Microns == micrometers! 1000nm == 1um

Magnification

The maximum magnification that can be achieved by an optical microscope typically **ranges from 500x to 1500x**. In contrast, an electron microscope may be able to provide magnifications **greater than 160,000x**.

Magnification in an SEM can be controlled over a range of about 6 orders of magnitude from about 10 to 3,000,000 times.

However, there is a principal limit to the resolution of any optical system, **due to the physics of diffraction**.

For microscopic instruments, **the diffraction-limited spatial resolution is proportional to the light wavelength**, and to the numerical aperture of either the objective or the object illumination source, whichever is smaller.

Considering green light around 500 nm and a NA of 1, the Abbe limit is roughly -- 500nm / 2 = 250 nm.

For f/8 and green (0.5 μm wavelength) light, d = 9.76 μm

The **diffraction limit** is **only valid** in the **far field**.

The limits on focusing or collimating a laser beam are very similar to the limits on imaging with a microscope or telescope.

Diffraction comes from the wave nature of light and is determined by the ***finite aperture of the optical elements***.

https://commons.wikimedia.org/wiki/File:High_Resolution_THz_image.png

The trend in cameras is for the sensor size to decrease, and cameras with pixels as small as 4 x 4 microns are currently available in the consumer market.

The resolvable unit from the Abbe diffraction limit at a wavelength of 550 nm using a 1.25 numerical aperture lens is 0.27 um (or 270 nm).

Sensor Pixel Sizes

If a 100x objective is employed, the projected size of a diffraction-limited spot on the face of the CCD would be 27 um.
A sensor size of 13 um x 13 um pixels would just allow the optical and electronic resolution to be matched, with a 9 um x 9 um pixel preferred.

The Google Pixel 7's **50-megapixel** primary camera sensor has a pixel size of **1.2 μm**.
The Samsung Galaxy S23 has a **50-megapixel** primary camera with **1μm** pixels.

For violet, the shortest wavelength visible light, the wavelength λ is about 420 nanometers (see cone cells for sensitivity of S cone cells). This gives a value for x of about 4 μm.

Sensor Sizes

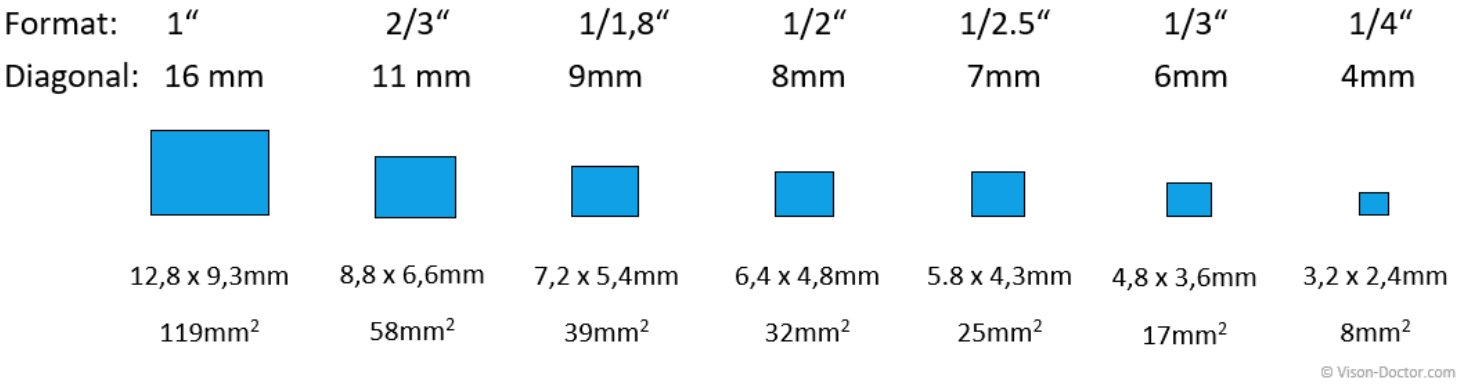
In a digital camera, making the pixels of the image sensor smaller than half this value (one pixel for each object, one for each space between) would not significantly increase the captured image resolution.

