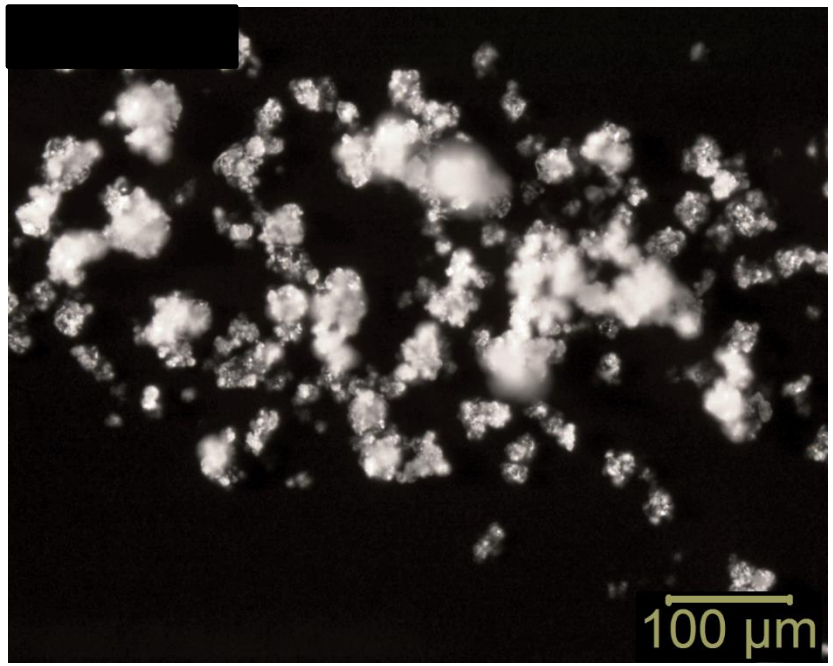


Reflected Light - Crossed Polarizers with
1st Order Red Plate and Rotating Analyzer

