OmniVision Technologies
OmniBSI™ Technology

OmniVision

the clear advantage ™

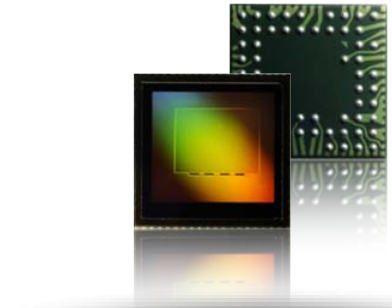
Safe harbor statement

- Except for historical information, the matters discussed in this presentation may contain forward-looking statements that are subject to risks and uncertainties. These risks and uncertainties could cause the forward-looking statements and OmniVision's actual results to differ materially. In evaluating these forward-looking statements, you should specifically consider various factors, including the factors listed in the "Risk Factors" section of the Company's most recent annual report filed on Form 10-K and most recent quarterly reports filed on Form 10-Q. These factors may cause the Company's results to differ materially from any forward-looking statement. Forward-looking statements are only predictions and actual events or results may differ materially.

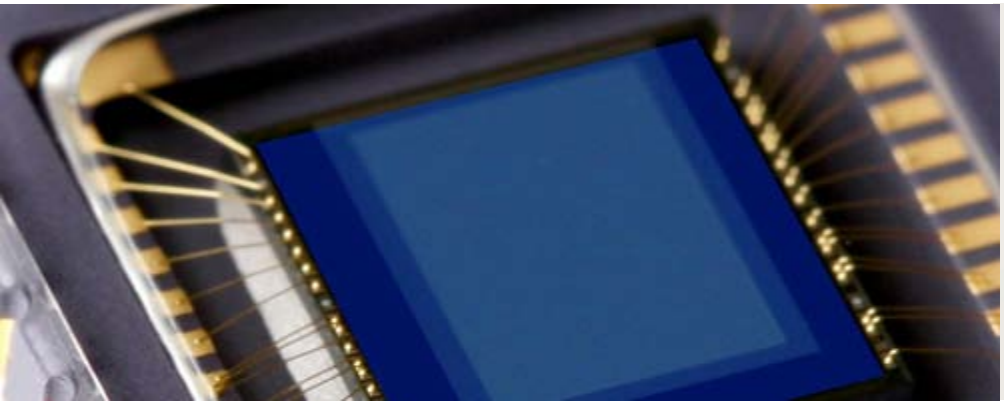
- OmniVision disclaims any obligation to update information contained in any forward-looking statement.

Agenda

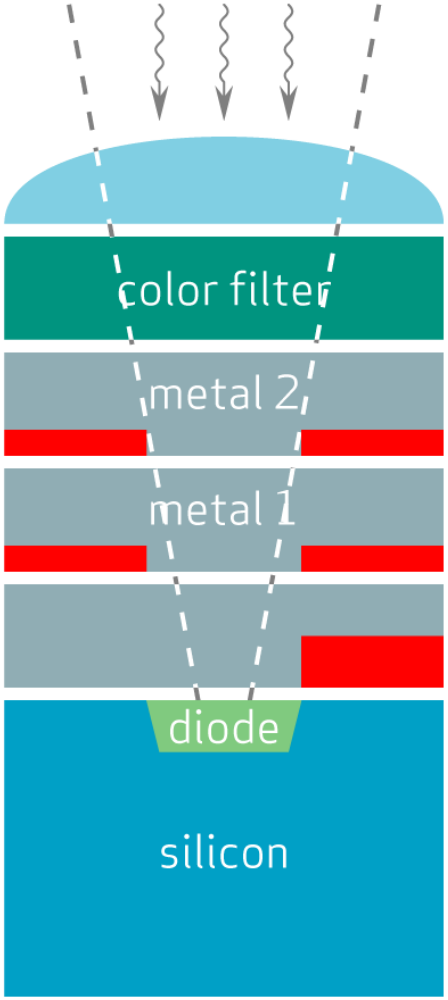
- Pixel technology background
- Manufacturing OmniBSI devices
- Advantages of OmniBSI™
- Summary



