WHAT IS MACHINE VISION?

- IMAGE BASED AUTOMATED INSPECTION FOR QUALITY ASSURANCE, PROCESS CONTROL, SORTING, AND ROBOTICS.
- INCLUDES CAMERA, PC/VISION CONTROLLER, LIGHTING, AND LENSING.

MACHINE VISION SOLUTIONS - EQUIPMENT

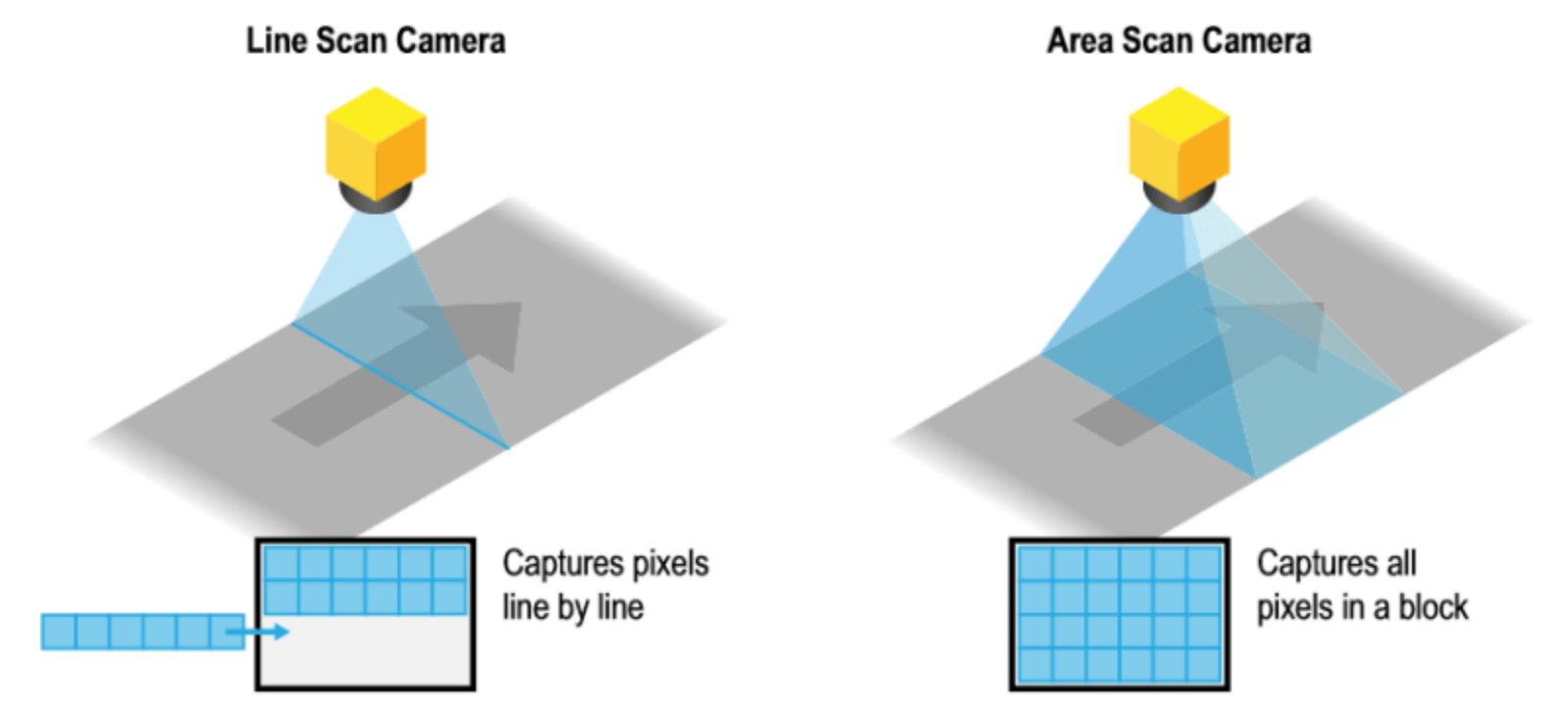
EQUIPMENT SELECTION:

- CAMERA FORMAT: LINE SCAN VS AREA SCAN
- MONOCHROME VS COLOR
- LENSING – STANDARD VS TELECENTRIC
- LIGHTING – DEFECT

PARAMETERS:

- LINE SPEED
- FIELD OF VIEW
- WORKING DISTANCES
- APPLICATION TYPE: MEASUREMENT, DEFECTS, PICK & PLACE, SORTING, ETC.
- FEATURE OF INTEREST: COLOR, TOPOGRAPHY, FINISH, ETC.

CAMERA TYPES – LINE SCAN VS AREA SCAN



LINE SCAN CAMERAS

LINE SCAN CAMERAS

- ADVANTAGES:
  - CONSISTENT LIGHTING METHODS
  - FAST SENSOR CAPTURE RATES
  - TDI (TIME DELAY INTEGRATION)
- USES:
  - SPINNING PARTS
  - CONTINUOUS WEBS
  - LARGE AREAS

AREA SCAN CAMERAS

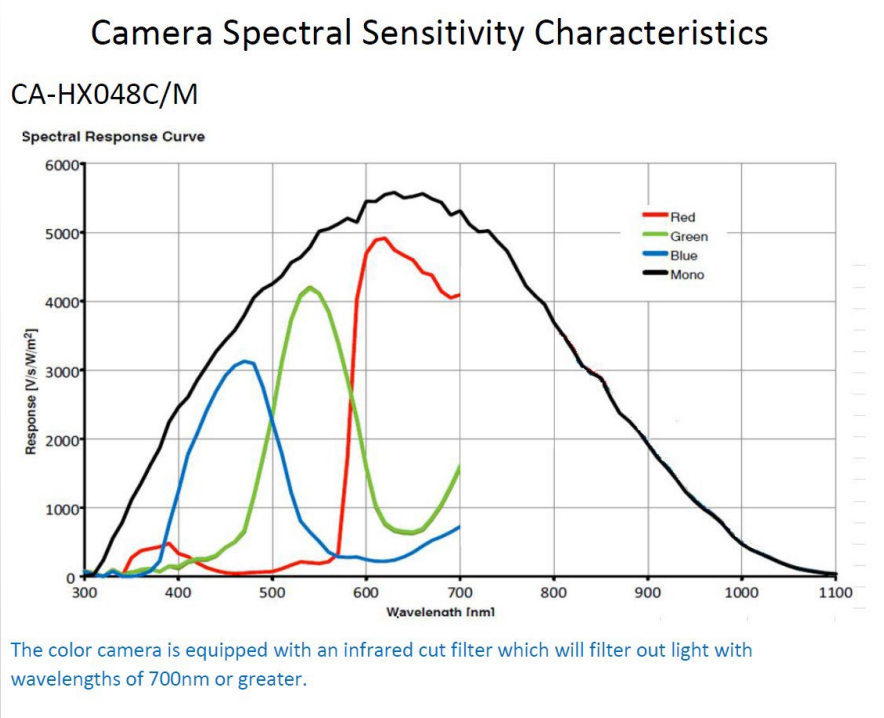
AREA SCAN CAMERAS

- ADVANTAGES:
  - COST
  - SETUP EASE
- USES:
  - GENERAL INSPECTION
  - ROBOTICS

COLOR VS. MONOCHROME

WAVELENGTH SELECTION:

- UV: 300-400NM
- COLOR: 400-700NM
- MONOCHROME: 350-1000NM
- SWIR: 1000-1700NM



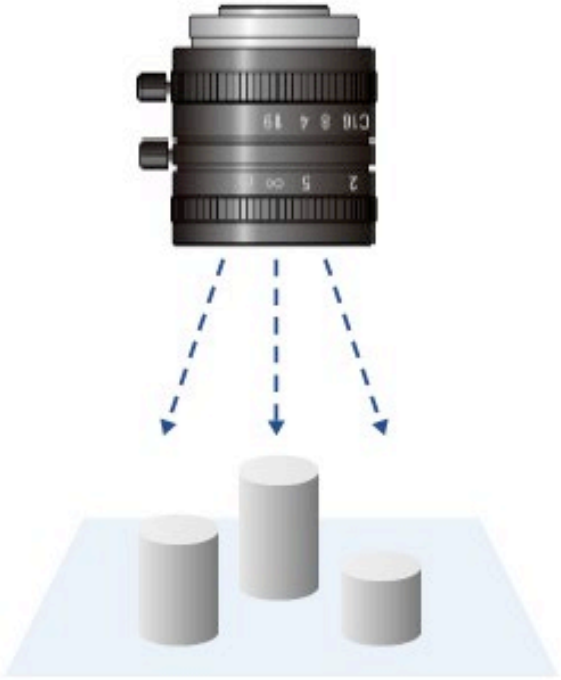
LENSES – STANDARD VS TELECENTRIC

STANDARD LENSES:

