

EXHIBIT M

Infringement of U.S. Patent No. 11,721,714

ISOCELL Image Sensor S5K2LD
Samsung Galaxy Z Flip5

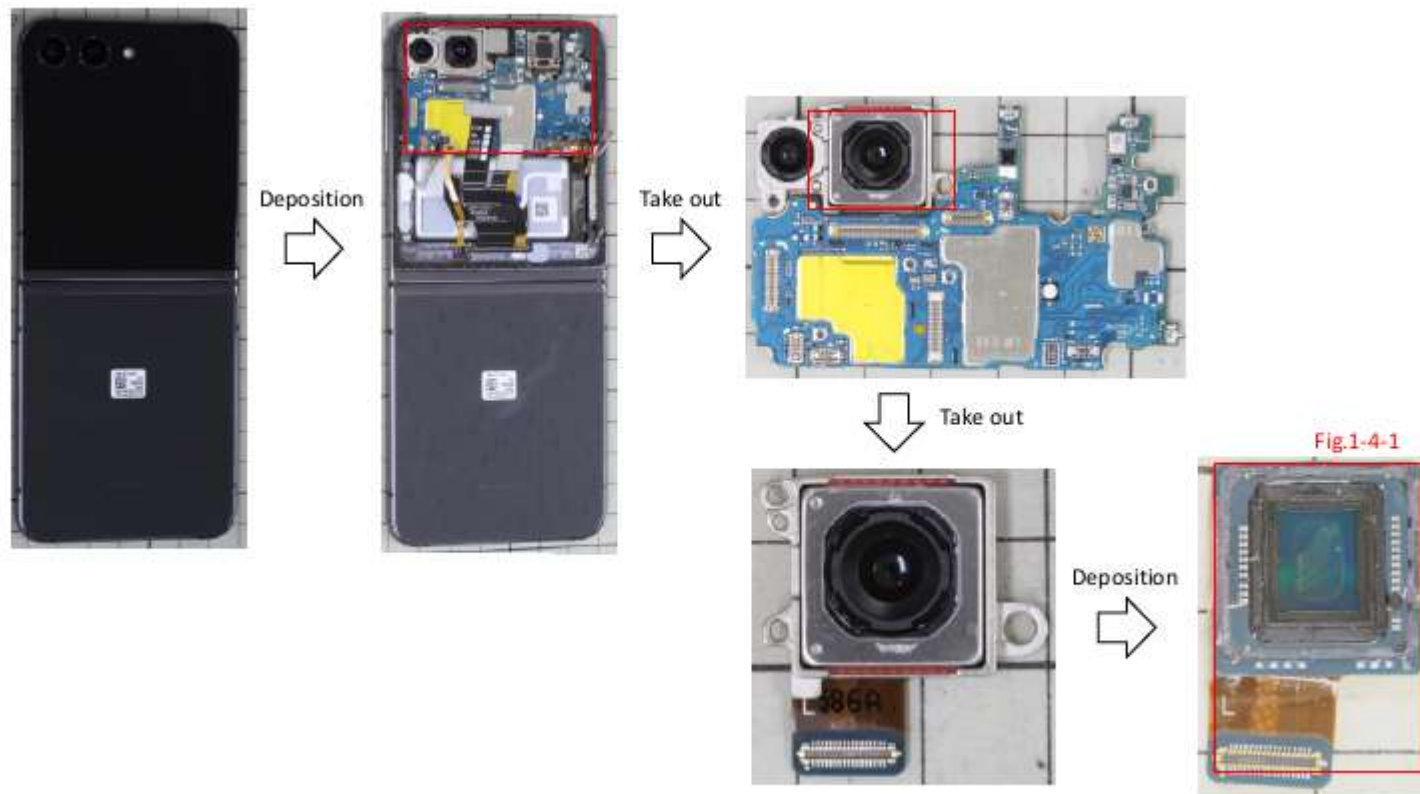
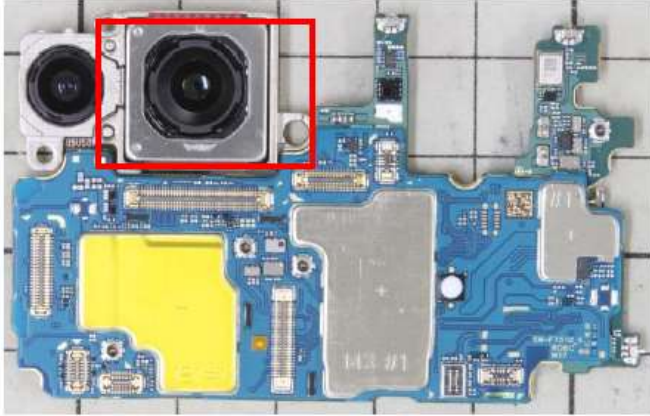
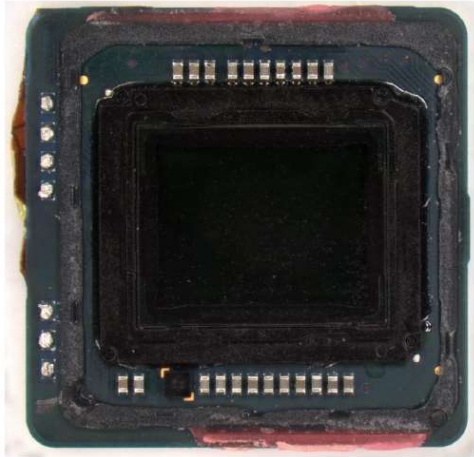


