Light Microscopy & Verification of Malus’ Law

Ja’far Abbas
Outline

- Light Microscopy and Variations
- Purpose of Experiment
- Method of Experiment
- Results
Light Microscopy

• Utilises Light to View Object:
  • *Dark Field*
  • *Bright Field*

• Three Basic Categories:
  • *Compound*
  • *Stereo*
  • *Digital*
Dark Field

• Sample Fully Illuminated
• Dark Background
• Good Contrast
• Good for Biological Samples
• Directly Transmitted Light not Collected by Objective
• High Intensity Light- Possible Sample Damage
Bright Field

• Simple Technique
• Bright Background Dark Image
• Popular
• Very Low Contrast
Compound Microscopes

- Two Eyepiece Lenses of 10X – 15X Magnification
- Single Optical Path
- Combine with 3-4 Objective Lenses to give up to 1000X Magnification
- Useful for Identifying Drug Structures
- Relatively Inexpensive
Stereo Microscope

• Two Optical Paths at Differing Angles
• Provides 3D viewing of Sample
• Low Magnification
• Used for Circuit Board Inspection, Microsurgery and Watchmaking
• Relatively Inexpensive
Digital Microscope

- Eyepieces Optional
- Uses Computers to View Detailed Images
- Real Time Imaging Possible
- Up to 1000X Magnification
- Ease of Image Analysis
Malus’ Law

• When completely plane polarised light is incident on the analyser, the intensity I of the light transmitted by the analyser is directly proportional to the square of the cosine of angle between the transmission axes of the analyser and the polariser.
• Electric Field Vector Resolved into Two Components
• Perpendicular Component Absorbed
• \( I = I(Cos(x))^2 \)
Purpose of Experiment

• To Verify Malus’ Law
• Gain Basic Understanding of Polarisation
• Ability to Analyse and Interpret Data
• Use of Computational Software to Ease and Accelerate Work
Experimental Setup

- **Apparatus:**
  - *Motic Stereo Zoom Microscope SMZ 168*
  - *Motic Polarising Accessory*
  - *Thor Labs Rotating Polariser RSP05/M*
  - *Retort Stand*
  - *Motic Imaging Camera 2.0 MP*
- **Data Analysis:**
  - *Motic Imaging Software*
  - *Matlab 2013*
Rotating Polariser being Viewed Underneath The Stereo Zoom Microscope. Fixed Polariser Attached To Microscope.
Method of Experiment

• Polarisers were Set up and Focused
• Bright Field Technique was Used
• Rotating Polariser was Rotated at 5 Degree intervals
• Resulting Images were Collected using Motic Imaging Software
• Images were Loaded into Matlab as Matrices
Data Analysis

• Images in Matlab were converted to Grey scale with Pixel Intensities Ranging from 0-255
• A Specific Region of the Images was Cropped
• Mean Value of Intensities from Cropped Matrices were Extracted
• Mean Values were Plotted Against Degrees
• Curve Fitting was Performed
Results
Uncertainty in Results