Pixel technology background



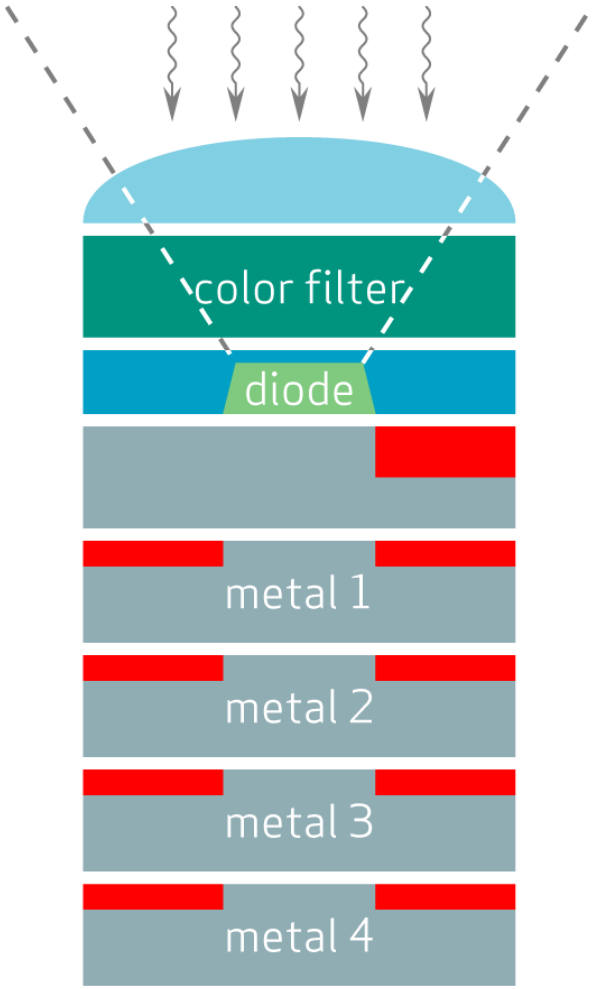
Front-side Illuminated (FSI) pixels



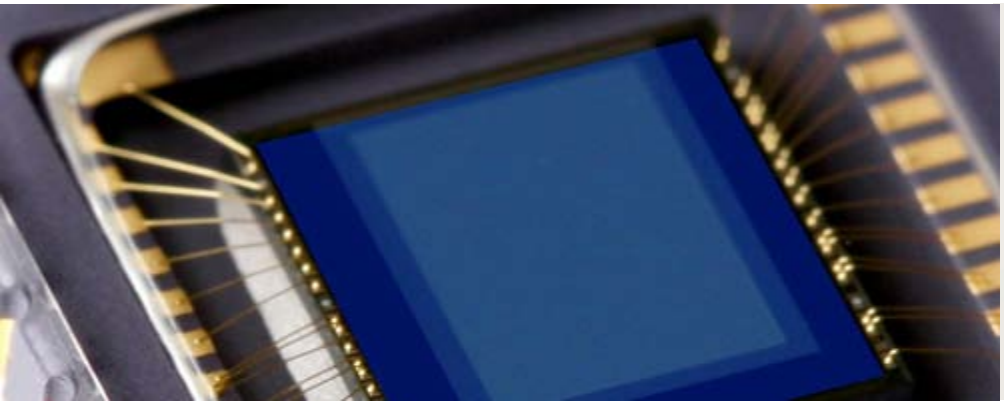
- Most common sensing technology
- Tall metal stack-up makes getting photons to the photodiode difficult
  - → Compromises sensitivity
- Restricts Chief Ray Angle (CRA)
  - → Increases lens height
- Significant optical and electrical crosstalk
- Color and luminance shading varies with illuminant
- Smaller FSI pixels deliver unacceptably poor performance

OmniBSI technology

- Back-side Illuminated (BSI) sensors have been used for many years in highest performance applications
  - Astronomy, military, scientific
- BSI devices were expensive due to fragility and processing costs
- OmniBSI breakthrough – the ability to mass produce very small, cost effective BSI pixels for high performance products