White Particle Dispersion on Smooth Black Carbon Tape

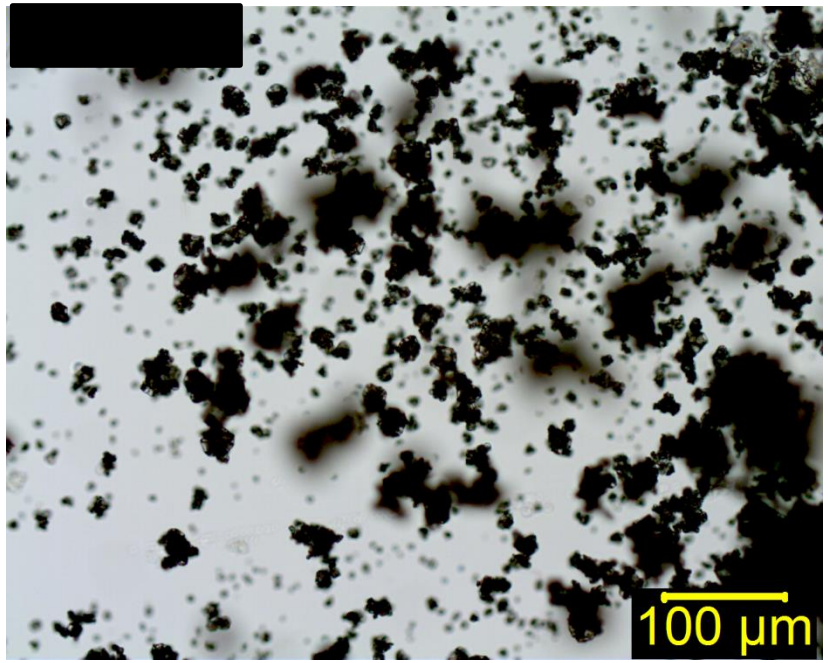


Reflected light

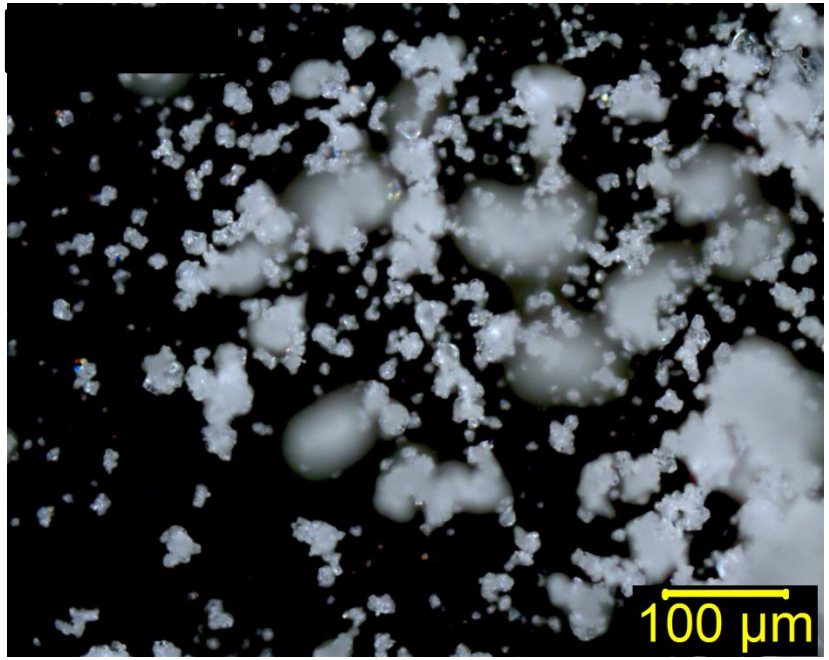


Oblique light

White Particle Dispersion on Glass Microscope Slide

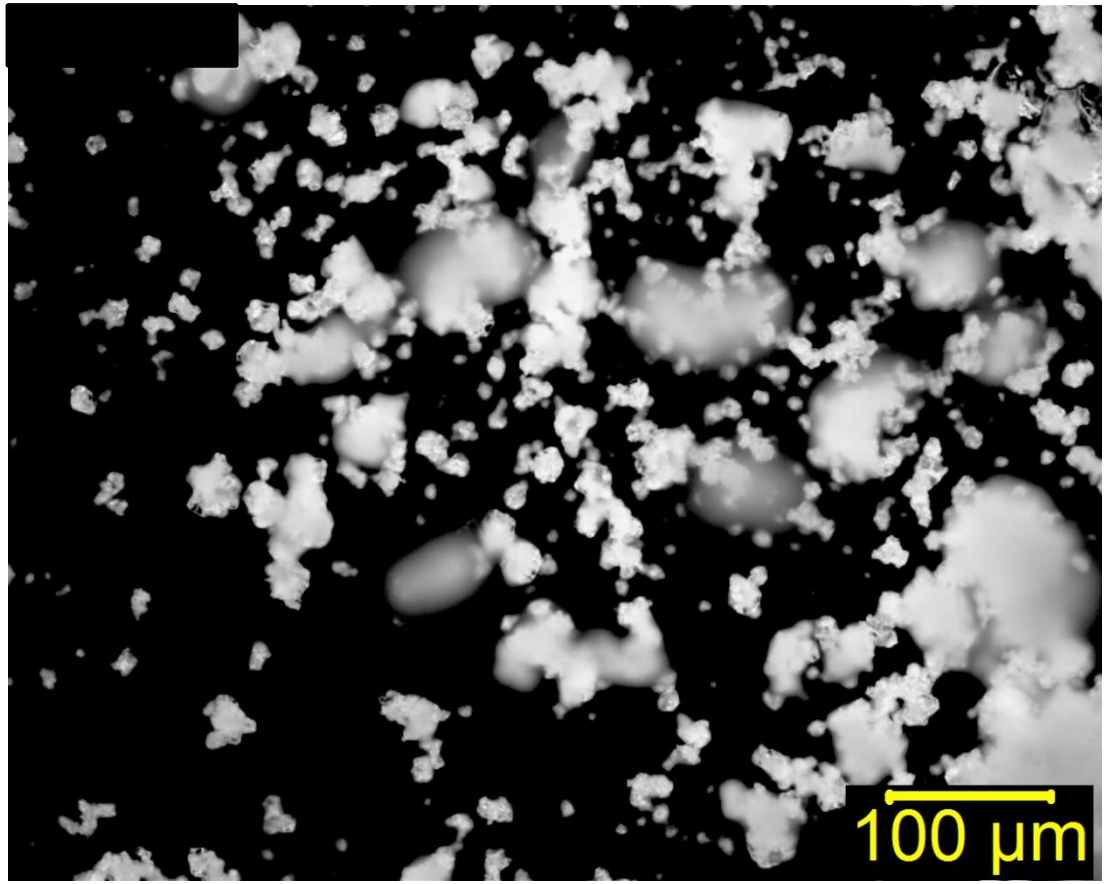


