Combating Glare with Polarized Sensors & LED Lighting Solutions
The differences of these structures

① On-glass or On-chip process
- **Conventional structure**: The polarizer is assembled on cover glass aligned to the position of the cell later, so the accuracy cannot be so high and to make the cell smaller is also difficult.
- **Sony's Polarization image sensor**: The polarizer is fabricated using a wafer process under an on-chip lens. Then it can perform higher accuracy, uniformity and mass productivity.

② Distance between polarizer and photodiode
- The distance from the polarizer to the photodiode is important for the polarization sensor. A polarizer close to the photodiode improves the extinction ratio and the incident angle dependence.
Capture four directional polarized images simultaneously

**Sensor specification**
- Image size: Diagonal Type 2/3
- Number of effective pixels: Approx. 5.07M pixels
- Unit cell size: 3.45um(H)x3.45um(V)
- Readout rate (All-pixel scan mode):
  - 163.4 frame/s (8bit)
  - 144.7 frame/s (10bit)
  - 89.5 frame/s (12bit)
- Global shutter function

**Polarizer specification and performance**
- Polarizer Direction: 0°/45°/90°/135° degrees
- Extinction Ratio: >20:1
- Transmittance: ~70%

※0°,45°,90°,135°：the polarizer angle viewed from the sensor face.
※90°,45°,0°,135°：the transmitted polarization angle.
(The light perpendicular to the polarizer is transmitted.)
4 IMAGES, 4 POSSIBILITIES

- You can see 4 independent images from the different pixels with different polarization angles.
- You can then use your imaging software only the polarization angle that gives you the best results.
- You can also through software combine the 4 images into a single composite image.

4 simultaneous images with 0°, 45° 90°, and 135° of sensor polarization.
Variety of Imaging Process Tools at Your Finger Tips

- Image Intensity
- DoLP - degree of linear polarization
- AoLP - angle of linear polarization (AoLP)
- Segment Processing – Process using specific polarization angle of the sensor
WHY LIGHTING MATTERS

• Picking the correct lighting can be critical for the application
• Lighting with Liner polarization can minimize variables in lighting, to reduce spectral refection, and make polarization angles more predictable for consistent imaging
• Correct lighting style can help reduce other lighting artifacts such as shadows or unevenness of light distribution
• High Intense LEDs Illumination can help over-come the light lose when using polarization
COMMON STYLE OF POLARIZED LIGHTS

Polarized Lights

- Line Light
- Backlight
- Ring Light
- Flat Dome Light
- EKLight
HOW TO POLARIZE LIGHT

- The micro levers in the Linear Polarizers only allows light to pass through in a certain polarization angle.

- Polarization film can be produced in a flexible film to contour to the shape of the light or be a ridged sheet for more structural stability.

- You can then use techniques of cross-polarization between the light and the sensor.

- This is a commonly used polarization technique to cut down glare or unwanted spectral reflection.
IMPORTANCE OF LIGHTING

Polarization

Non-Polarized Imager & Non-Polarized Light

Polarized Imager & Non-Polarized Light

Polarized Imager & Cross Polarized Light

BAD

OK

GREAT

Come see our live polarization demo
PICKING THE CORRECT LIGHT

- Image taken with Exolight barlight
- With lighting coming only at less angles, shadows are created by the pins and sidewalls
- Light is less diffused causing uneven distribution of light

- Image taken with diffused OBL Flat Dome
- Less shadows created by the pins and size wall, more even illumination over the entire field of view
- More light reflected back to the camera for better intensity
STRESS DEFECTS

Polarization imaging (a) reveals stress in objects where conventional imaging cannot (b)

- Polarization is great in identifying stress defects in optically clear glass and plastic
- When using controlled polarized light, you can easily detect change in the polarization angle caused by a defect or stress point in the glass
STRESS DEFECTS

Type stuff
Shape Recognition

Enhancement in recognizing dark color objects in low contrast
Shape Inspection (scratches or dust flat surface)

Detection of scratches with polarized light source

- Ambient light
  - Normal image
  - DoP
  - w/ Unpolarized light
    - Normal image
    - DoP
- w/ Linearly polarized light
  - Normal image
  - DoP
Shape Inspection (scratches or dust flat surface)

Detection of scratches with polarized light source

<table>
<thead>
<tr>
<th>Ambient light</th>
<th>w/ Linearly polarized light</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal image</td>
<td>DoP</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>w/ Unpolarized light</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal image</td>
</tr>
</tbody>
</table>
ANY QUESTIONS?

Visit our booth
for a live demo showing the benefits of
Polarized lighting and Sony’s Polarized Sensor