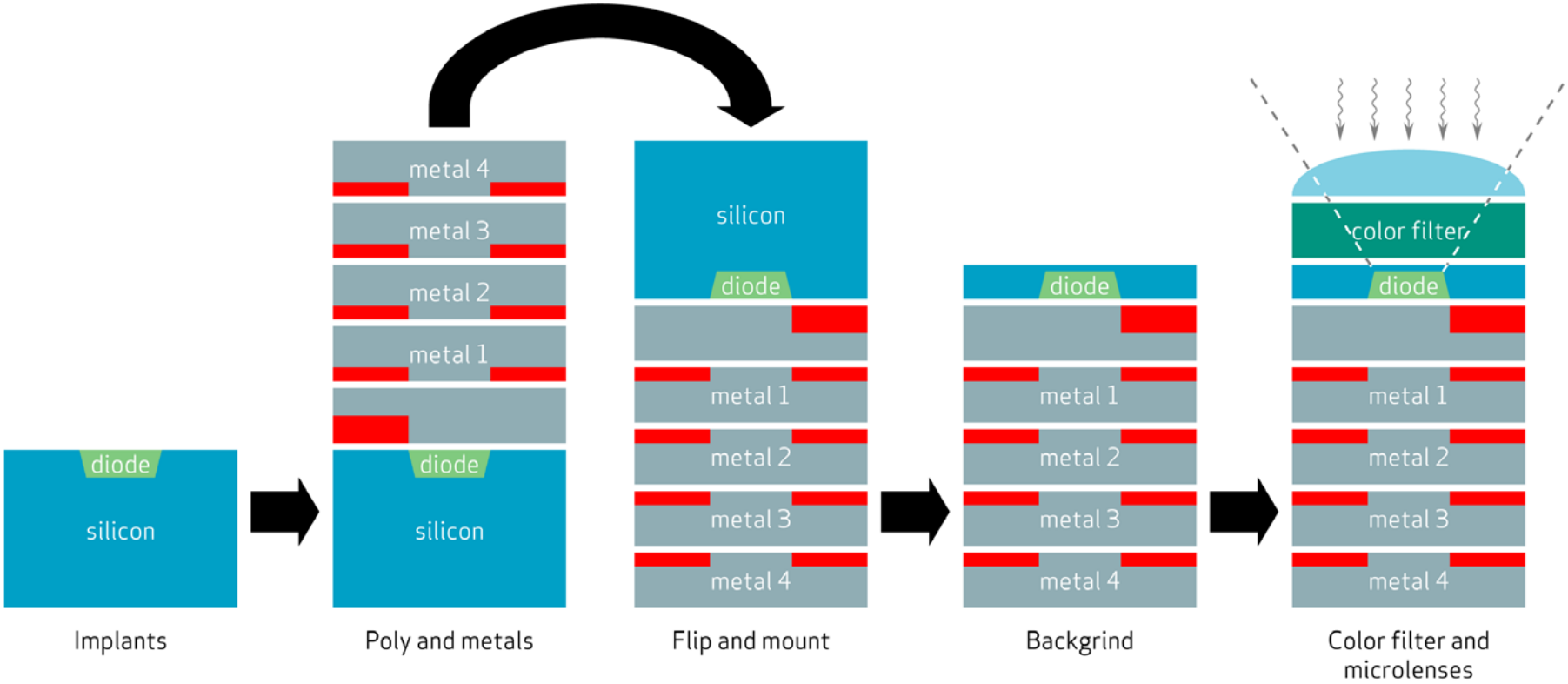


Manufacturing OmniBSI devices



Manufacturing OmniBSI devices

OmniBSI manufacturing process



Manufacturing OmniBSI devices

Manufacturing advantage of OmniBSI technology vs. SOI BSI

- Silicon On Insulator (SOI) is traditional technology for manufacturing BSI devices
- OmniVision's proprietary BSI processing technology has none of the drawbacks of SOI-based BSI

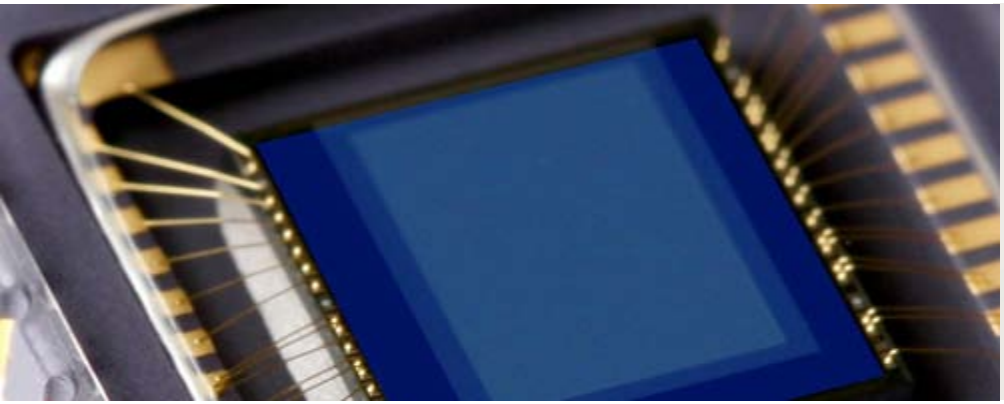
	OmniBSI	SOI BSI
Global manufacturing capacity	Practically unlimited No sourcing risk	Limited global production capacity for SOI wafers
Dark current and hot pixel density	Impurities can be removed from active area and removed completely during thinning process	Impurities in EPI layers are trapped by insulating layer, increasing dark current and hot pixels
Manufacturing cost	Uses standard wafers	Costs of SOI raw wafers is approx. 8x higher

Manufacturing OmniBSI devices

Comparison of OmniBSI impact vs. FSI to module design

Property	FSI vs. OmniBSI	Implications
Die size	**SAME** or **BETTER** - OmniBSI XY die size is the same for a given optical format & resolution. OmniBSI die may be smaller due to potential for additional metal layers and higher routing density	OmniBSI doesn't increase module XY size. OmniBSI is compatible with FSI module design rules
Die thickness	**SAME** - OmniBSI and FSI can be supplied in the same die thicknesses	No impact on die handling processes or yield
Packaging technology	**SAME** - OmniBSI offered in both CSP and COB packages	OmniBSI is compatible with the same die attach processes
Bondpad size	**SAME** - Bondpad geometry, materials, layout, and design rules are identical	No impact to bonding yield or processes
Electrical properties	**SAME** - OmniBSI device power and interfaces are electrically identical to FSI products	No change in support components, processors, PCB, or interconnect
Optical properties	**SAME** or **BETTER** - OmniBSI is more sensitive and more tolerant of lens XY misalignment (less color-shift and shading)	No impact to alignment, focus, or image quality testing processes or yields