Fig. 1-3-1 Deposition process

Claim 1: A light trapping device, comprising:

Claim 1	
A light trapping device, comprising:	The Samsung Galaxy Z Flip5 is a light trapping device at least because it includes a Samsung ISOCELL sensor. The images below show the Samsung S5K2LD image sensor from the Samsung Galaxy Z Flip5.   Fig. 2-1-1 Image sensor appearance (Front)

U.S. Patent No. 11,721,714

Claim 1: A light trapping device, comprising:

Claim 1

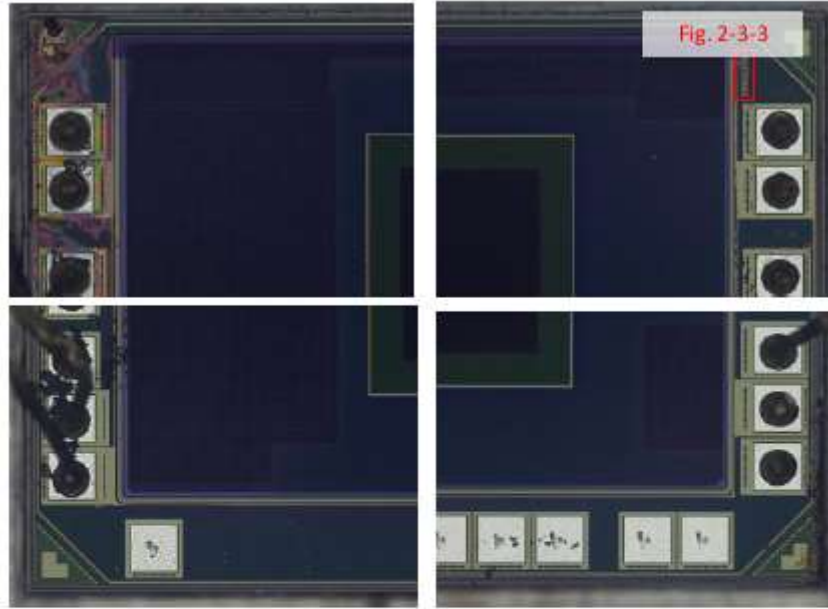


Fig. 2-3-2 Die corner



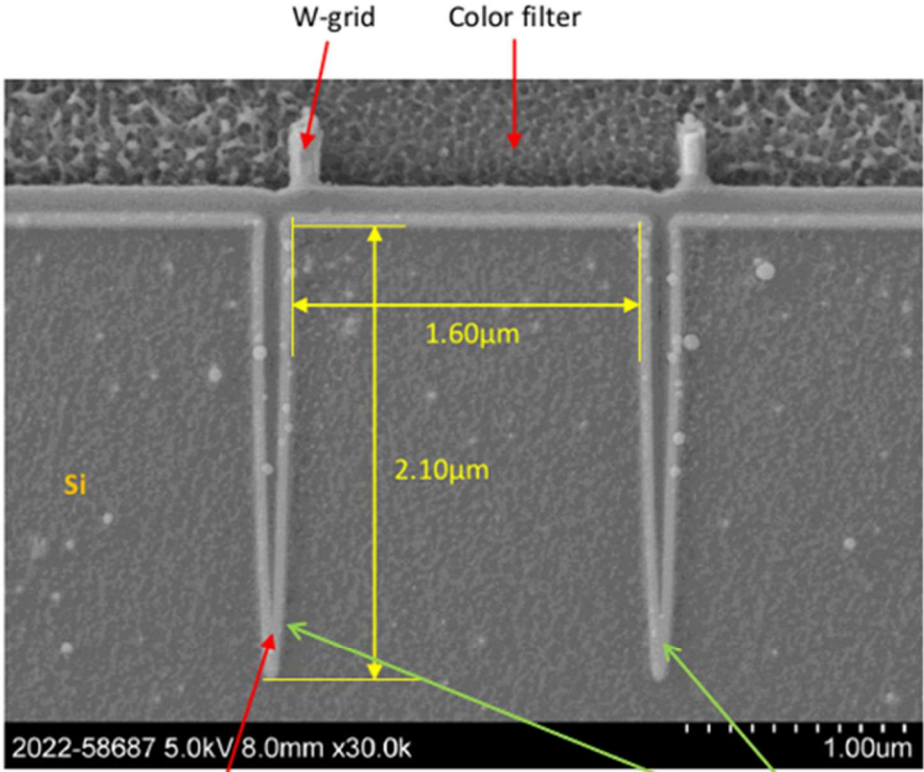
Fig. 2-3-3 Die marking (OM)

Claim 1(a): at least one light sensitive pixel having a light incident surface, a backside surface opposite the light incident surface, and a peripheral sidewall disposed into at least a portion of the pixel and extending at least substantially around the pixel periphery;

Claim 1(a)	
at least one light sensitive pixel having a light incident surface, a backside surface opposite the light incident surface, and a peripheral sidewall disposed into at least a portion of the pixel and extending at least substantially around the pixel periphery;	The ISOCELL sensor from the Samsung Galaxy Z Flip5 includes at least one light sensitive pixel having a light incident surface, a backside surface opposite the light incident surface, and a peripheral sidewall disposed into at least a portion of the pixel and extending at least substantially around the pixel periphery. The scanning electron microscope (“SEM”) cross sections below show light sensitive pixels of the ISOCELL sensor. Further, the images below show a light incident surface and a backside surface, opposite the light incident surface. In addition, the images below show cross sections of the peripheral sidewalls, which extend into at least a portion of the pixel. The SEM cross-section