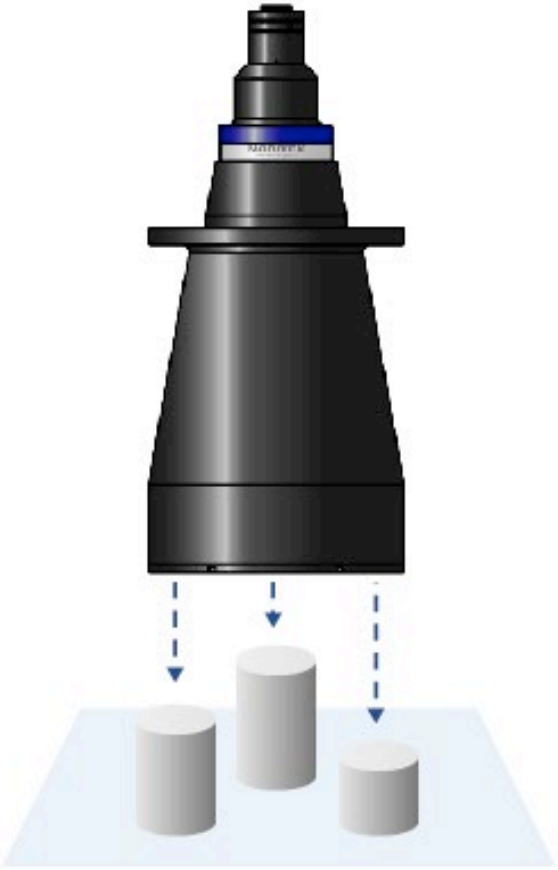
- STANDARD APPLICATIONS
- VARIABLE APERTURE
- ECONOMICAL

TELECENTRIC LENSES:

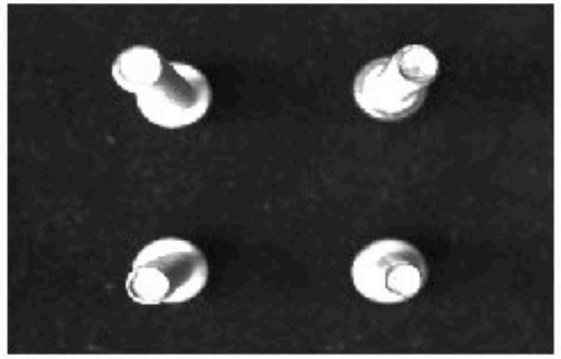
- MEASUREMENT APPLICATIONS
- FIXED APERTURE
- LARGE FOOTPRINT
- LIMITED FOV
- COSTLY



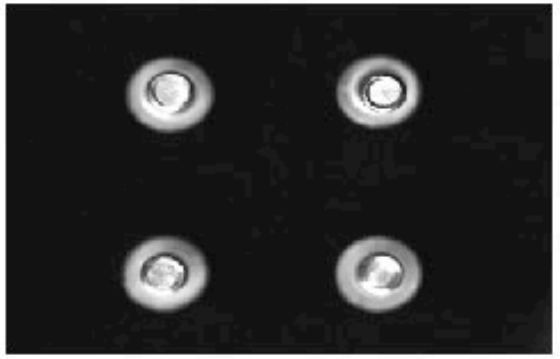
Part of the object's surface may be hidden by surface unevenness