Advantages of OmniBSI



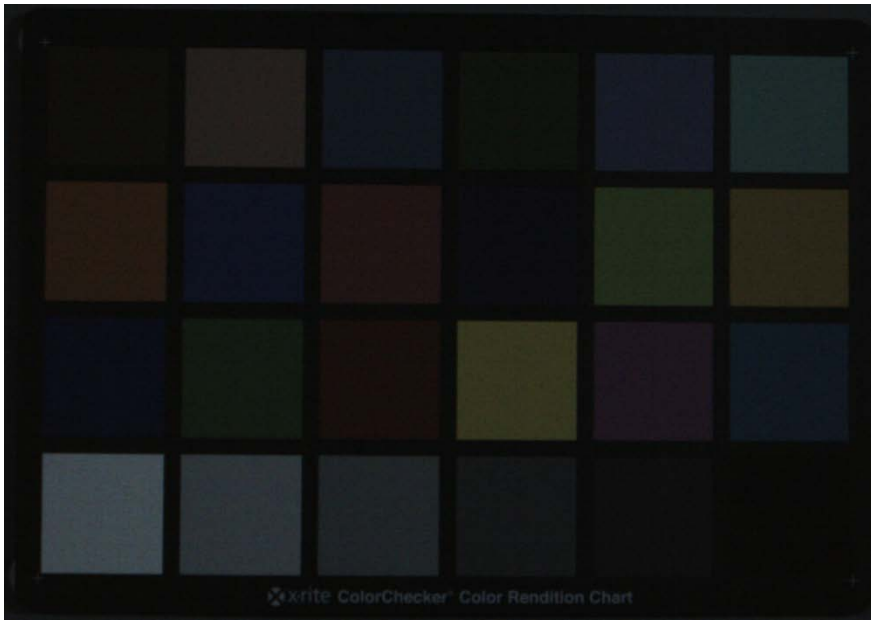
Advantages of OmniBSI

- Improved Quantum Efficiency (QE) and sensitivity
  - OmniBSI achieves 70-80% QE compared to 40% for FSI
  - OmniBSI offers 50% increase in sensitivity
- Dramatically less electrical and optical crosstalk
  - Less sensitivity to illuminant changes
- Wider Chief Ray Angle (CRA)
  - Enables thinner modules
  - Allows large aperture lenses for better low light performance
  - Less shading due to CRA sensitivity
  - Better for zoom lenses where CRAs change

