Sony Releases “Exmor RS,” the World’s First*1 Stacked CMOS Image Sensor

The "Digital Imaging World" of Sony is Further Expanding

Sony has released a newly developed “Exmor RS,” the world’s first CMOS image sensor that employs the unique "stacked structure."

Shipments of the new product will start from October.*2

The new "stacked structure" was also announced in this Side View section of CX-NEWS, Volume 68, but this release is the first time we can introduce the series of technical innovations leading up to the present release and the "digital imaging world" that it makes possible.

*1: As of August 20, 2012.
*2: News release: http://www.sony.net/SonyInfo/News/Press/201208/12-107E/
* The details are those provided on August 20, 2012.

2012 CMOS IMAGE SENSORS

The supporting substrate in the conventional back-illuminated CMOS image sensor has been replaced with a chip where signal processing circuits are formed. In the unique "stacked structure," the pixel section where the back-illuminated pixels are formed is placed on top of the processing circuits.

The "stacked structure" concept
1. Effective use of the supporting substrate
2. Complete separation of pixel section and circuit section

Advantages of a "stacked structure"
– Compact size
– High image quality
– Advanced functionality, high speed and low power consumption

2012.1 Announcing Stacked CMOS Image Sensors*3

2012.4 Announcing Policies that will Strengthen Image Sensors as Sony Core Business*4

Sony has announced the business policies of the new management structure. Sony sees the three business areas of digital imaging, games and mobile devices as the prime electronics business targets for concentrating investment and technical development. Image sensors play an important part also in Sony core businesses.

2012.6 Announcing Increase of Productive Capacity*5

From the first half of FY 2012 to the first half of FY 2013, the Nagasaki Technology Center of Sony Semiconductor Corporation will make a business investment (a total of ¥80 billion) to boost productive capacity of stacked CMOS image sensors. Total productive capacity of CCD and CMOS image sensors is expected to increase to 60,000 units per month by the end of September, 2013.*6

*4: News release: http://www.sony.net/SonyInfo/News/Press/201204/12-056E/
*5: News release: http://www.sony.net/SonyInfo/News/Press/201206/12-084E/
*6: Total productive capacity (based on 300 mm wafer amount) includes manufacturing processes outsourced to other companies. The production figures for 200 mm wafer lines at the Kagoshima Technology Center and the Nagasaki Technology Center have been converted to 300 mm production figures.
On August 20, Sony held an "Image sensor business briefing session" for the press and analysts at Sony Headquarters (Tokyo). This event brought in twice as many people as expected, a total of 63 journalists (newspaper, telecommunication, magazine and Internet media) and 18 analysts, so more chairs had to be brought in to seat everybody. That there was intense interest in the Sony image sensor business and our new CMOS image sensors was evident from the presence of a TV crew that covered the event.

Following news distribution by the Internet media on the day of the briefing session, many newspapers both in Japan and overseas published articles on the "Exmor RS" CMOS image sensor the next day. These articles elaborated on the advantages of a stacked structure and the functions of the image sensor while also providing demonstration videos of the briefing session.

For example, one article referred to statements made by Tomoyuki Suzuki (EVP, Corporate Executive Officer, President of Device Solutions Business Group, Sony Corporation) and Mr. Ueda at the briefing. It quoted Mr. Suzuki saying that Sony was at least two years ahead of its competitors and that he had vowed to use to devices to turn Sony around. The article also mentioned that Yasuhiro Ueda (SVP, Corporate Executive, Senior General Manager of Image Sensor Business Division, Device Solutions Business Group, Sony Corporation) had said Sony technology roadmaps look 10 years ahead and that he wanted the image sensor "Exmor RS" to become a product that Sony could ship a 100-million units of per year.

The following pages will introduce the growth of Sony CMOS image sensor technology and the guiding principle behind it.
Sony CMOS Image Sensors Exceeds Human Vision.

Direction of Image Sensor Technology

**CMOS Image Sensor — Exceeds Human Vision —**

- **High resolution**: 100M pixels
- **Super HD**: 4K × 2K, 240 frame/s
- **High sensitivity**: <0.1 lx
- **High speed**: >1,000 frame/s

**CMOS Image Sensor — Exceeds Film Quality —**

- **Moving images**
  - Camcorder
- **Still images**
  - DSC
  - D-SLR

"As we had created it, I wanted to make clear what we wanted to do and what our goals were. In development, these are essential, I think."
— Tomoyuki Suzuki
— From the Side View section in CX-NEWS, Volume 60 (May 2010)

Remembering the keynote speech at the San Francisco Plenary Session "ISSCC 2010."