The entire surface of the object is visible

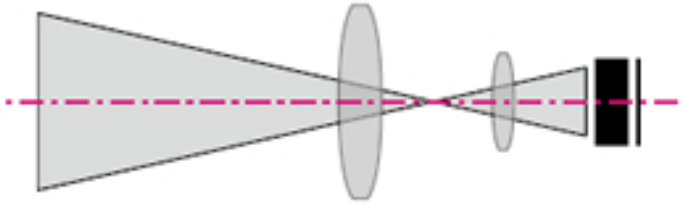


Size of the image changes

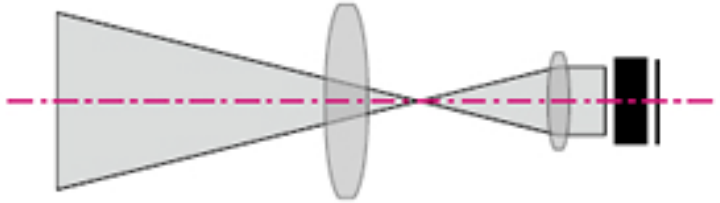


Size of the image remains the same

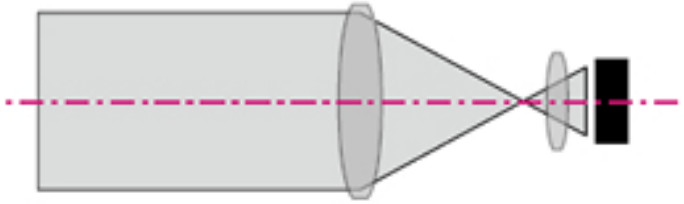
Conventional lens



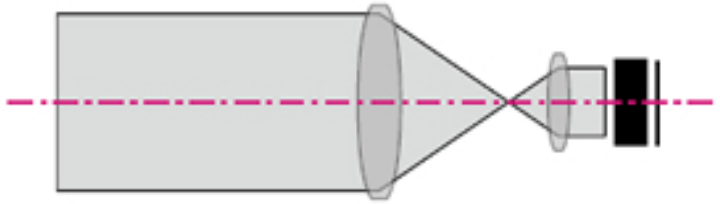
Sensor-side telecentric lens



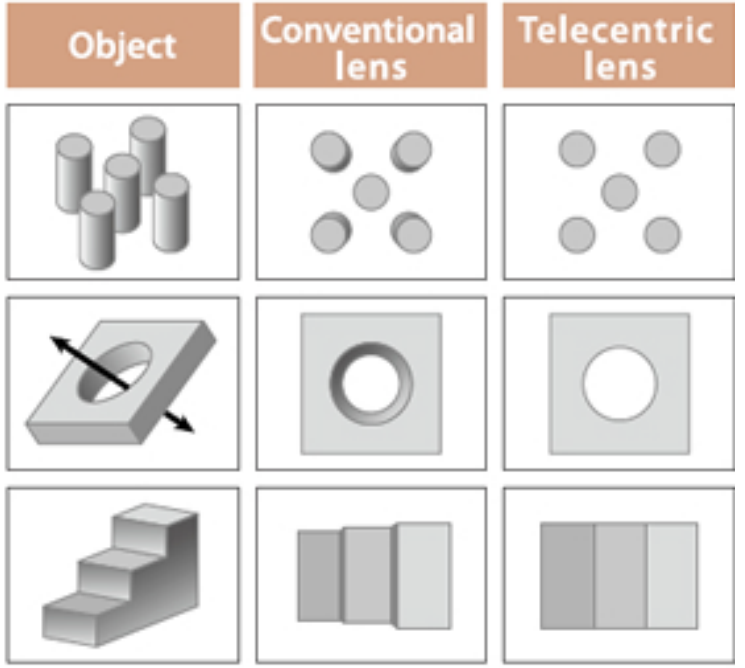
Object-side telecentric lens

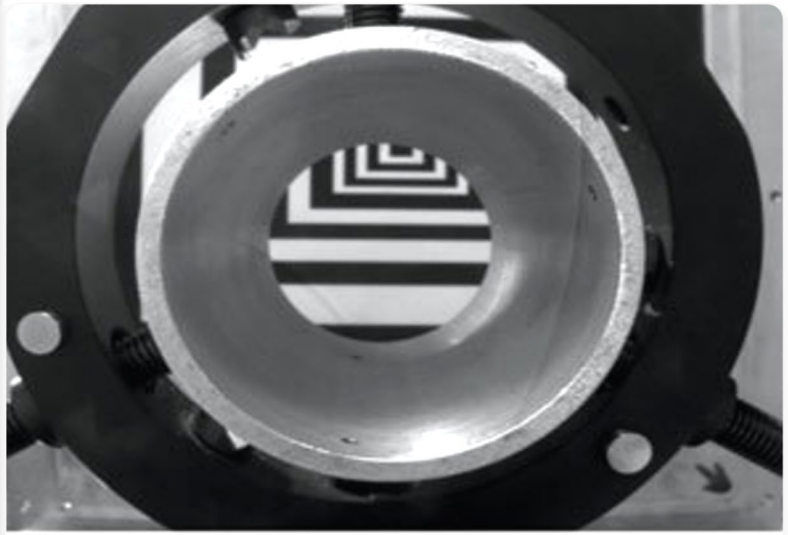


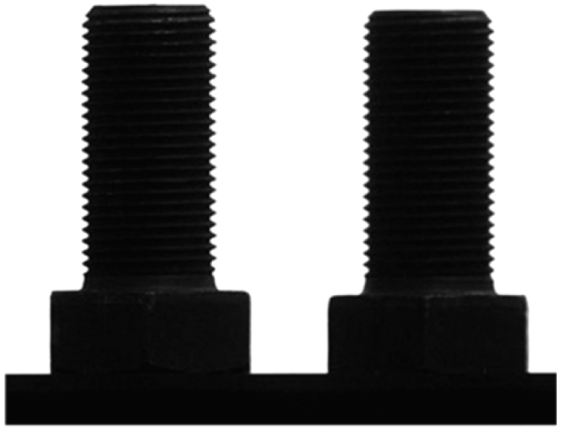
Both-sides telecentric lens



Optical axis





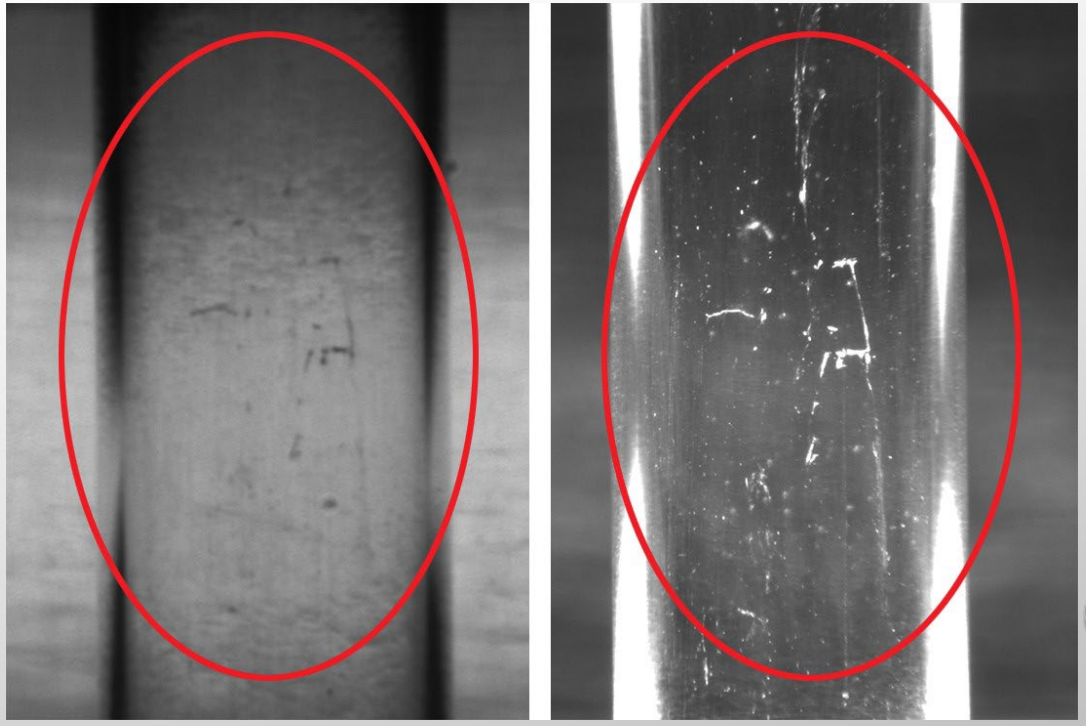


MACHINE VISION LIGHTING

- LINE LIGHTS
- BACKLIGHTS
- RING LIGHTS
- OFF AXIS LIGHTS
- BAR LIGHTS
- DOME LIGHTS
- FLAT DOME LIGHTS
- COAXIAL LIGHTS
- CODL LIGHTS
- SPOT LIGHTS
- PATTERN PROJECTORS
- BARCODE READER LIGHTS
- LIGHT ENGINES

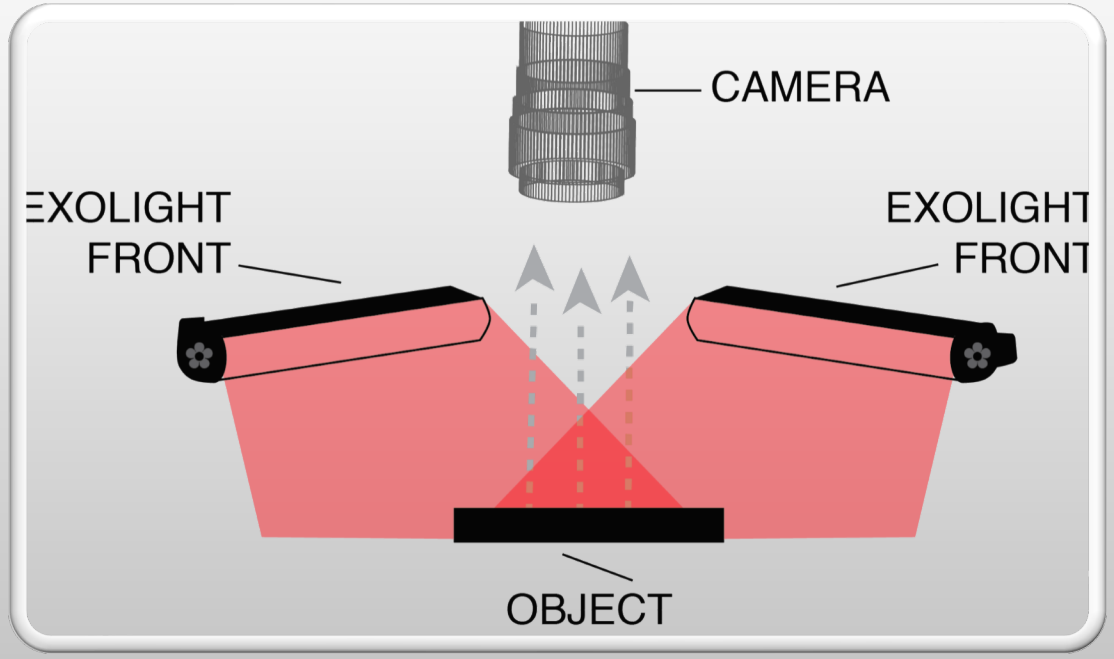
BRIGHTFIELD VS DARKFIELD

- BRIGHT FIELD – DIRECT LIGHTING USED AS EITHER A FRONT LIGHT OR A BACKLIGHT TO HIGHLIGHT DARK FEATURES
- DARKFIELD – INDIRECT LIGHTING USED AS AN OFF AXIS OR OBLIQUE LIGHTING TECHNIQUE TO HIGHLIGHT SURFACE DEFECTS.