Advantages of OmniBSI

OmniBSI delivers higher sensitivity

D65, 10 lux, 15 fps



OV5633

FSI is 960mV/lux-sec at 1.75 µm pixels

OV5653

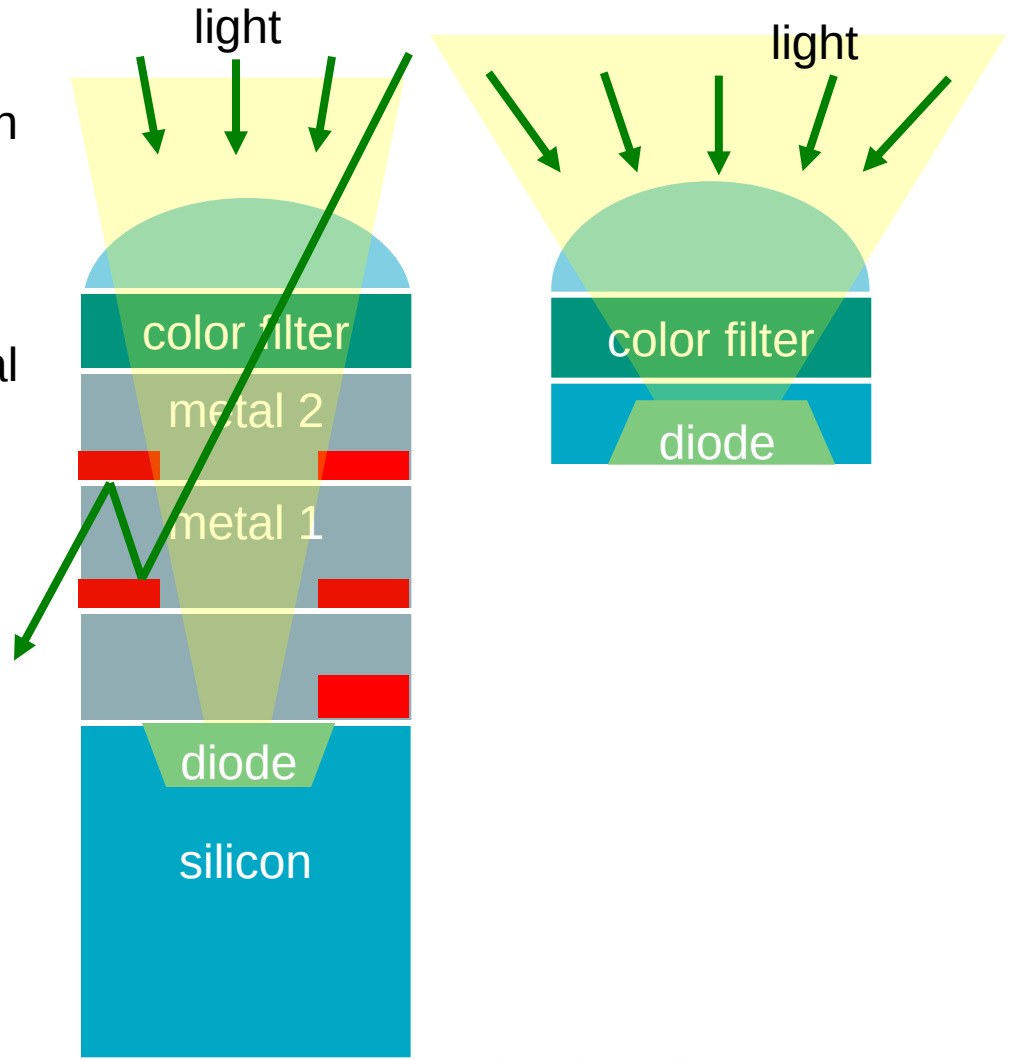
BSI is1300 mV/lux-sec at 1.75 µm pixels

OmniBSI is 50% more sensitive than FSI

Advantages of OmniBSI

Optical crosstalk in FSI

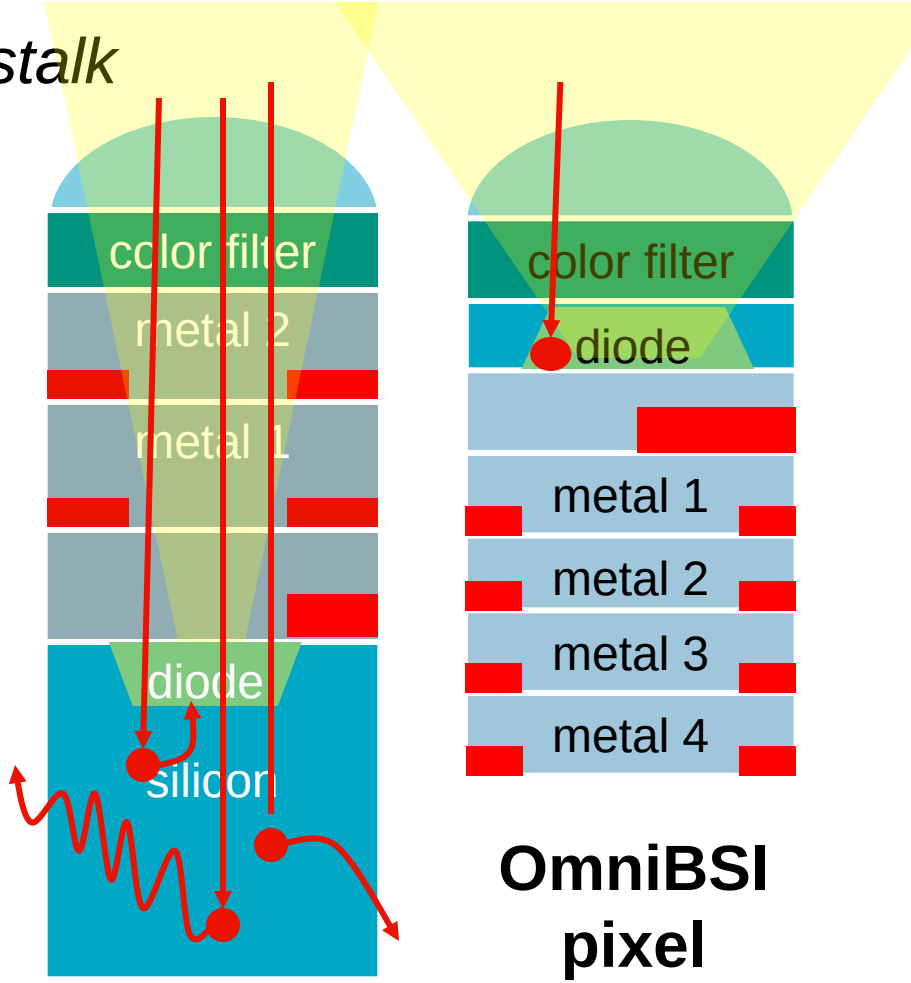
- Optical crosstalk occurs when photons don't follow their intended path
- Photons can bounce off metal layers into adjacent pixels, causing color crosstalk and loss of sharpness
- The ideal solution is to move the metal layers completely out of the optical path



Advantages of OmniBSI

OmniBSI reduces electrical crosstalk

- Electrical crosstalk occurs in silicon after the photon converts to an electron
- Goal: get all electrons into right photodiodes
- Three possible fates for an electron:
  - Collected in correct photodiode ☺
  - Collected in wrong photodiode ☹
  - Absorbed into substrate and lost ☹
- Misplaced electrons reduce sharpness and color fidelity and increase noise
- OmniBSI photodiodes fill the majority of the silicon volume
  - Nowhere for electrons to get lost
- Much higher probability that electrons end up in the right photodiode
  - Increased QE & sensitivity
  - Reduced color noise
  - Increased sharpness (MTF)