image shows a pixel structure. At the top, there is a W-grid, followed by a Color filter, and then a Micro lens. Below the micro lens is the light-incident surface. The pixel is formed in a substrate labeled 'Si'. A vertical dimension of 2.81µm is shown between the light-incident surface and the backside surface. The backside surface is at the bottom of the pixel. The peripheral sidewall of the pixel is labeled 'DTI'. The entire structure is labeled 'Pixels'. The image includes technical data at the bottom: 2022-56686 5.0kV 8.0mm x15.0k and a scale bar of 3.00µm. Fig. 3-7 SEM cross section

U.S. Patent No. 11,721,714

Claim 1(a): at least one light sensitive pixel having a light incident surface, a backside surface opposite the light incident surface, and a peripheral sidewall disposed into at least a portion of the pixel and extending at least substantially around the pixel periphery;

Claim 1(a)	
	 The SEM cross-section image shows a pixel structure on a silicon (Si) substrate. A central pixel area is defined by a width of 1.60μm and a depth of 2.10μm. The top layer is labeled 'Color filter' and the underlying grid is labeled 'W-grid'. A red arrow points to the 'DTI' (Deep Trench Isolation) region. A green box labeled 'Peripheral Sidewalls' points to the vertical walls of the pixel. The image includes a scale bar of 1.00μm and technical data: 2022-58687 5.0kV 8.0mm x30.0k. Fig. 3-8 SEM cross section

Claim 1(a): at least one light sensitive pixel having a light incident surface, a backside surface opposite the light incident surface, and a peripheral sidewall disposed into at least a portion of the pixel and extending at least substantially around the pixel periphery;

Claim 1(a)

The top-view of the ISOCELL sensor, shows that the peripheral sidewalls substantially surround the pixel periphery.