The CMOS Image Sensor Slogan — Exceeds Human Vision

At the ISSCC 2010, Mr. Suzuki said the numerical targets that would be needed to achieve this goal were "100M pixels," "4K × 2K, 240 frame/s," capability to shoot video in low-light situations below 0.1 lx" and "high-speed shooting at 1000 frame/s."
At the August 20 "Image sensor briefing session," Mr. Suzuki announced that these numerical targets had for the most part been achieved.

Back-illuminated structure provides higher sensitivity

The position of the photodiodes and the wiring layers have been reversed so that more incident light directly reaches the photodiodes to improve light collecting efficiency.

Greater Sensitivity than the Human Eye!

A camera with an "Exmor R" image sensor can capture subjects that are too dark for the human eye to see. As Mr. Ueda says "you can use such a camera to shoot birds of paradise at night."

The rapid growth in smartphones and tablets has also diversified how cameras are used. In the process, Sony has added *Functionality* as a vertical axis to *high speed* and *high image quality* on the development axes of the CMOS image sensor. By making "Exmor RS" provide an image experience that is great fun and user friendly, we will be able to satisfy the customer demand for greater differentiation in final products.
Adding Functional Value
to a CMOS Image Sensor that Exceeds Human Vision!

Sony’s functional ideas and new technology are integrated as a signal processing block into the circuit section of an "Exmor RS" stacked CMOS image sensor and can be delivered to the customer when needed.

"I think that it will be our duty to shift the burden of more advanced processing to the image sensor. Even general-purpose image sensors should have the innate capacity to provide the customer with excellent quality." (Yasuhiro Ueda)

— From the Side View section in CX-NEWS, Volume 64 (May 2011)

This was said before the announcement of the stacked CMOS image sensor.

For example, the following value added functions can be provided:

• "High dynamic range (HDR) movie" function
  By setting two different exposure conditions within a single screen shooting, the appropriate signal processing is conducted for the captured image information under each optimal exposure condition. And this process generates an image with a broad dynamic range and enables shooting with brilliant colors even in a bright environment.

  Functional example 1 of the “Exmor RS” stacked CMOS image sensor
  HDR movie function on
  HDR movie function off

• "Super zoom" function
  Image sensor characteristics are processed using a proprietary Sony super zoom algorithm to achieve an electronic zoom with high picture quality.

  Functional example 2 of the “Exmor RS” stacked CMOS image sensor
  Normal digital zoom
  Super zoom

Rapid growth in smartphones and tablets...

Exmor™

and stacked structure provide advanced functionality

Exmor™

Back-illuminated and stacked structure provide advanced functionality

Exmor™

Back-illuminated structure provides higher sensitivity

Exmor™

Higher speed with column-parallel A/D conversion

Beauty
industry

Learning

Health care

Viewing

Exceeding Human Vision—Towards Super Reality—

Super zoom

Functionality

Image Quality

High Speed

Sensing

Sony CMOS Image Sensors Provide
New Comfortable Ways of Enjoying Images

In July 2012, total shipments of image sensors reached 2 billion units!

On July 24, 2012, total shipments of Sony image sensors reached 2 billion units. Until January 2009, Sony has shipped 1 billion units in the 29 years since mass-production of consumer video cameras with CCDs started, a figure that has now been doubled in the barely three years since then. This corresponds to roughly 30% of the current world population.

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Exmor™

* "Exmor" is a trademark of Sony Corporation. The “Exmor” is a version of Sony’s high performance CMOS image sensor with high-speed processing, low noise and low power dissipation by using column-parallel A/D conversion.

Exmor™

* "Exmor R" is a trademark of Sony Corporation. The “Exmor R” is a Sony’s CMOS image sensor with significantly enhanced imaging characteristics including sensitivity and low noise by changing fundamental structure of “Exmor” pixel adopted column-parallel A/D converter to back-illuminated type.

Exmor™

* "Exmor RS" is a trademark of Sony Corporation. The “Exmor RS” is a Sony’s CMOS image sensor with high-resolution, high-performance and compact size by replacing a supporting substrate in “Exmor R” which changed fundamental structure of “Exmor” pixel adopted column-parallel A/D converter to back-illuminated type, with layered chips formed signal processing circuits.