FSI pixel

OmniBSI pixel

Advantages of OmniBSI

Reduced color crosstalk in images

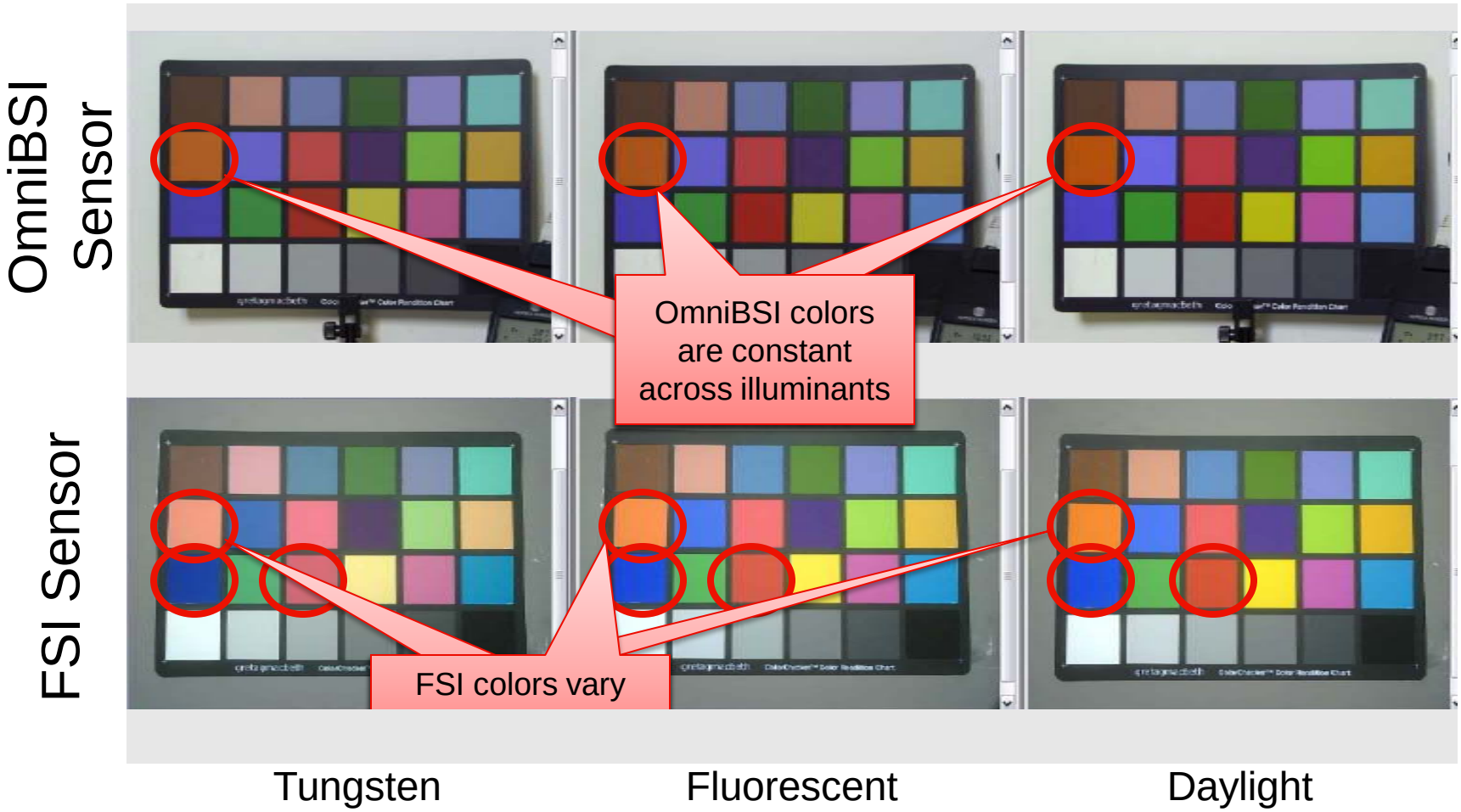
OmniBSI sensor

FSI sensor

Tungsten Fluorescent Daylight

Advantages of OmniBSI

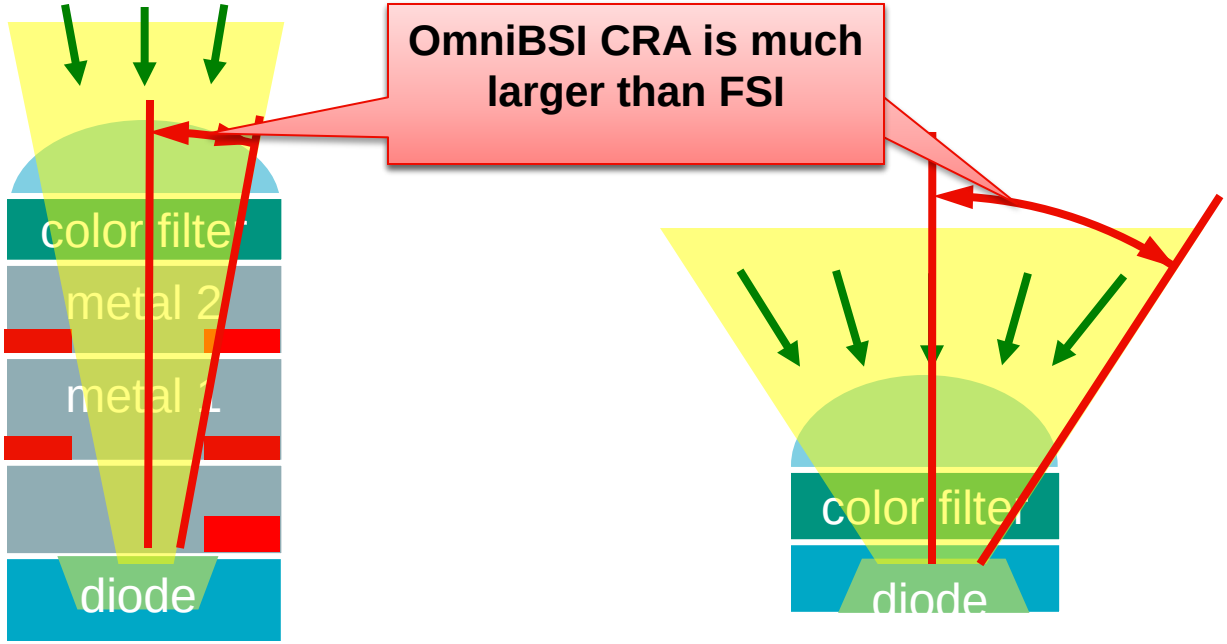
Reduced color crosstalk in images



Advantages of OmniBSI

OmniBSI enables wider Chief Ray Angles (CRAs)

<u>Key observation</u>: metal layers form an aperture, limiting the pixel's acceptance angle