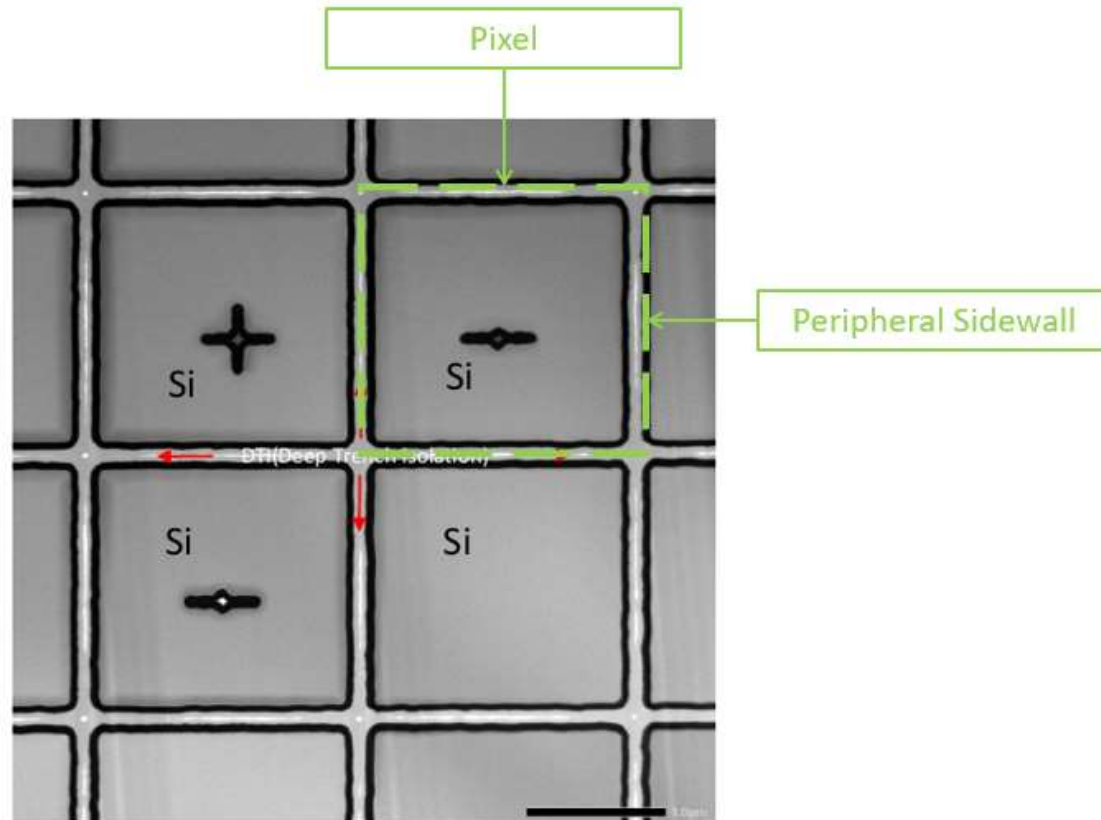
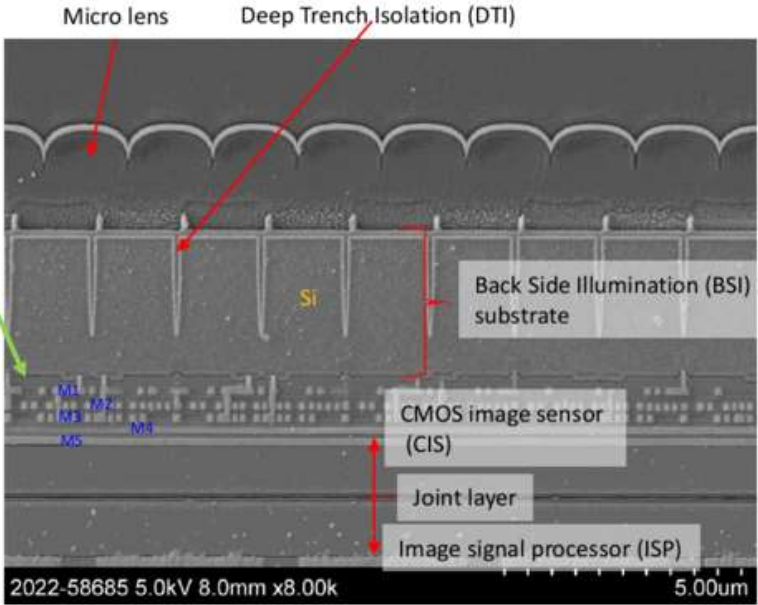