Plane polarized transmitted light



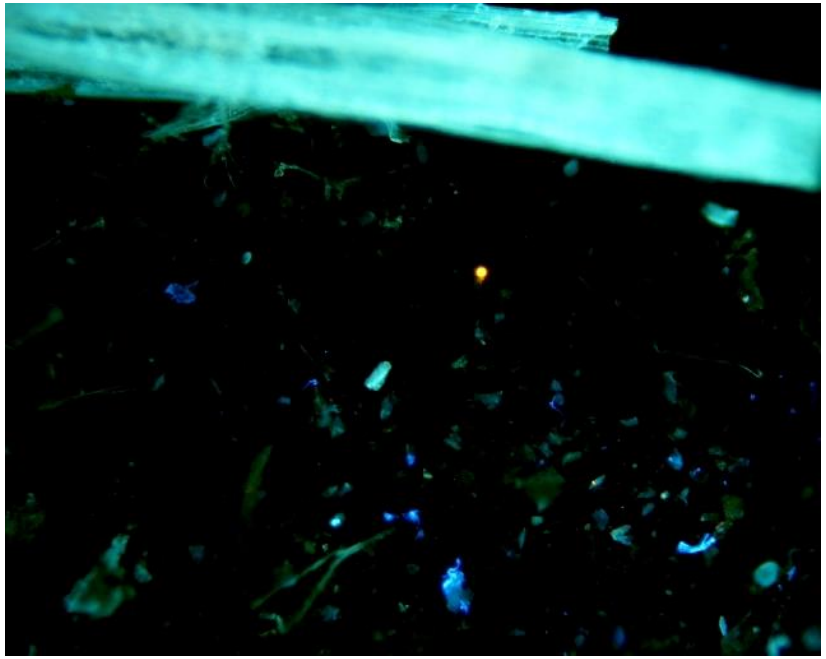
Transmitted light – fully crossed polarizers

White Particle Dispersion on Glass Microscope Slide

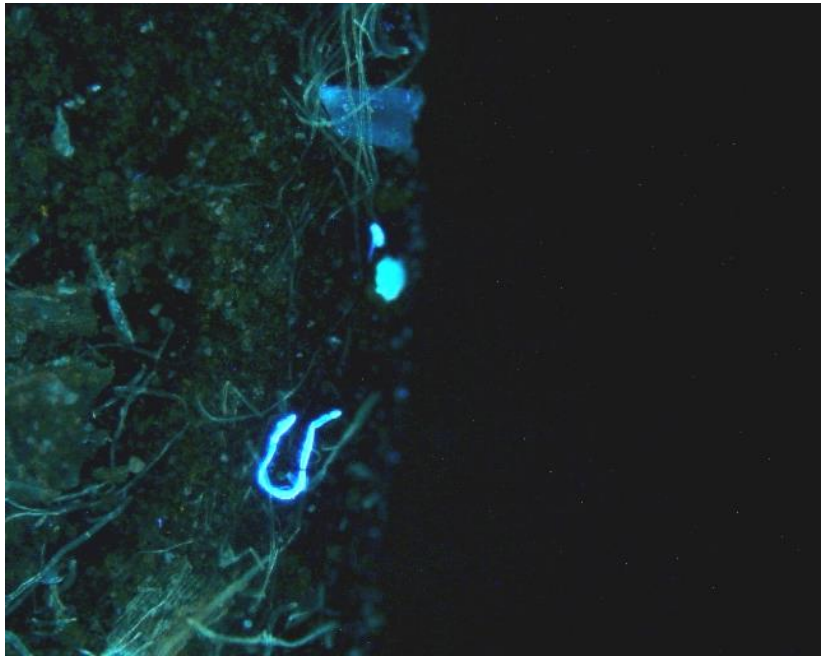


Transmitted light - Darkfield

Fluorescence Lighting
(Original Magnification: X40)

