




The Principle of
Semiconductor

Great Wisdom Crystallized in Tiny Devices

What Is a CMOS Image Sensor?

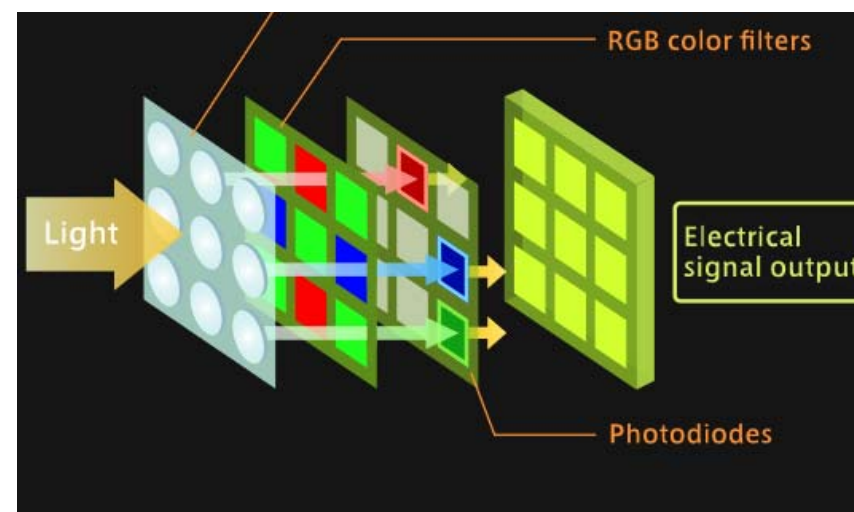
Semiconductor device that serves as an "electronic eye"

The working principle of a CMOS (complementary metal oxide semiconductor) image sensor was conceived in the latter half of the 1960s, but the device was not commercialized until microfabrication technologies became advanced enough in the 1990s. Image sensors built into today's digital cameras and mobile phones mostly use either the CCD (charge coupled device) or CMOS technology.

Both CCD and CMOS are semiconductor devices that serve as "electronic eyes." While both use photodiodes, they differ in terms of manufacturing process and signal readout method. Although the  technology was



sensors from 2004 onwards in shipment volume.



Faster in data rate than CCD

A charge-coupled device (CCD) image sensor has an array of capacitors, each carrying an electric charge corresponding to the light intensity of a pixel. A control circuit causes each capacitor to transfer its contents to its neighbor, and the last capacitor in the array dumps its charge into a charge amplifier. The bucket-brigade style of data transfer is characteristic of CCD sensors.

In contrast, a complementary metal oxide semiconductor (CMOS) image sensor has a photodiode and a CMOS transistor switch for each pixel, allowing the pixel signals to be amplified individually. By operating the matrix of switches, the pixel signals can be accessed directly and sequentially, and at a much higher speed than a CCD sensor. Having an amplifier for each pixel also gives another advantage: it reduces the noise that occurs when



Cheaper, energy-efficient, and on-chip integratable

CMOS image sensors cost less to produce than CCD image sensors, because existing semiconductor manufacturing equipment can be repurposed for their production. Unlike CCD sensors that use high-voltage analog circuits, CMOS sensors employ a smaller digital circuitry that uses less power, and are in principle free from smear (vertical white streak in the image taken under bright light) and blooming (corruption of images such as white spots). Since a logic circuitry can be built into the chip during the manufacturing process, CMOS sensors with an on-chip image processing circuit are being developed for such applications as image recognition and artificial vision, and some devices are already being put to practical use.

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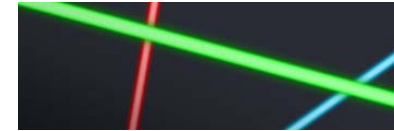
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