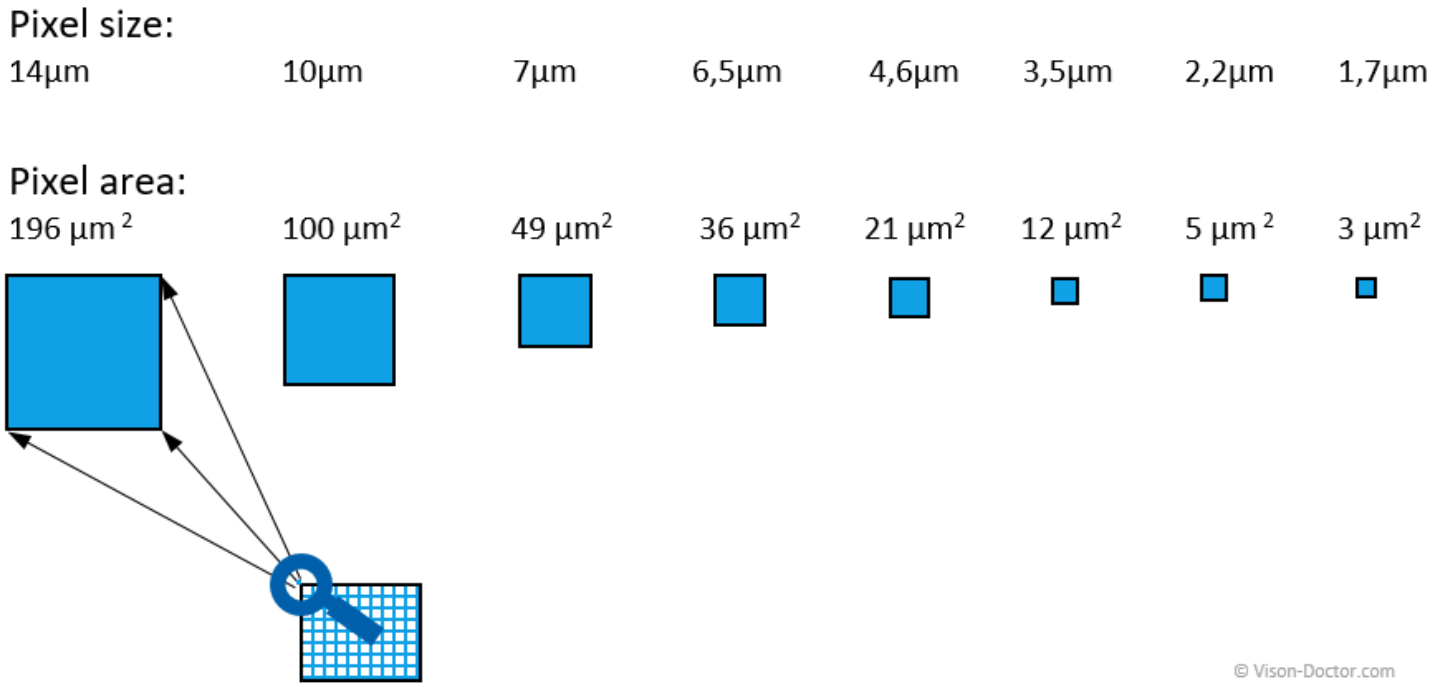
Most smartphone sensors typically measure just **1/2.55 inches** or about **1cm** across, although higher-end smartphones are increasingly packing in **1/1.31-inch** and larger sensors.

By comparison, DSLR camera sensors clock in above an inch across, easily making them 4 or 5 five times the size. Smartphone sensors are simply tiny by comparison, although a few brands are closing the gap on the traditional point-and-shoot sensor size.

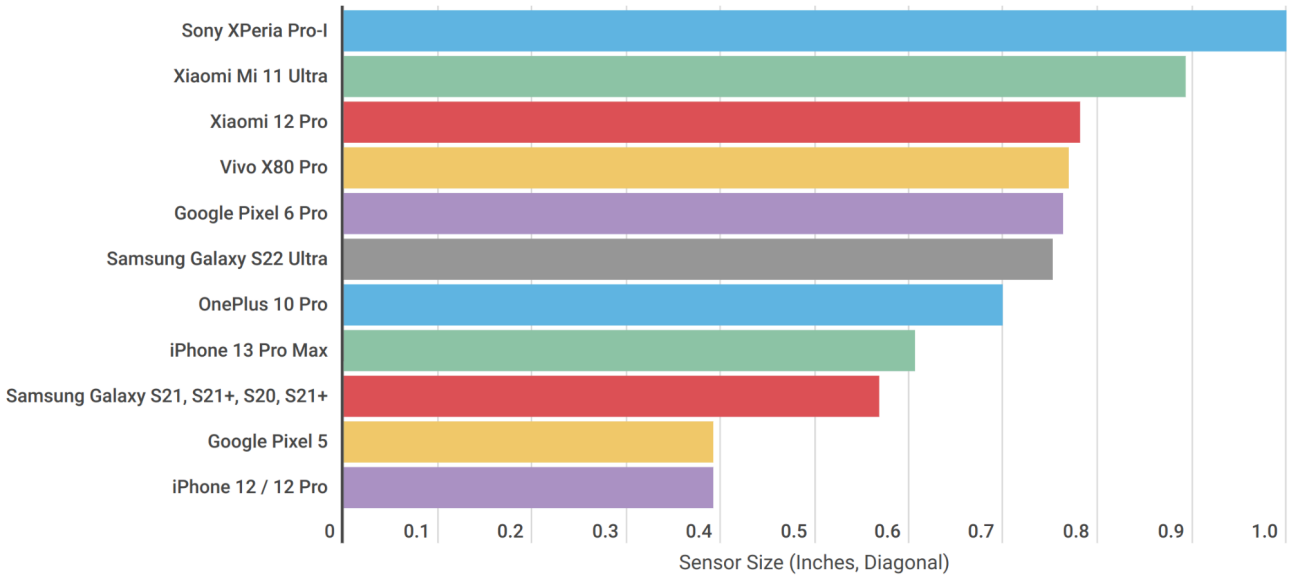
The Sony Xperia Pro-I, Xiaomi 13 Pro, and others are some of the mobile industry's largest at **1-inch diagonal**.