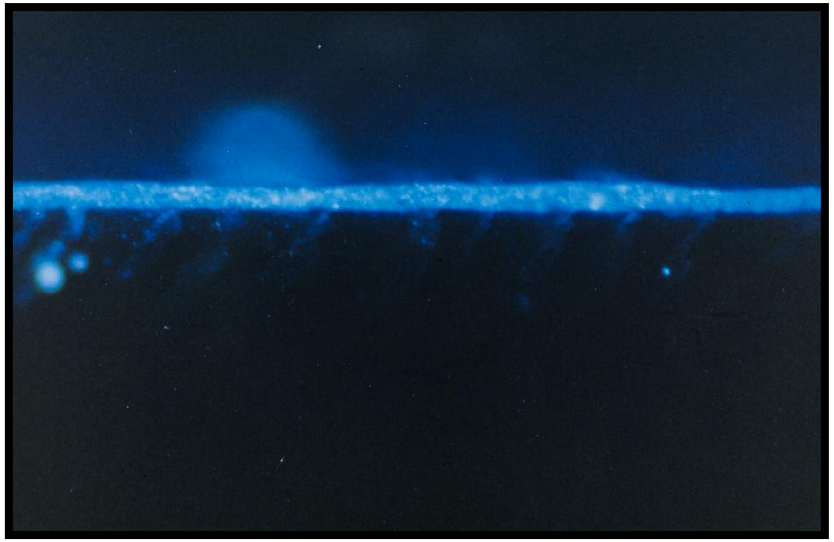


Soil Particles

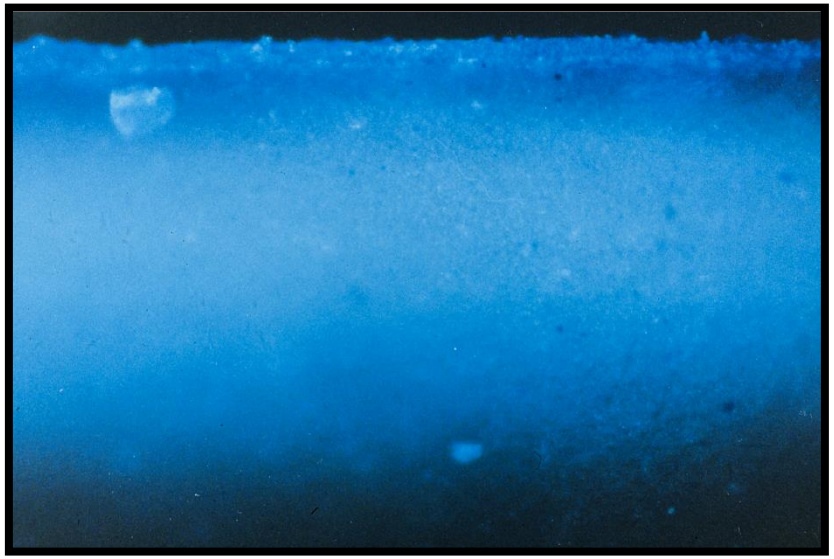


Soil Particles

Fluorescence Lighting
Dye/Resin Penetration into Plastic



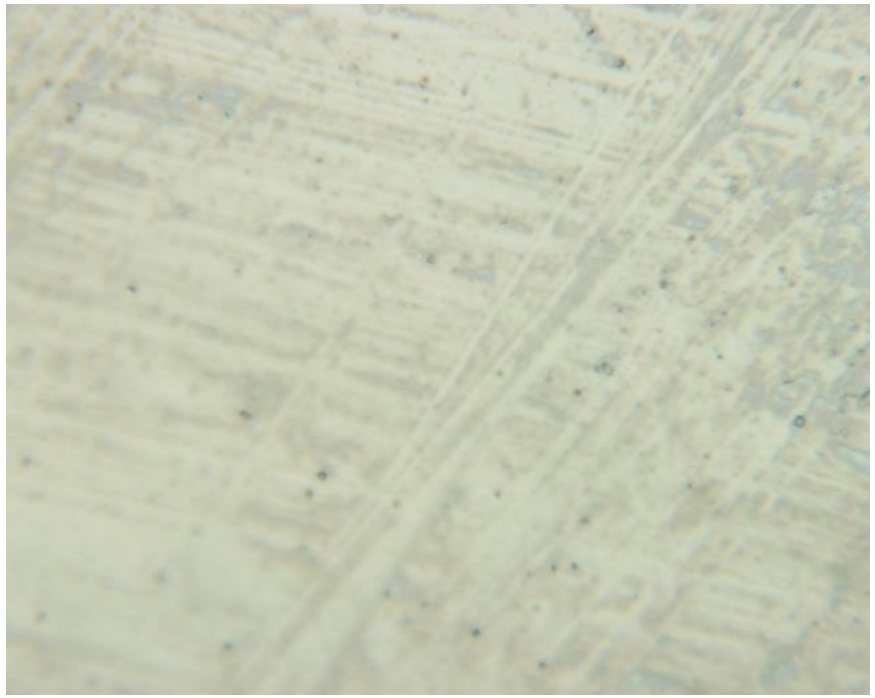
No Penetration



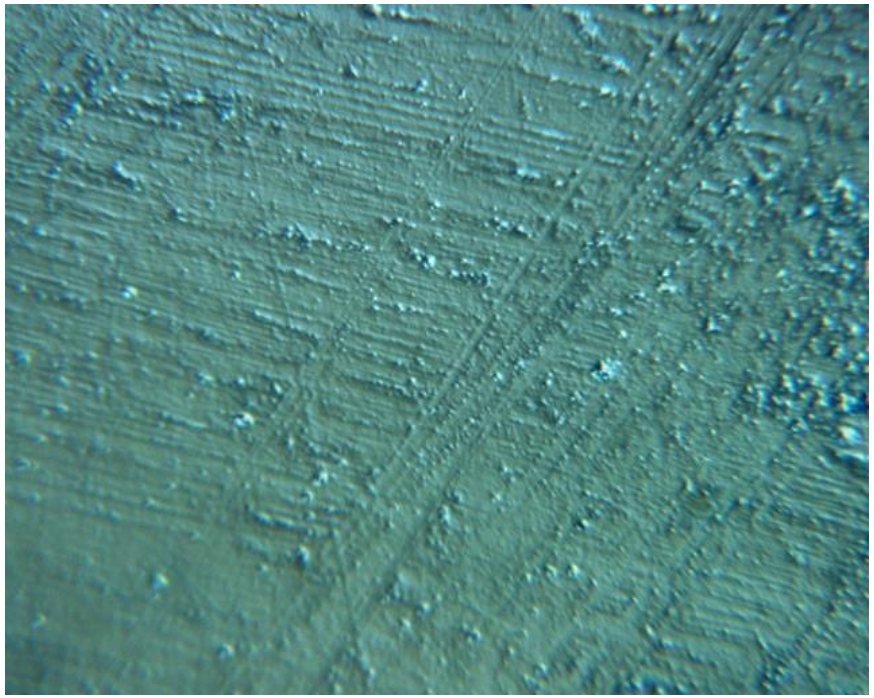
450 - 500 µm Penetration

Plastic Surface

(Original Magnification: X800)