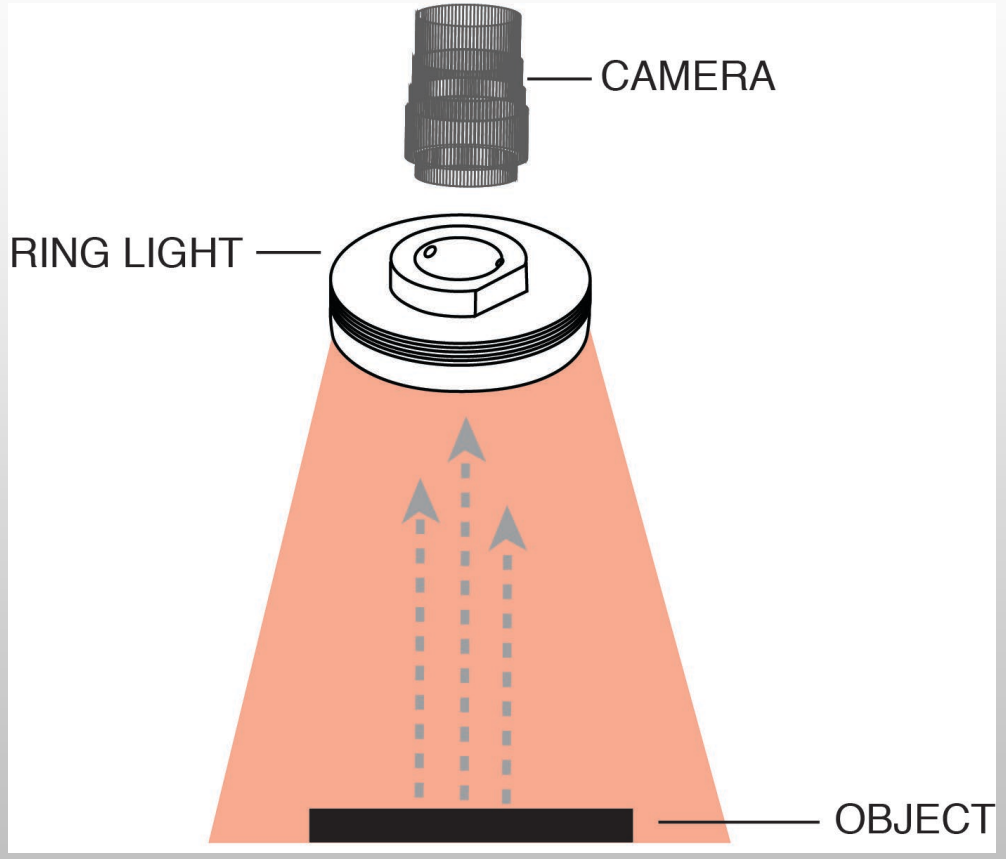
BAR LIGHTING

BAR LIGHTS ARE A TYPE OF FRONT LIGHTING THAT ARE USED FOR GENERAL ILLUMINATION



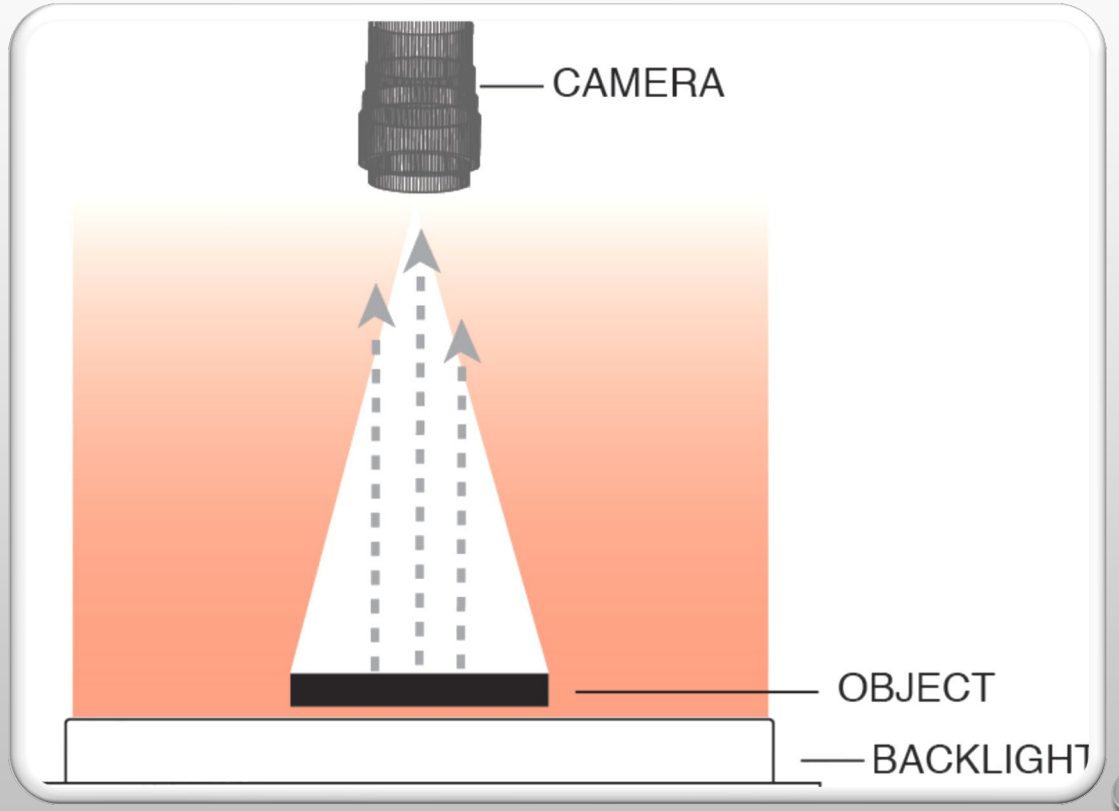
RING LIGHTING

RING LIGHTS ARE A TYPE OF FRONT LIGHTING THAT HAVE A FORM FACTOR DESIGNED AROUND THE CAMERA



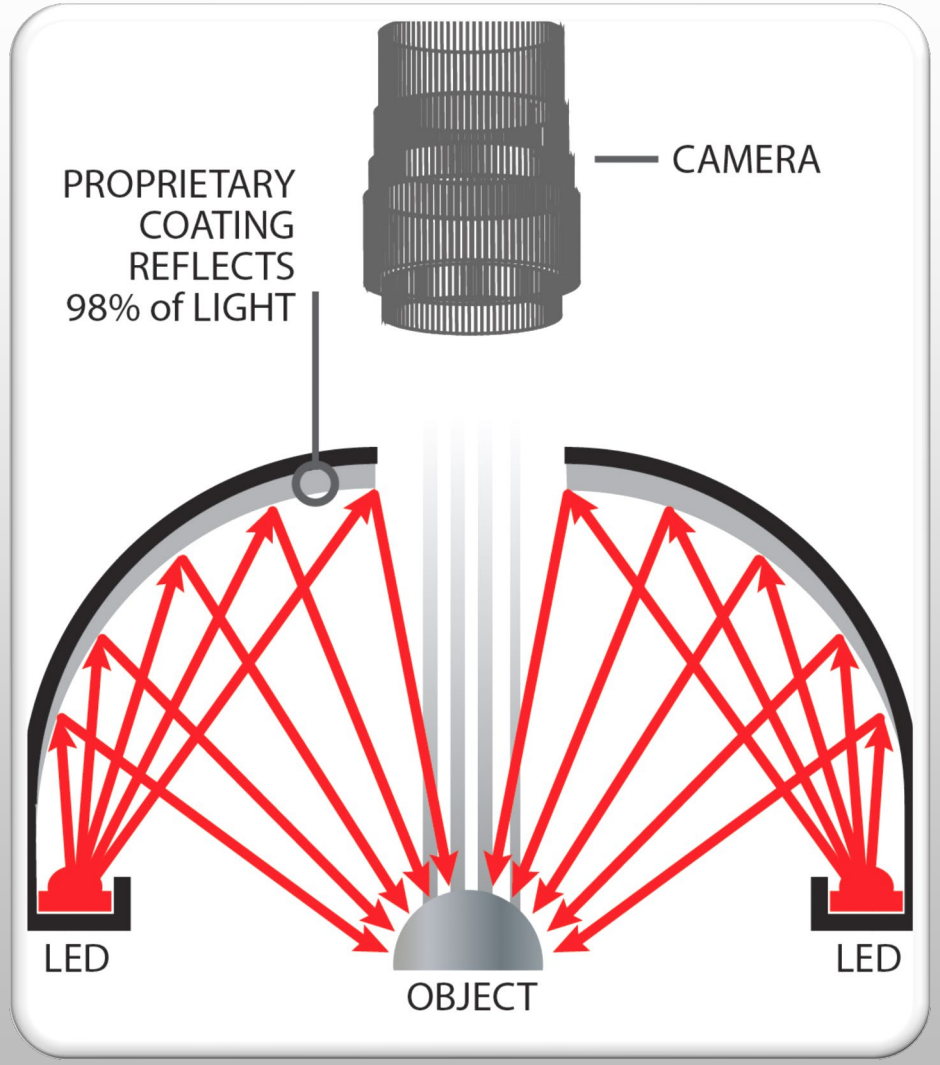
BACK LIGHTING

BACKLIGHT IS USED TO CREATE A SILHOUETTE FOR MEASUREMENTS AND ABSENCE/PRESENCE