https://www.vision-doctor.com/en/camera-technology-basics/sensor-and-pixel-sizes.html





Smartphone Camera Sensor Sizes



8 megapixel	BSI	1/3.2 inch	1.40 microns	Apple iPhone 5
8 megapixel	BSI	⅓ inch	1.50 microns	Apple iPhone 5S, iPhone 6, 6 Plus
12 megapixel	BSI	⅓ inch	1.22 microns	Apple iPhone 6S, 6S Plus
12 megapixel	BSI	1/2.5 inch	1.40 microns	Samsung Galaxy S7 - f/1.7 aperture, OIS
12 megapixel	BSI	1/2.3 inch	1.55 microns	HTC 10 - includes OIS
13 megapixel	BSI	⅓ inch	1.15 microns	Moto G (3rd Gen), Huawei P8 (max ISO1600)
16 megapixel	BSI	1/2.6 inch	1.12 microns	Samsung Galaxy S6 Edge
20 megapixel	BSI	1/2.3 inch	1.12 microns	Sony Xperia Z3
20 megapixel	CMOS	1 inch	2.40 microns	Panasonic Lumix CM1
21 megapixel	BSI	1/2.4 inch	1.10 microns	Moto X Style
23 megapixel	BSI	1/2.3 inch	1.10 microns	Sony Xperia Z5 Premium
40 megapixel	CMOS	1/1.2 inch	1.40 microns	Nokia PureView 808
6 megapixel	CCD	1/1.7 inch	2.50 microns	Fujifilm FinePix F30
8 megapixel	CMOS	1/2.5 inch	1.74 microns	Vivitar Vivicam 8370
10 megapixel	CCD	1/1.7 inch	2.10 microns	Canon Powershot S95
12 megapixel	CMOS	⅔ inch	2.20 microns	Fujifilm X10, X20, X30
12 megapixel	BSI	1/1.7 inch	1.90 microns	Canon Powershot S100
12 megapixel	CMOS	1/2.3 inch	1.55 microns	Panasonic Lumix TZ70
13 megapixel	CMOS	⅓ inch	1.15 microns	Nikon Coolpix S02
14 megapixel	CCD	1/2.3 inch	1.43 microns	Olympus SZ-14
16 megapixel	BSI	1/2.3 inch	1.30 microns	Fujifilm FinePix XP90

18 megapixel	BSI	1/2.3 inch	1.26 microns	Sony Cyber-shot WX220, Panasonic Lumix TZ80
20 megapixel	BSI	1/2.3 inch	1.17 microns	Canon Powershot SX720
4.5 megapixel	CMOS	20.7 x 13.8mm	7.80 microns	Sigma DPx (Foveon)
12.8 megapixel	CMOS	1.5inch (18.7x12.5)	4.20 microns	Canon Powershot G1 X Mark II (*multi-aspect)
12.8 megapixel	CMOS	Micro Four Thirds	3.75 microns	Panasonic Lumix LX100 (16mp total)
14.3 megapixel	CMOS	1.5inch	4.20 microns	Canon Powershot G1 X
15.6 megapixel	CMOS	APS-C	5.10 microns	Sigma DPx Merrill (Foveon APS-C)
16 megapixel	CMOS	APS-C	5.10 microns	Nikon Coolpix A, Fujifilm X100T, X70
20 megapixel	BSI	1inch	2.40 microns	Sony Cyber-shot RX100 II - OIS
24 megapixel	CMOS	Full-frame	6.00 microns	Leica Q, Sony Cyber-shot RX1
42 megapixel	BSI	Full-frame	4.50 microns	Sony Cyber-shot RX1R Mark II