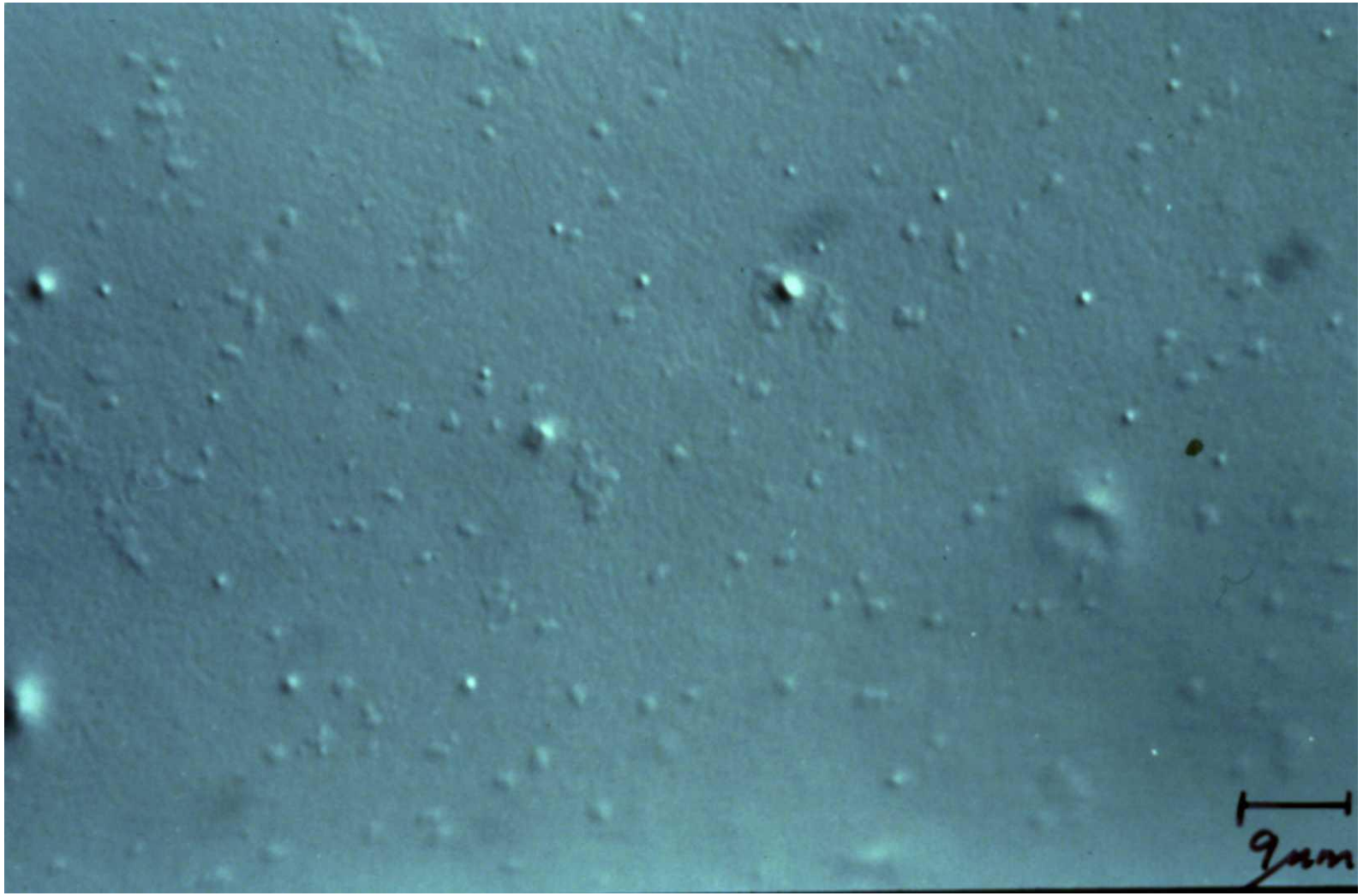


Reflected Light - Brightfield