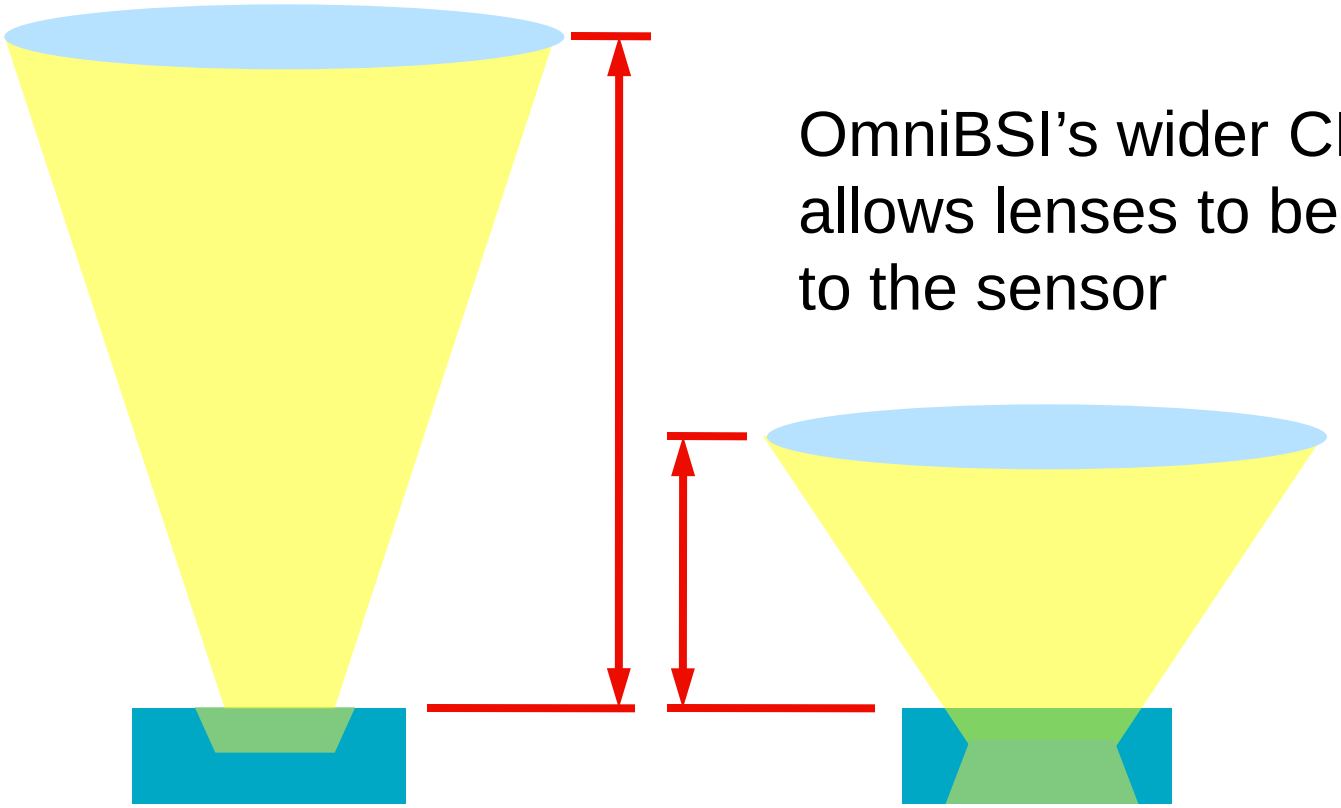


FSI imager

OmniBSI imager

Advantages of OmniBSI

OmniBSI enables thinner modules



OmniBSI's wider CRA allows lenses to be closer to the sensor

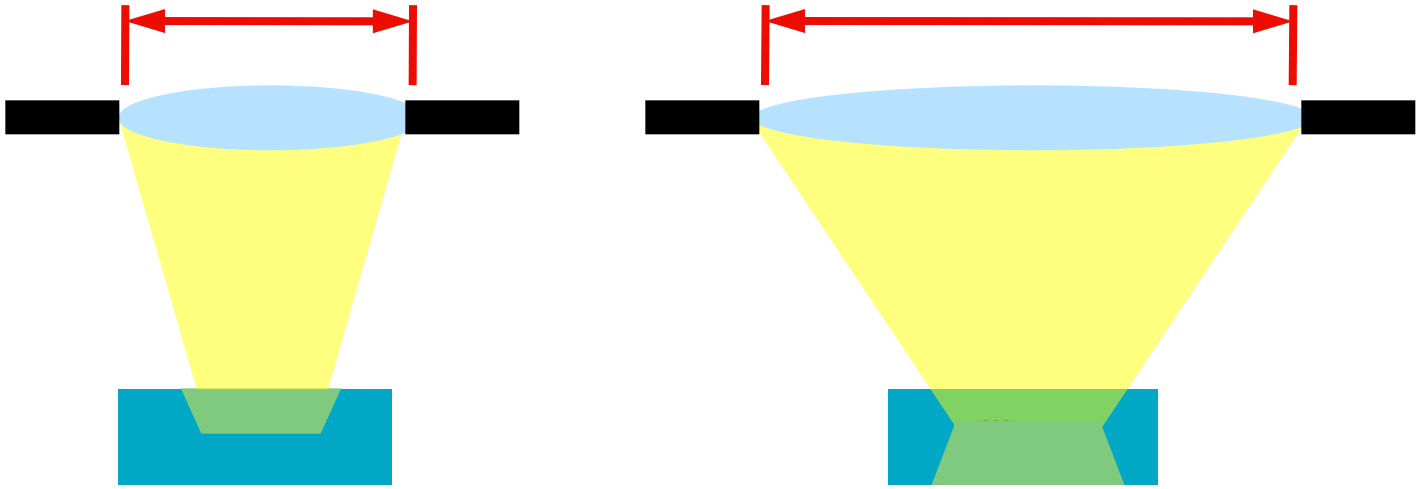
FSI imager

OmniBSI imager

Advantages of OmniBSI

OmniBSI enables larger aperture lenses

- Larger aperture lenses, such as f/2.0 lenses, improve low-light performance by 2x
- Have to be careful to assess sharpness and manufacturability of large f/# lenses