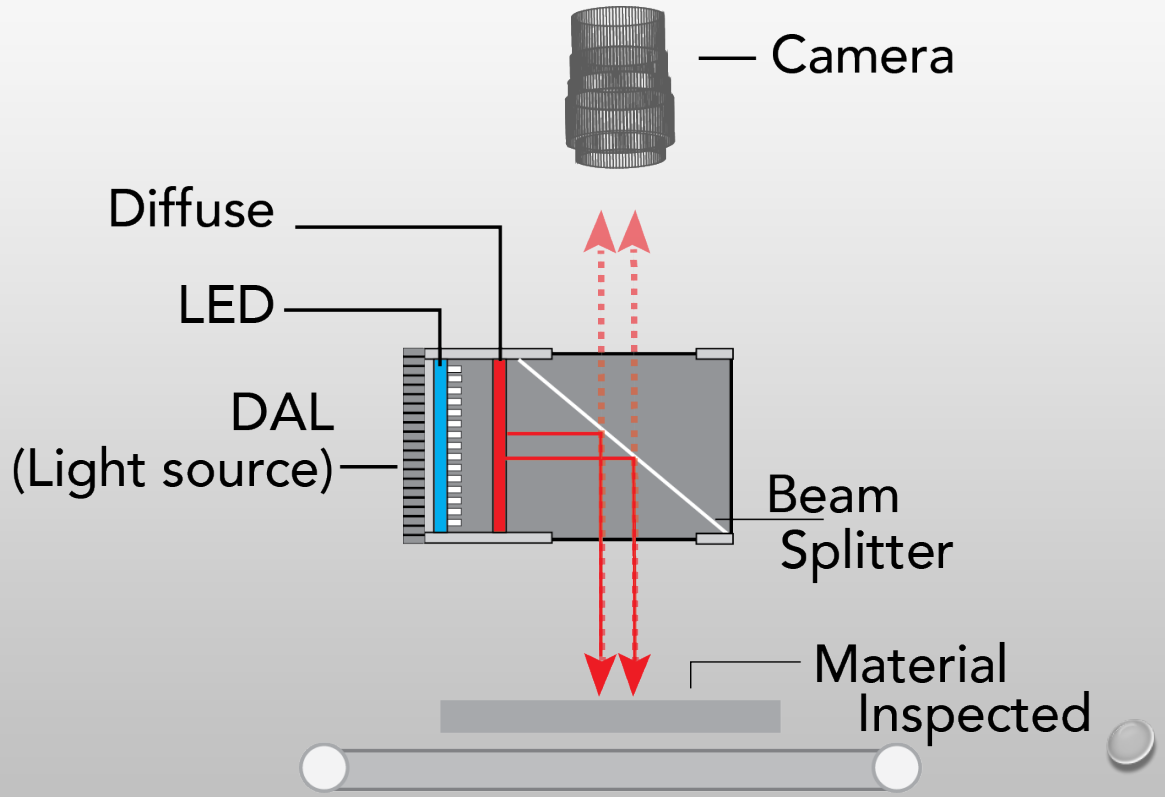
DOME LIGHTING

DOME LIGHT IS USED TO PROVIDE UNIFORM ILLUMINATION OF PARTS THAT HAVE TOPOGRAPHICAL FEATURES



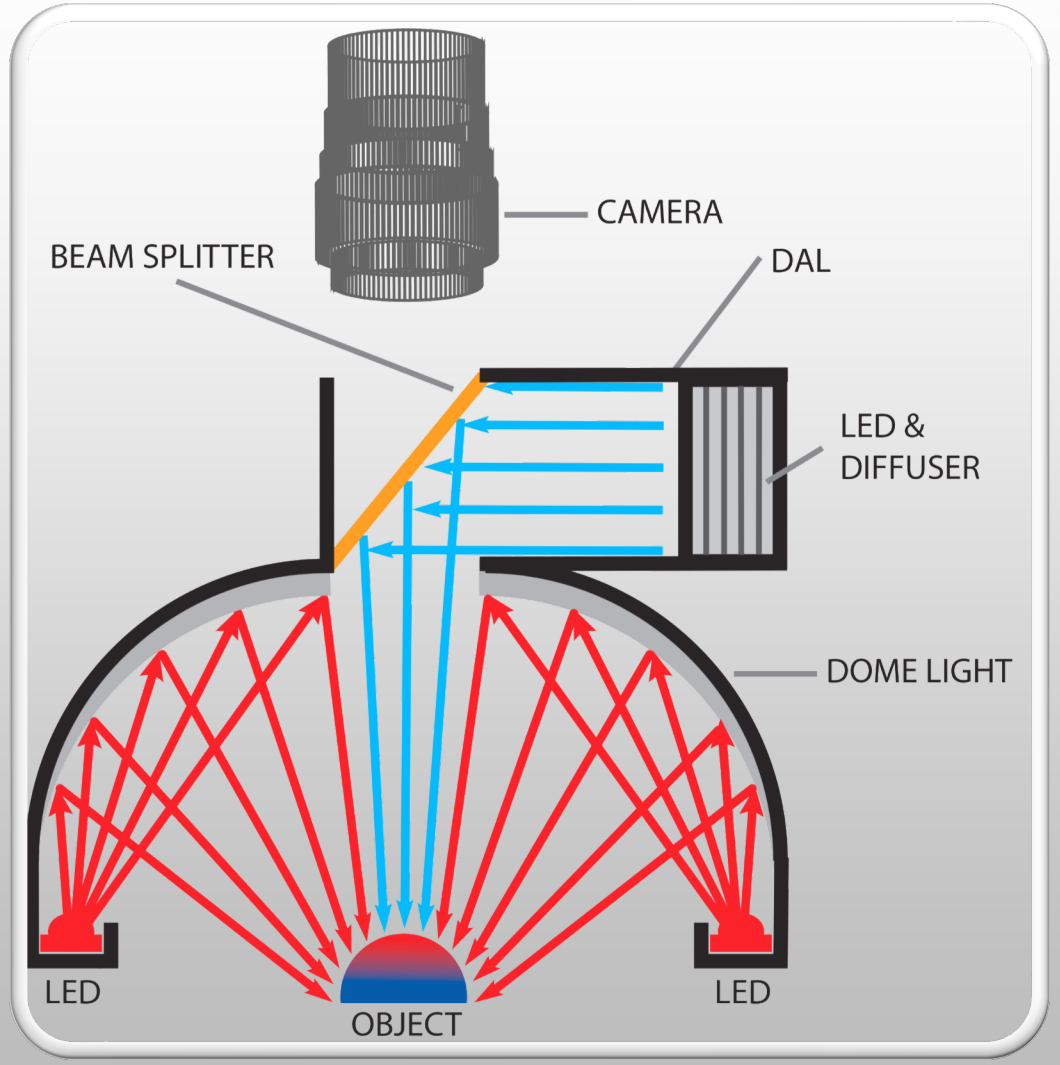
COAXIAL LIGHTING

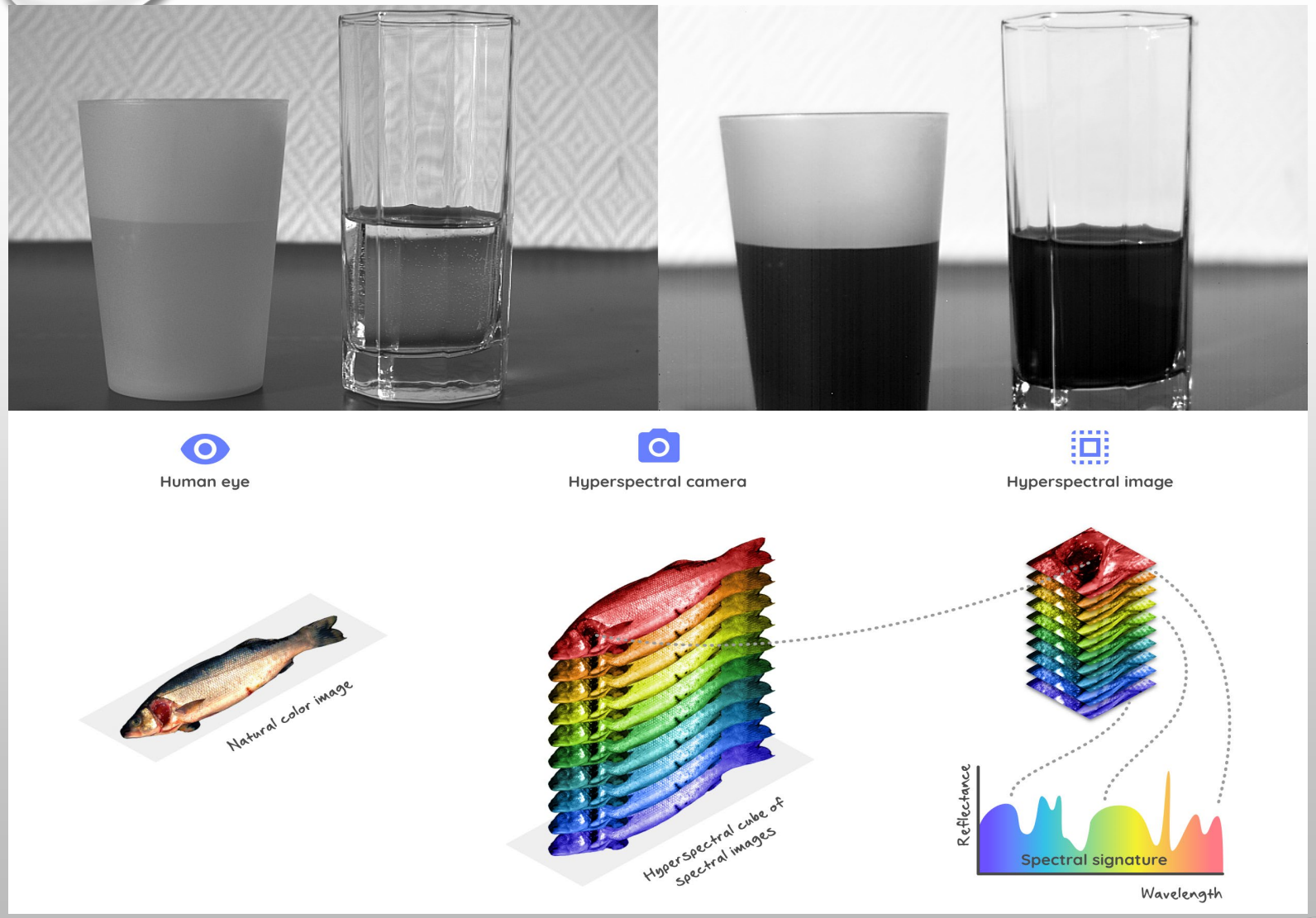
COAXIAL LIGHTS ARE USED FOR SHINY/SPECULAR OBJECTS TO REMOVE THE CAMERA HOLE FROM VISIBILITY IN THE IMAGE