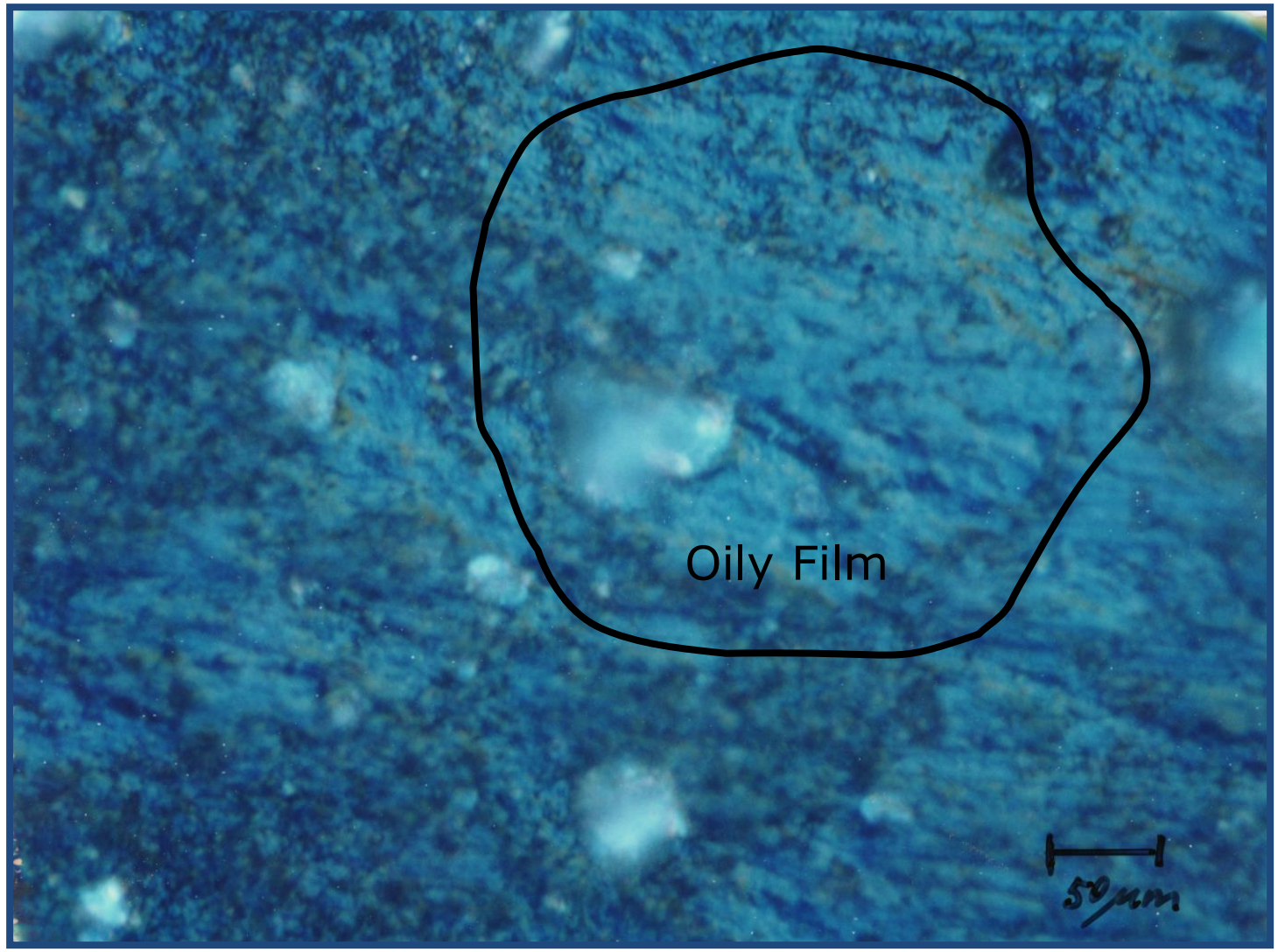


Nomarski Differential Interference Contrast (NDIC)