Fig. 4-2 BF STEM image

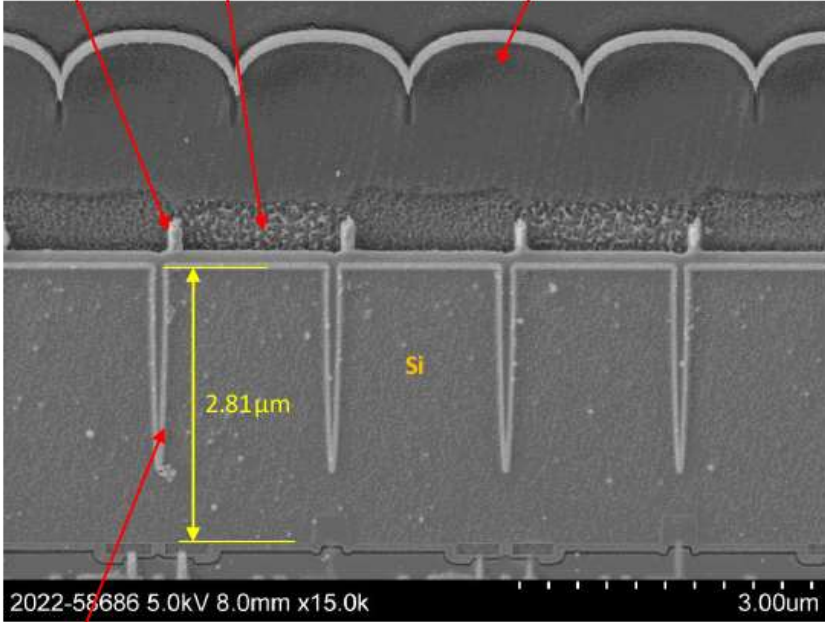
U.S. Patent No. 11,721,714

Claim 1(b): a backside light trapping material at least partially covering the backside surface; and

Claim 1(b)	
a backside light trapping material at least partially covering the backside surface; and	The ISOCELL from the Samsung Galaxy Z Flip5 includes a backside light trapping material substantially covering the backside surface. The SEM images below show that the backside surface is substantially covered by backside light trapping material. Backside light trapping material  The SEM cross-section image shows a layered structure. At the top, there are 'Micro lens' and 'Deep Trench Isolation (DTI)' structures. Below these is a layer of 'Back Side Illumination (BSI) substrate'. Underneath the BSI substrate is the 'CMOS image sensor (CIS)', which includes a 'Joint layer' and an 'Image signal processor (ISP)'. A green box labeled 'Backside light trapping material' points to a layer between the BSI substrate and the CIS. The image also shows a 'Si' layer. Technical details at the bottom include '2022-58685 5.0kV 8.0mm x8.00k' and a scale bar of '5.00um'. Fig. 3-6 SEM cross section

U.S. Patent No. 11,721,714

Claim 1(c): a peripheral light trapping material substantially covering the peripheral sidewall;

Claim 1(c)	
a peripheral light trapping material substantially covering the peripheral sidewall;	The ISOCELL sensor from the Samsung Galaxy Z Flip5 includes a peripheral light trapping material substantially covering the peripheral sidewall. As shown in the SEM cross-section below, the ISOCELL sensor includes peripheral light trapping material substantially covers the peripheral sidewall.  W-grid Color filter Micro lens Si 2.81µm DTI 2022-58686 5.0kV 8.0mm x15.0k 3.00µm Fig. 3-7 SEM cross section

Claim 1(c): a peripheral light trapping material substantially covering the peripheral sidewall;

Claim 1(c)

As shown in the energy dispersive X-ray spectroscopy below, the peripheral sidewall in the ISOCELL sensor is covered with a peripheral light trapping material, comprised of silicon, silicon oxide, hafnium oxide, aluminum oxide, and a void.