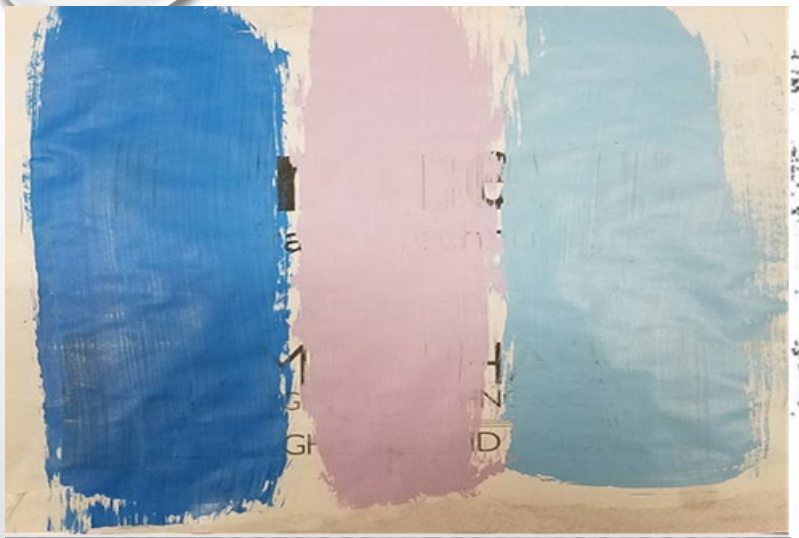
CODL LIGHTING

CODL LIGHTS ARE COMBINATION OF DOME AND COAXIAL LIGHTS AND ARE USED FOR SHINY PARTS THAT HAVE TOPOGRAPHICAL FEATURES





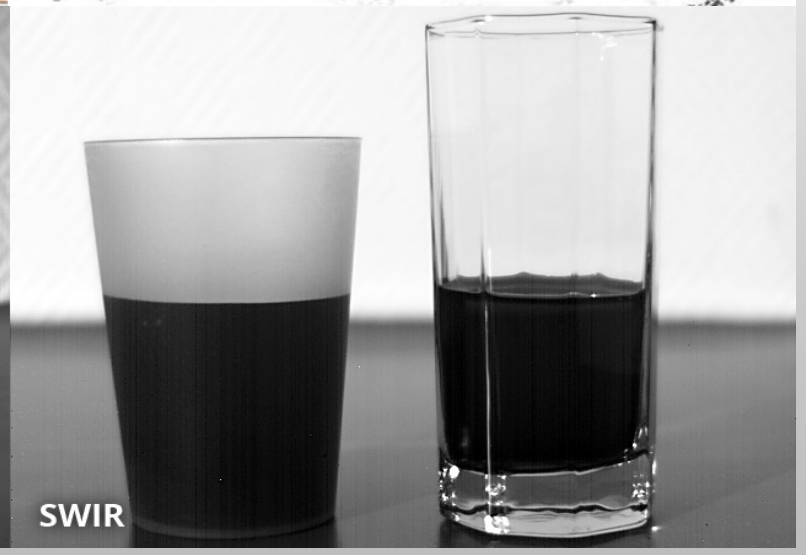
NEW TECHNOLOGY



Princeton Infrared Technologies

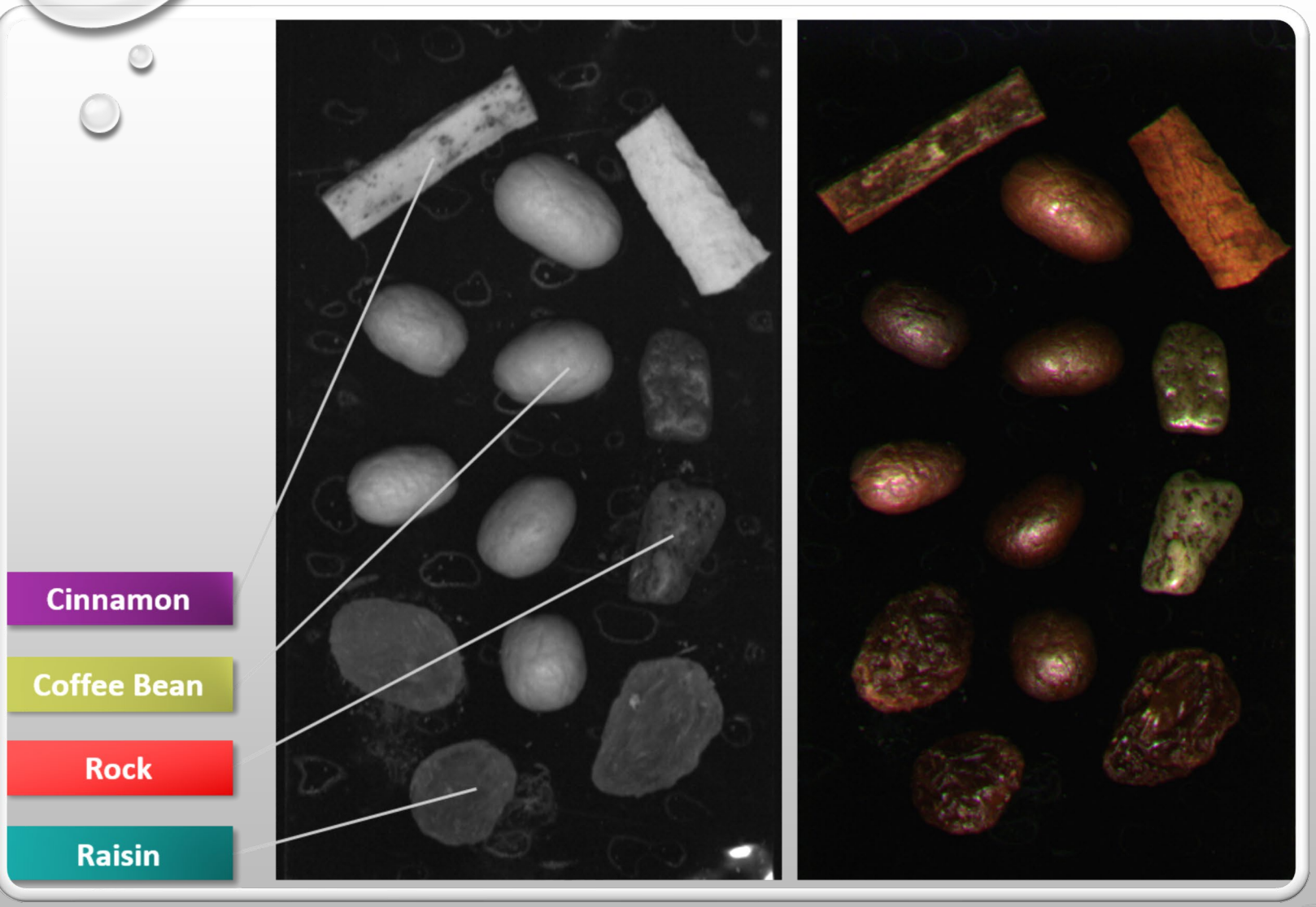
METAPHASE LIGHTING TECHNOLOGIES

LIGHT BEYOND VISION



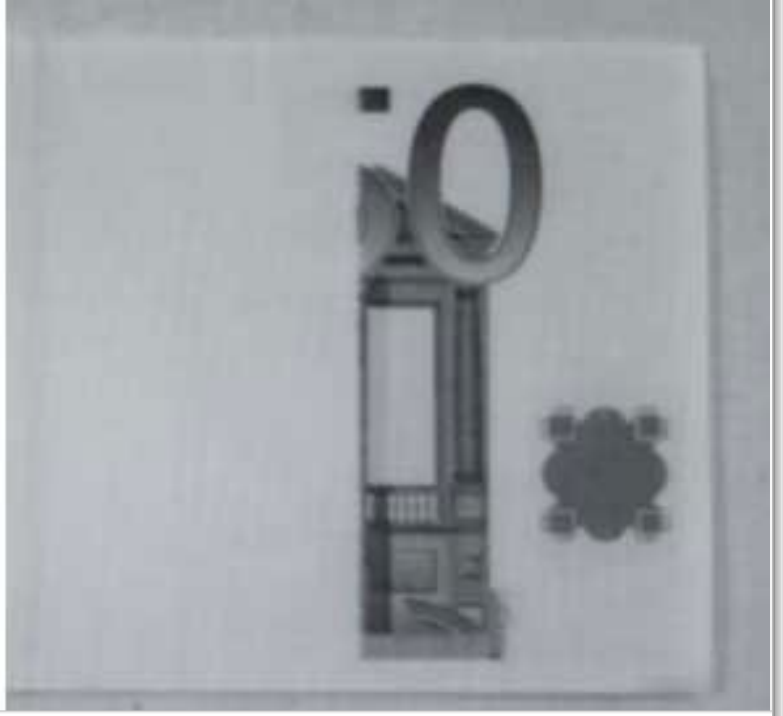
SHORT WAVE INFRARED - SWIR

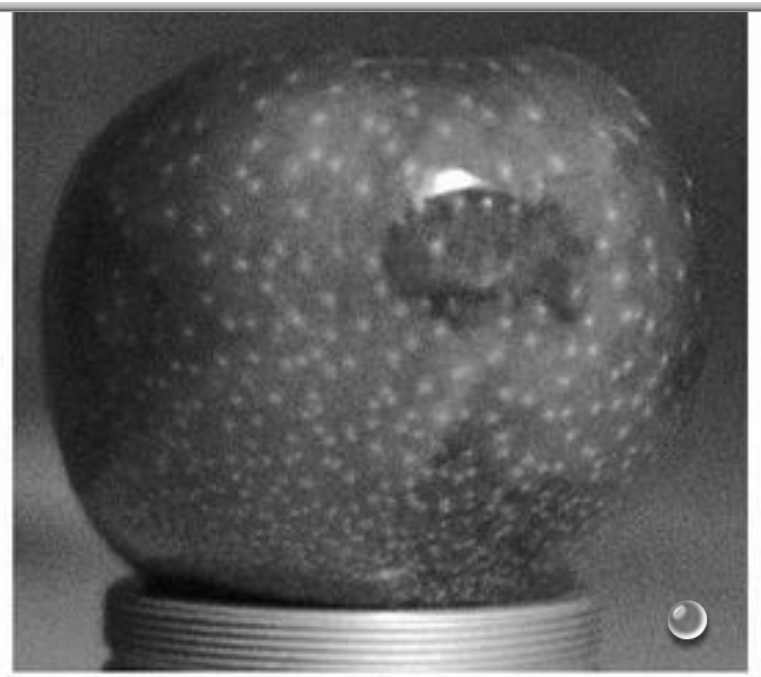
- 1000-1700NM WAVELENGTHS
- STRONG ABSORBANCE BANDS FOR WATER AND CARBON
- LONGER WAVELENGTHS PENETRATE PLASTICS



SWIR APPLICATIONS

- SORTING: BY USING HYPERSPECTRAL FINGERPRINTS, DIFFERENT MATERIALS CAN BE SEPARATED AT SPECIFIC BANDS THAT DEMONSTRATE ABSORBANCE DIFFERENTIALS





