Ways to Examine Metals by Light Microscopy

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Common Light Microscopy Methods for Metals

Reflected (episcopic) Illumination

• Brightfield
• Darkfield
• Crossed Polarizers
• Nomarski Differential Interference Contrast (NDIC)
“Brown” Stains Under a Food Can Internal Clear Coating

PLM of “brown stains” – episcopic illumination with crossed polarizing filters
Examining Contamination on Tinplate Steel

Brightfield episcopic illumination

Episcopic illumination with crossed polarizers

Episcopic illumination with crossed polarizers and first-order red (560nm) compensator inserted
Electrolytic Tin Plated Steel

( Original Magnification: X100 )

Episcopic Illumination with Crossed Polarizers

Stage Rotated 90°
Examination of Polished Beryllium

Brightfield Episcopic Illumination

Episcopic Illumination with Crossed Polarizers
Cut out a section of the “doubleseam” for metallographic grinding/polishing of the cross section

Polished cross section with 1% HF etch
Brightfield illumination
Metallography Examination-Episcopic Illumination

Cut out a section of the end opening score lines
Metallography Examination-Episcope Illumination

Score line polished cross sections with 1% HF etch
Brightfield illumination
Metallography Examination - Episcopic Illumination

Brightfield illumination of polished longitudinal section of cold worked carbon steel

2% nital etch
Metallography Examination - Episcopic Illumination

Polished section of aluminum sheet with major inclusion
Brightfield illumination
Brightfield illumination of polished section of stainless steel with severe stress corrosion cracks (unetched)
Metallography Examination - Episcopic Illumination
Sideseam joint weld from tinplated steel food can

Plane polarized light illumination (un-etched)

Crossed polarizers illumination (un-etched)

Crossed polarizers illumination and first-order red (560nm) compensator inserted (un-etched)
Nomarski Differential Interference Contrast (NDIC)

NDIC to highlight base metal surface polishing
unetched

NDIC for colorization contrast to show the presence of the base metal tin plating layer (arrows)
unetched
NDIC with increasing magnification (left to right) to highlight the ~2µm tin plating layer (arrows)
Metallography Examination-Episcopic Illumination
Sideseam joint weld from tinplated steel food can

I/S sideseam protective polymer coating

Weld zone

Plane polarized light illumination
2% nital etch
Metallography Examination - Episcopic Illumination
Sideseam joint weld from tinplated steel food can

Plane polarized light illumination of weld zone
2% nital etch

Crossed polarizers illumination of weld zone
2% nital etch

Recrystallized metal (tin?) grains in the fusion region
Metallography Examination - Episcopic Illumination
Sideseam joint weld from tinplated steel food can

NDIC colorization to highlight grain features
2% nital etch
Metallography Examination - Episcopic Illumination
Sideseam joint weld from tinplated steel food can

Plane polarized light illumination of weld zone and adjacent base steel.
2% nital etch

NDIC illumination of weld zone and adjacent base steel.
2% nital etch
Metallography Examination-Episcopic Illumination
Sideseam joint weld from tinplated steel food can

Plane polarized light illumination of weld zone and adjacent base steel.
2% nital etch

Darkfield illumination of weld zone and adjacent base steel.
2% nital etch
Metallography Examination - Episcopic Illumination
Polished Brass (1µm diamond paste)

Brightfield Illumination

Crossed Polarizers
Metallography Examination—Episcopic Illumination
Polished Brass (1µm diamond paste)

Darkfield Illumination

Nomarski Differential Interference Contrast (NDIC)
Reference Books

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First Printing, December 1990
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Freeze Drying
March 21 – 23, 2018

Pharmaceutical Materials and Contaminants
May 7-11, 2018

Thermal Microscopy for Pharmaceuticals
June 25-29, 2018

Upcoming Webinar

Robert’s Rules for Contamination Analysis

March 29 • 1:00 pm
Robert Carlton, Ph.D.