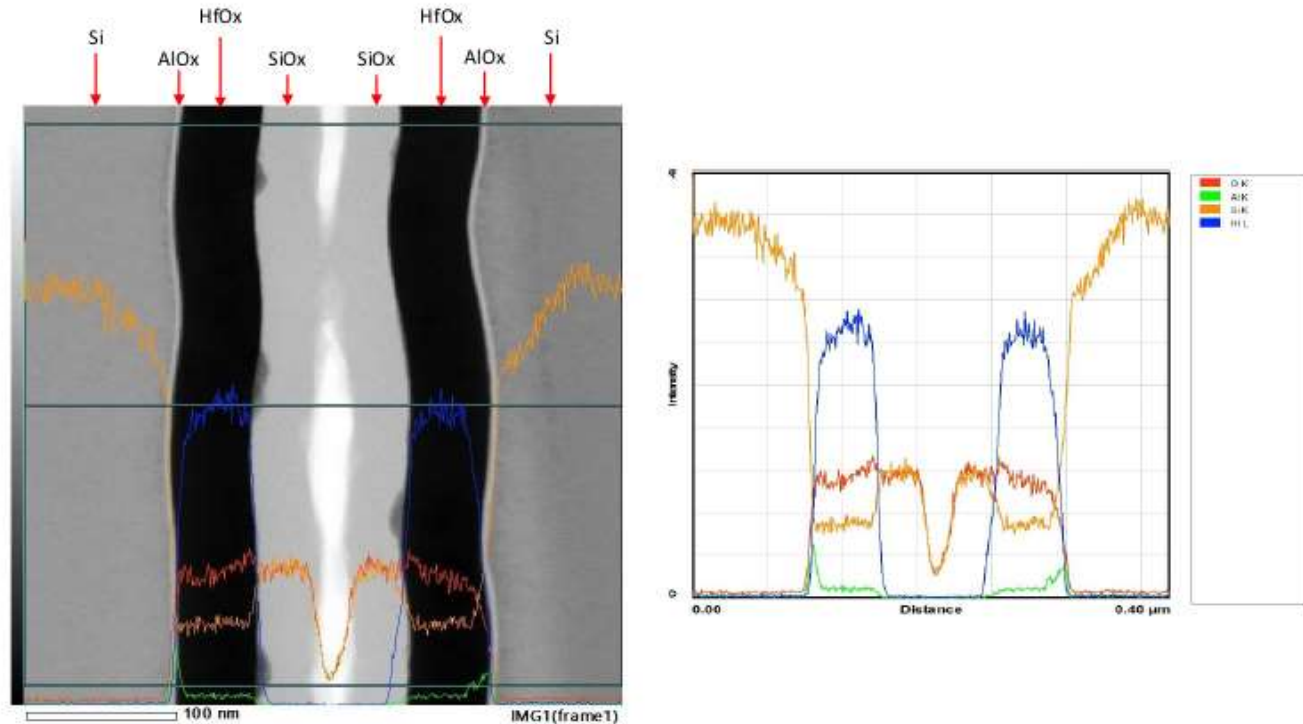


Fig. 6-1 Raw test data (number of atoms detected)