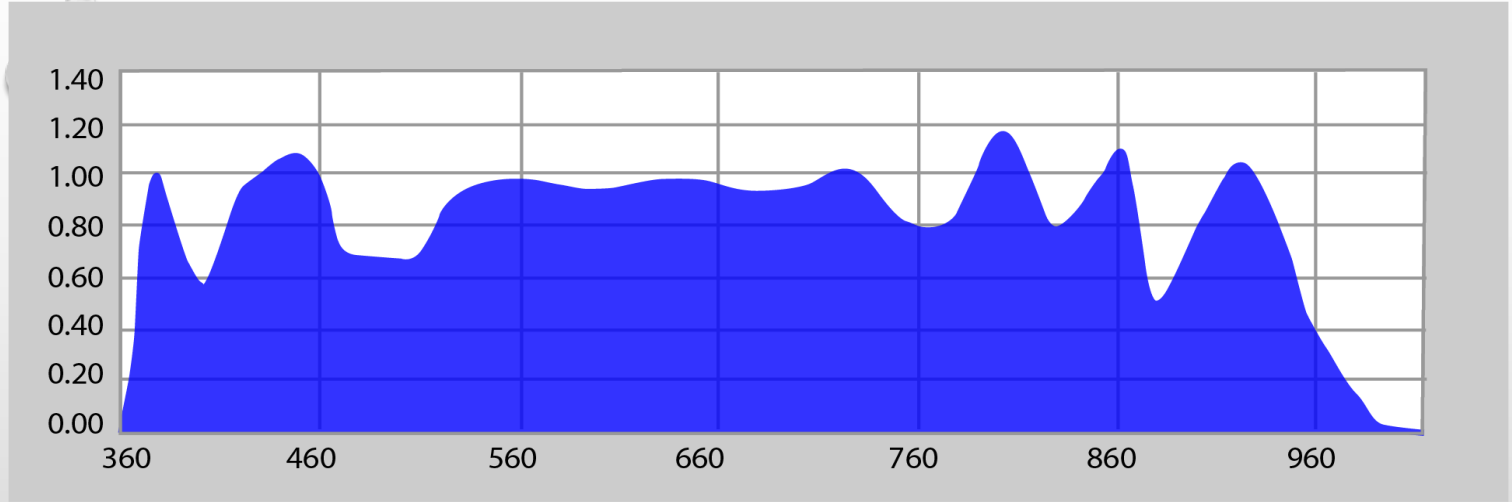
SWIR APPLICATIONS

- CURRENCY: INSPECTION OF CURRENCY WATERMARK FOR PRESENCE/ABSENCE, QUALITY, AND ALIGNMENT
- AGRICULTURE: INSPECTION OF

METAPHASE LIGHTING TECHNOLOGIES

Visible-NIR*

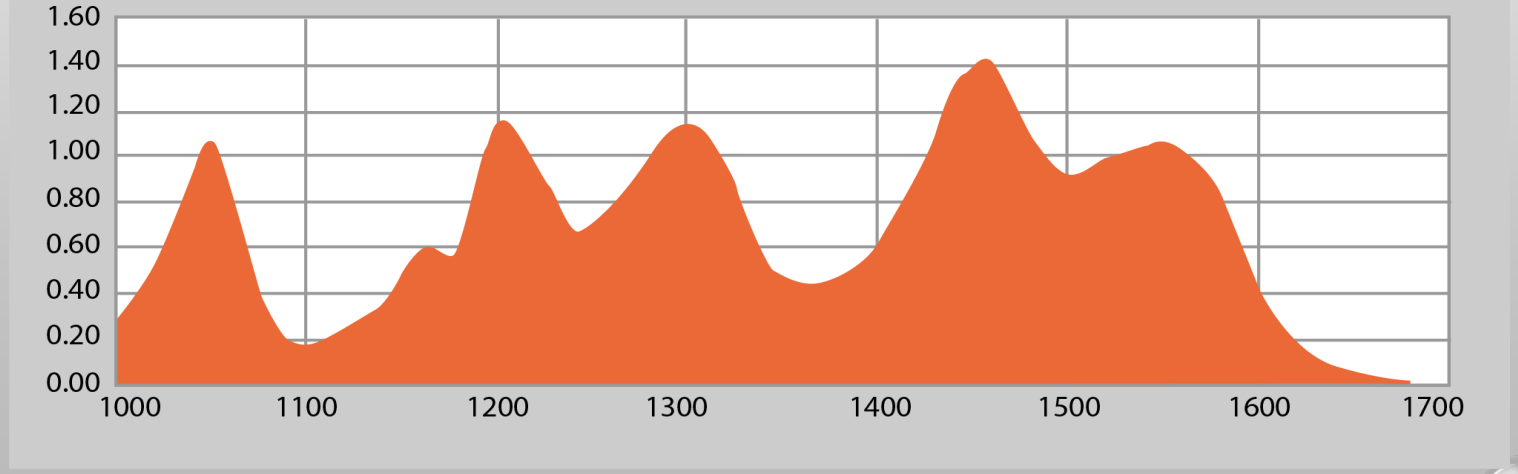
HYPERSPECTRAL LED ILLUMINATION SYSTEM



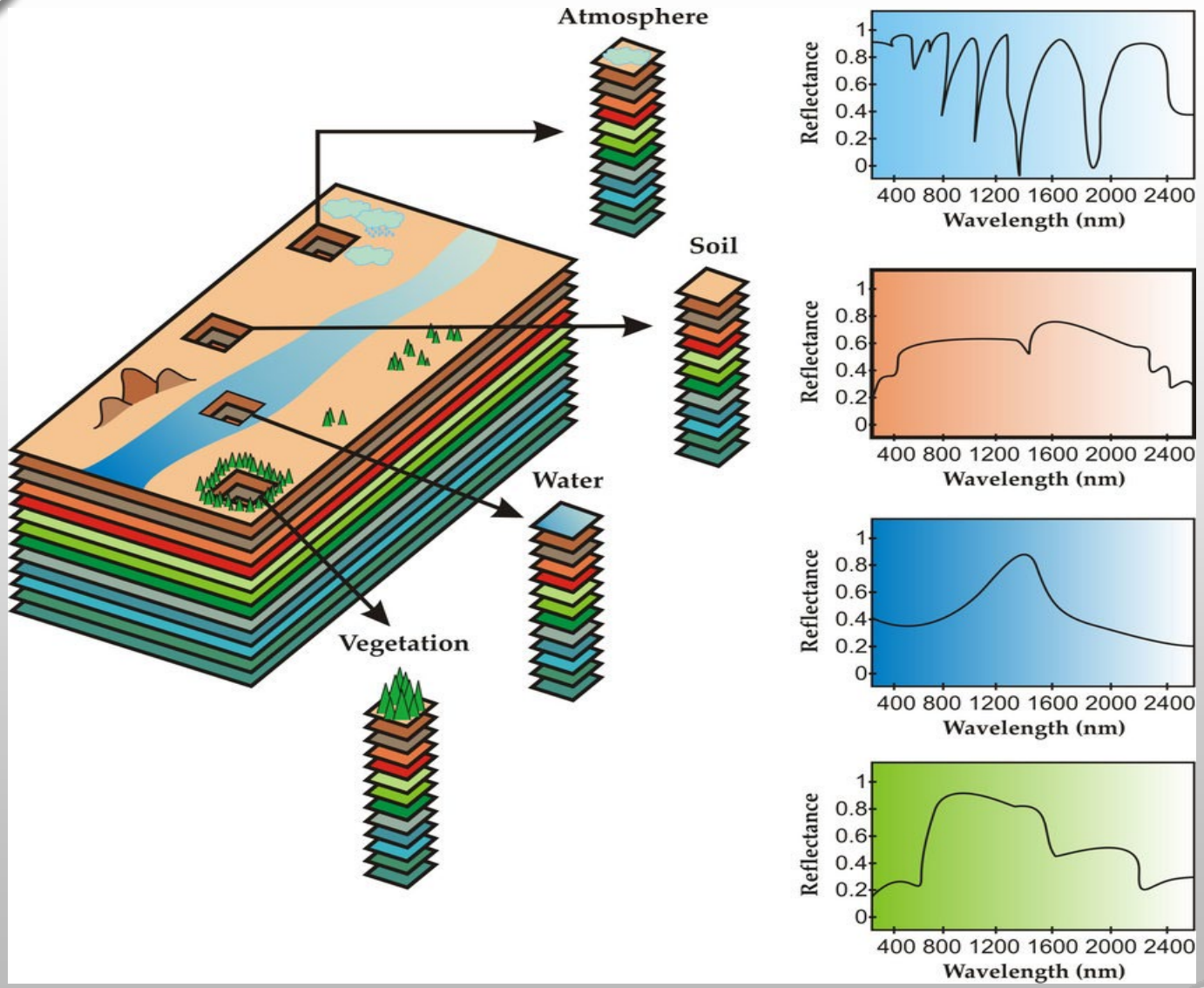
METAPHASE LIGHTING TECHNOLOGIES

Broadband SWIR

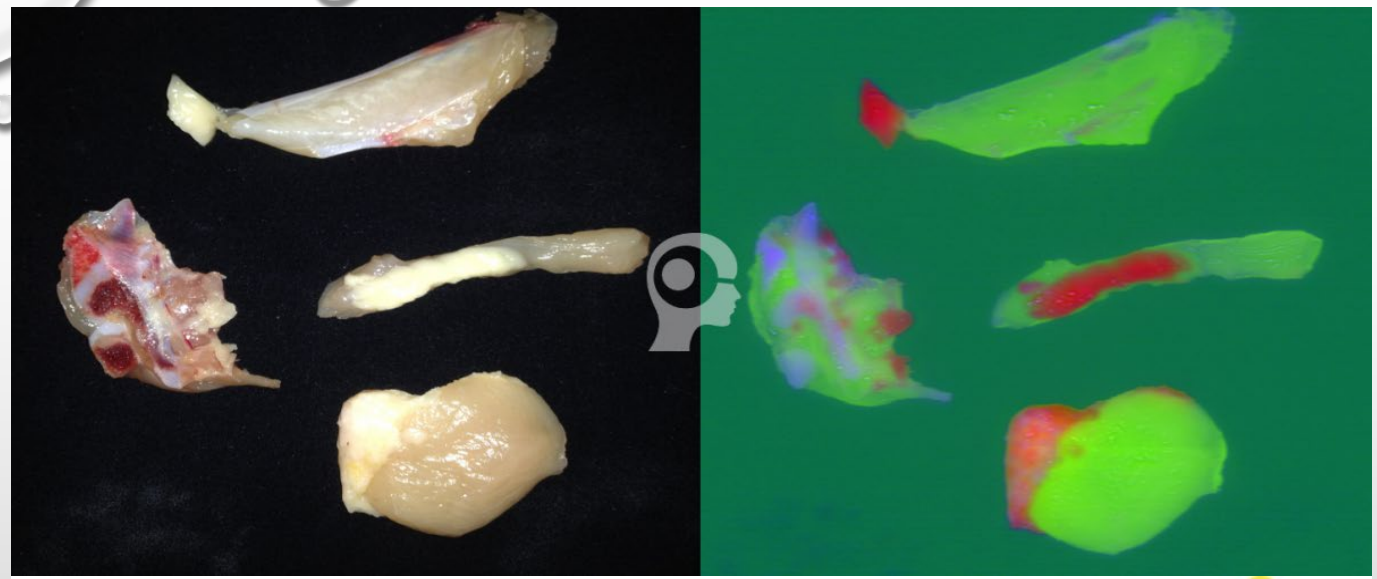
HYPERSPECTRAL LED ILLUMINATION SYSTEM

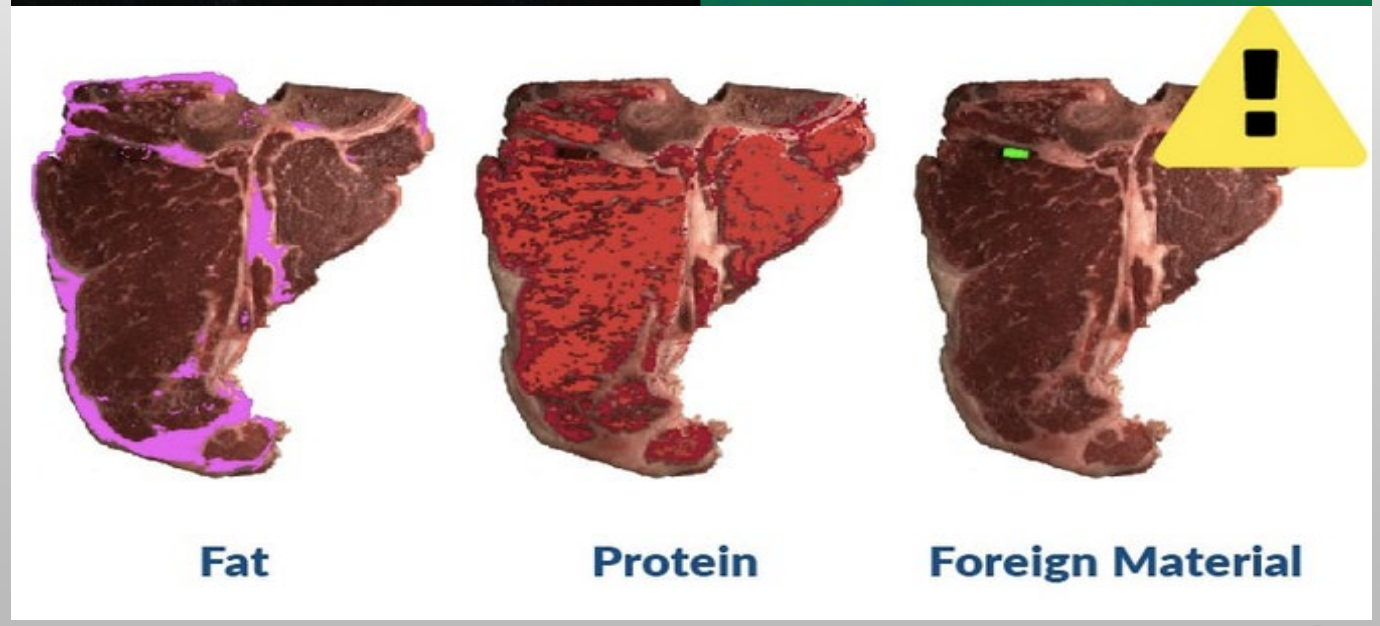