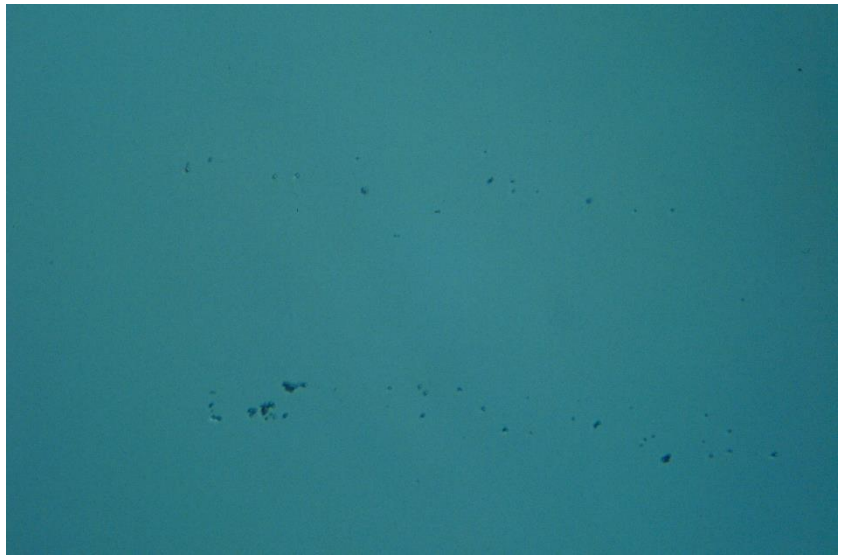
NDIC Polymer Surface Defects



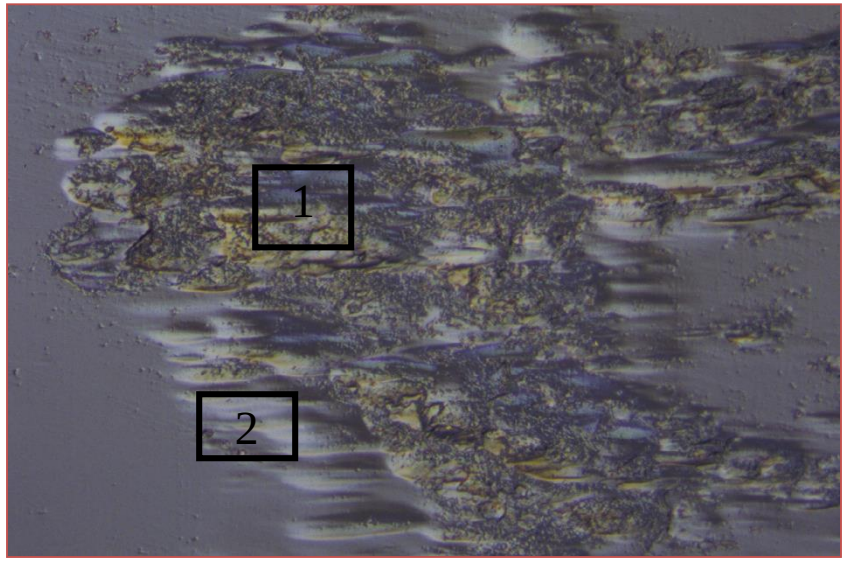
NDIC/ Adhesion Failure Substrate



NDIC Glass Surface Defects



Normal Surface



1) Physical defects

2) Refractive index variations

For microscopists striving for perfection

the CURSE is **UNAVOIDABLE**

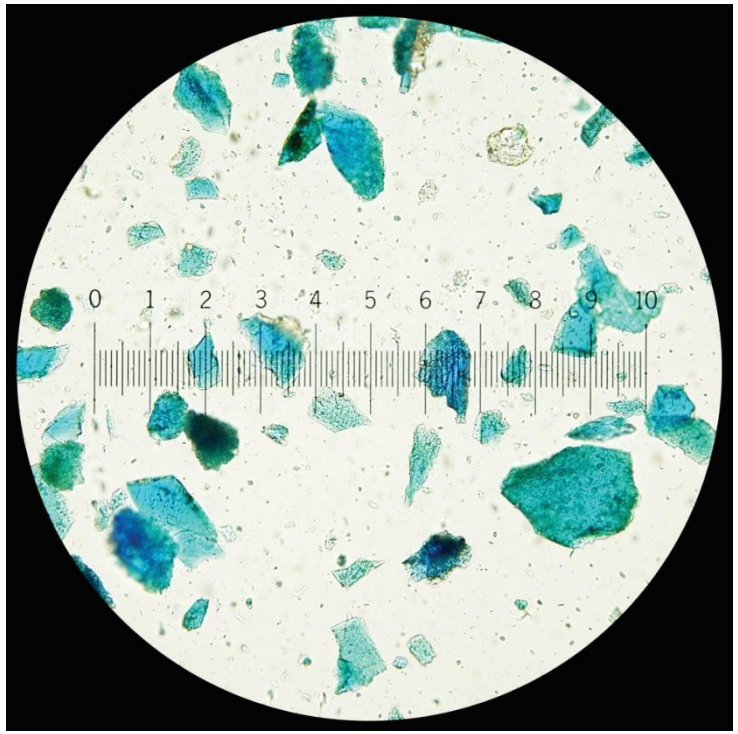
Initiate budgeting battle plans early!

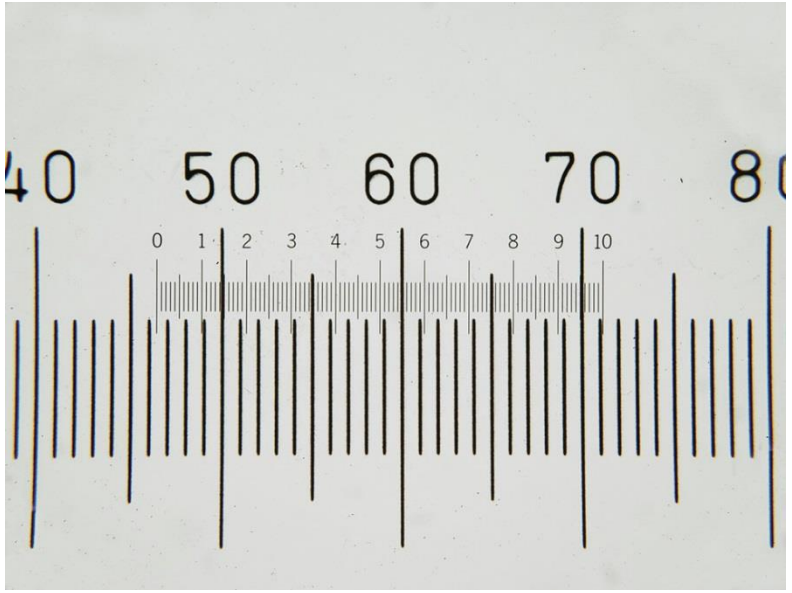
UPCOMING WEBINAR

Calibrating Your Microscope

Thursday, December 7, 2017 • 1:00 • Nicole Groshon

So, we know that every microscope and every objective is slightly different. In this webinar, Nicole is going to discuss how to calibrate your microscope so you can properly measure a particle.





Thank you for joining us.

Wayne D. Niemeyer
Senior Research Scientist
wniemeyer@mccrone.com• (630) 887-7100