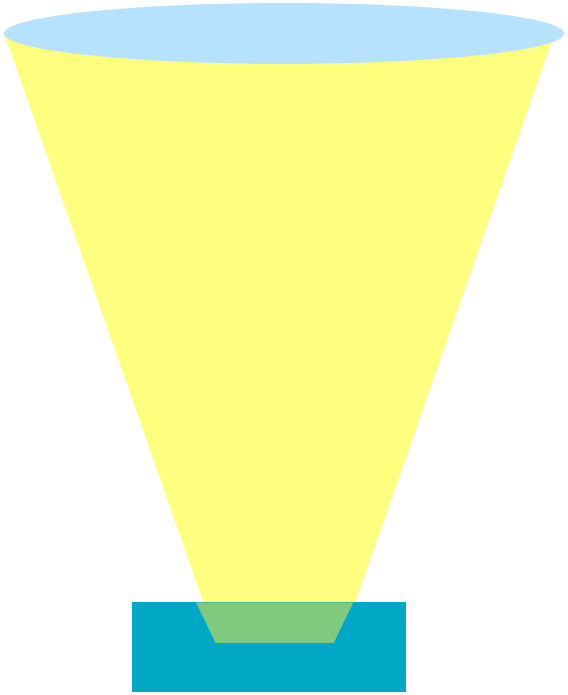
FSI imager

OmniBSI imager

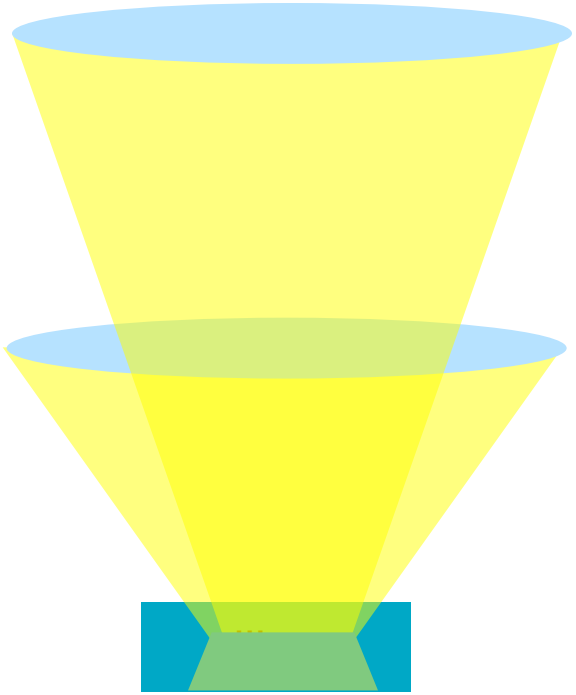
Advantages of OmniBSI

OmniBSI enables zoom lenses

- OmniBSI's wider CRA range allows lens to change CRAs, as is the case for zoom lenses



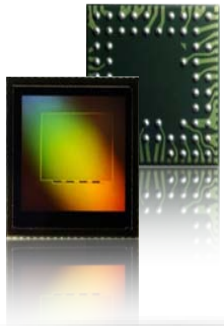
FSI imager

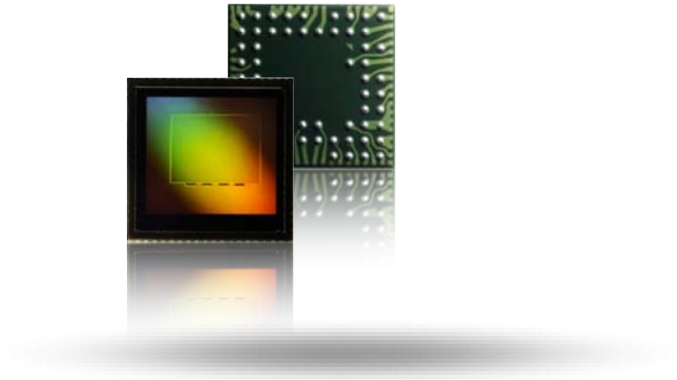


OmniBSI imager

Summary

- Advantages of OmniBSI
  - 40% higher QE and 50% more sensitivity
  - Less sensitivity to illuminant changes
  - Less color and luminance shading
  - Enables thinner modules
  - Support for larger aperture lenses
  - Well suited to zoom lens designs
- Manufacturing efficiency of OmniBSI
  - OmniBSI is superior to SOI BSI approaches
  - No impact to module manufacturing costs
- OmniBSI technology roadmap
  - Enables both very small pixels and highest quality pixels



OmniBSI Technology – the future of digital imaging

Thank You