HYPERSPECTRAL IMAGING – LED SPECTRAL OUTPUT



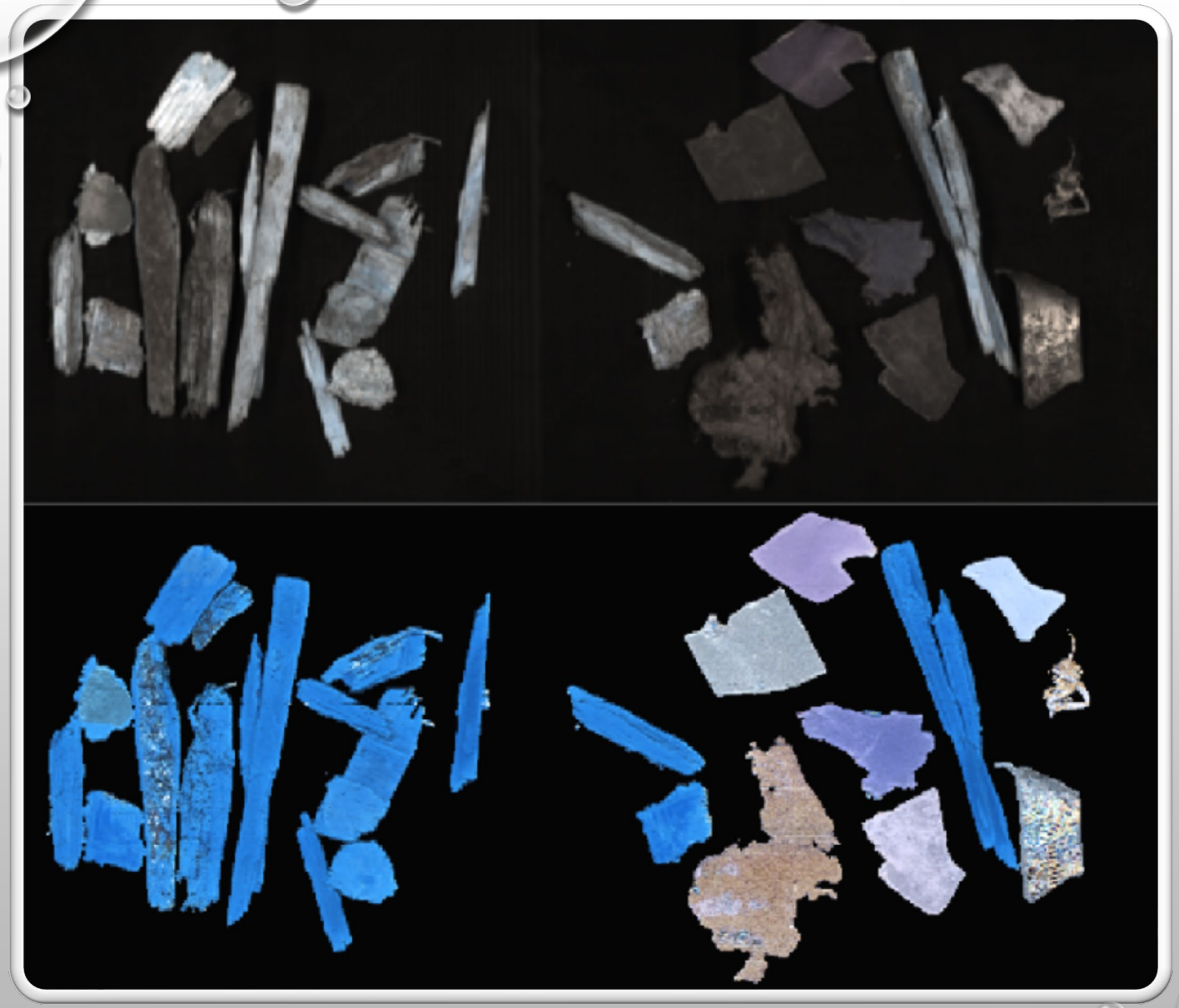
HYPERSPECTRAL IMAGING - SPECTRAL FINGREPRINTING





HYPERSPECTRAL APPLICATION

- FOOD PROCESSING: BONE, FAT, PROTEIN CHARACTERIZATION AND FOREIGN MATERIAL DETECTION



HYPERSPECTRAL APPLICATIONS

- WOOD SORTING: DETERMINING DIFFERENT SPECIES OF WOOD

HYPERSPECTRAL APPLICATIONS

- PLASTIC SORTING: DETERMINING DIFFERENT PLASTICS (HDPE, LDPE, PVC, PET, ETC.) FOR SORTING AT PLASTIC RECYCLING FACILITIES