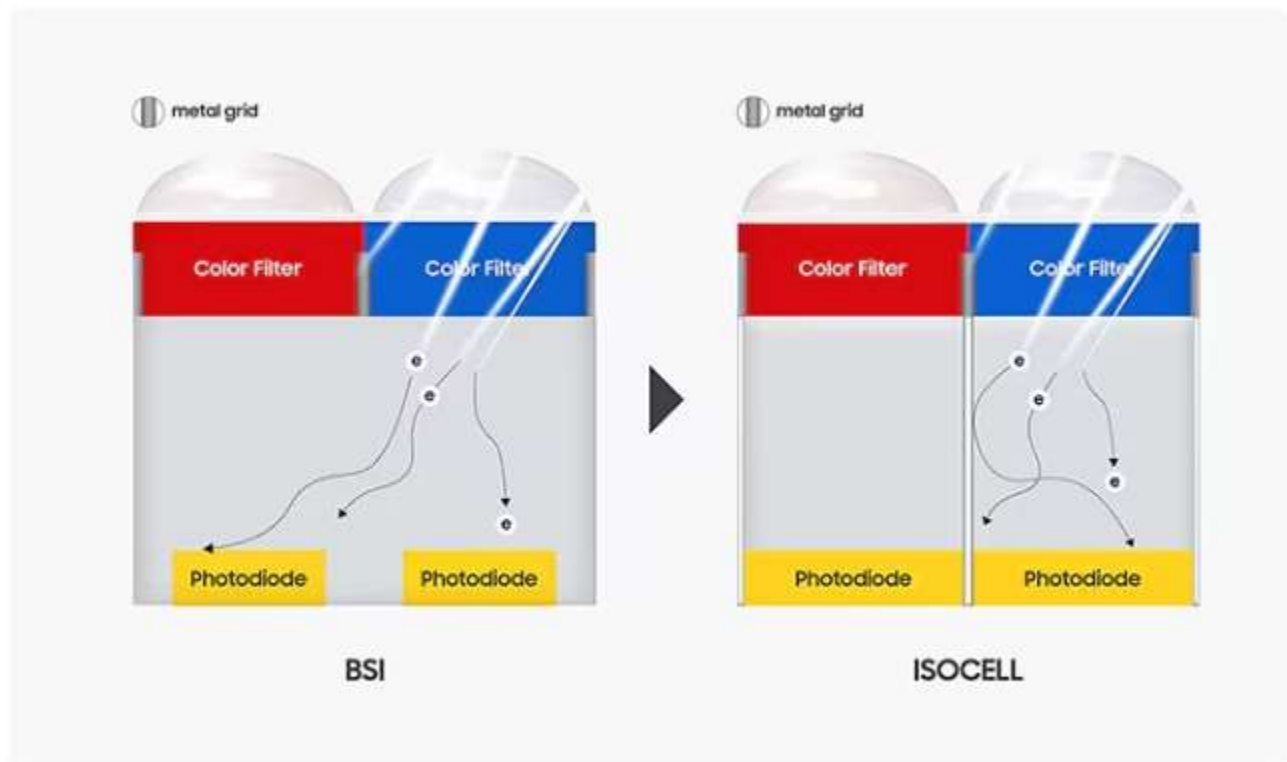
Claim 1(d): wherein light contacting the backside light trapping material or the peripheral light trapping material is reflected back toward the pixel;

Claim 1(d)

wherein light contacting the backside light trapping material or the peripheral light trapping material is reflected back toward the pixel;

The ISOCELL sensor from the Samsung Galaxy Z Flip5 is a sensor wherein light contacting the backside light trapping material or the peripheral light trapping material is reflected back toward the pixel.

As shown below, light contacting the peripheral light trapping material will be reflected back toward the pixel in Samsung's ISOCELL devices.



ISOCELL Plus: Leading the next generation of image sensors, Samsung Corp., <https://semiconductor.samsung.com/news-events/tech-blog/isocell-plus-leading-the-next-generation-of-image-sensors/> (last visited March 5, 2024)

Claim 1(e): wherein at least one of the backside light trapping material or the peripheral light trapping material includes a high refractive index material sandwiched between two low refractive index materials.

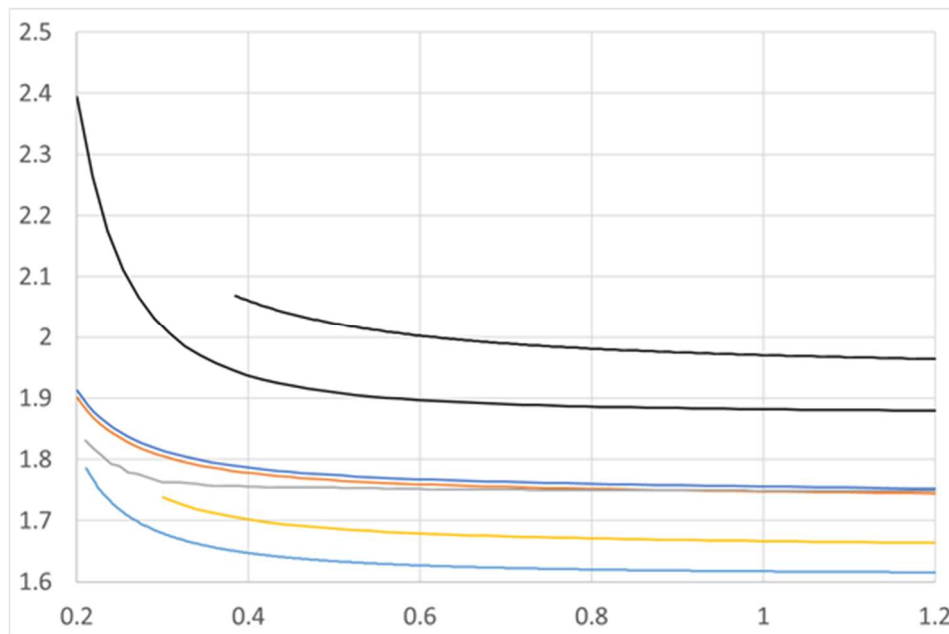
Claim 1(e)	
wherein at least one of the backside light trapping material or the peripheral light trapping material includes a high refractive index material sandwiched between two low refractive index materials.	The ISOCELL sensor from the Samsung Galaxy Z Flip5 includes a peripheral light trapping material substantially covering the peripheral sidewall, wherein at least one of the backside light trapping material and the peripheral light trapping material includes a high refractive index material sandwiched between two low refractive index materials. As shown by the graph in the image below, the peripheral light trapping material is comprised of, for example, HfOx sandwiched between SiOx and AlOx. The figure consists of two parts. On the left is a cross-sectional EDX spectrum showing intensity versus distance. The spectrum shows several peaks corresponding to different elements: O K (red), Al K (green), Si K (orange), and Hf L (blue). The peaks are labeled with their respective element symbols and line types. On the right is a line graph showing intensity versus distance. The graph has a legend on the right side with four entries: O K (red), Al K (green), Si K (orange), and Hf L (blue). The x-axis is labeled 'Distance' and ranges from 0.00 to 0.40 μm. The y-axis is labeled 'Intensity'. The graph shows four distinct peaks corresponding to the elements listed in the legend. Fig. 6-1 Raw test data (number of atoms detected)

U.S. Patent No. 11,721,714

Claim 1(e): wherein at least one of the backside light trapping material or the peripheral light trapping material includes a high refractive index material sandwiched between two low refractive index materials.

Claim 1(e)

The index of refraction for hafnium oxide (black curves) greater than aluminum oxide (colored curves).



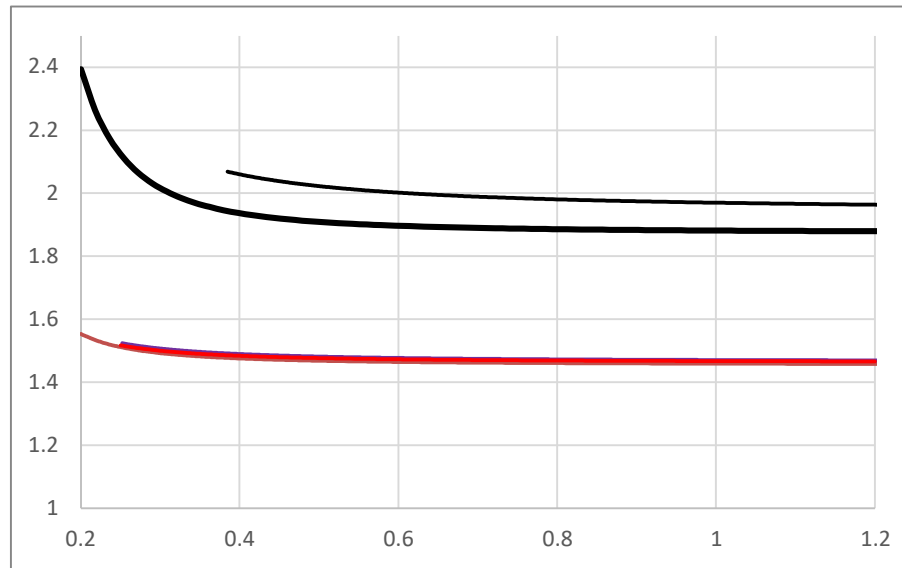
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U.S. Patent No. 11,721,714

Claim 1(e): wherein at least one of the backside light trapping material or the peripheral light trapping material includes a high refractive index material sandwiched between two low refractive index materials.

Claim 1(e)

The index of refraction for hafnium oxide (black curves) is likewise greater than the index of refraction for silicon dioxide (colored curves).



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