

# Leading-Edge Fab for CMOS Sensors Scheduled to go Online this Spring

## Sony Semiconductor Kyushu Corporation Kumamoto Technology Center

*The Kumamoto Technology Center is Sony's production site for imaging devices.*

*Sony begins mass production of CMOS sensors using 300 mm wafers in a 5000 m<sup>2</sup> clean room in part of Building 2 this spring.*

*This article introduces our activities at Kumamoto Technology Center, focusing on Building 2, which brings together leading edge fab concepts, including borderless production with the existing line (Building 1), full automation including facility operation, and thoroughgoing energy saving efforts.*



## Sony Semiconductor Kyushu Corporation

■ Production Site (technology center); Kagoshima, Oita, Nagasaki, Kumamoto

Sony is taking advantage of the Kyushu region and moving forward with business activities that aim at worldwide markets and that span a range from the development of Sony semiconductors, through design, production, distribution, quality control, and environmental efforts.

### Kumamoto Technology Center

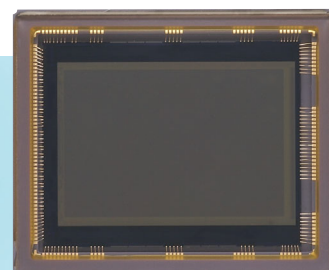
- Location: Kikuyo-machi, Kikuchi-gun, Kumamoto Prefecture, Japan
- Start of operations: October 2001
- Site area: 260,000 m<sup>2</sup>
- Floor area: 195,000 m<sup>2</sup>
- Employees: About 2,700 (As of August 2007, including contract and temporary staff)
- Products: Image sensors (CCD and CMOS sensors) and micro display devices (high-temperature polycrystalline silicon TFT LCDs, SXRD products)
- Wafer production capacity: 24,000 per month  
\* Combined processing capacity for Building 1 and Building 2 (operating at full capacity)

### Overview of Building 2 (As of August 2007)

- Floor area: 104,000 m<sup>2</sup>
- Clean room area: 20,000 m<sup>2</sup>  
(Of which 7500 m<sup>2</sup> have been fully equipped.)
- Products: CMOS sensors

### Building 2 Expansion (Announced June 2007)

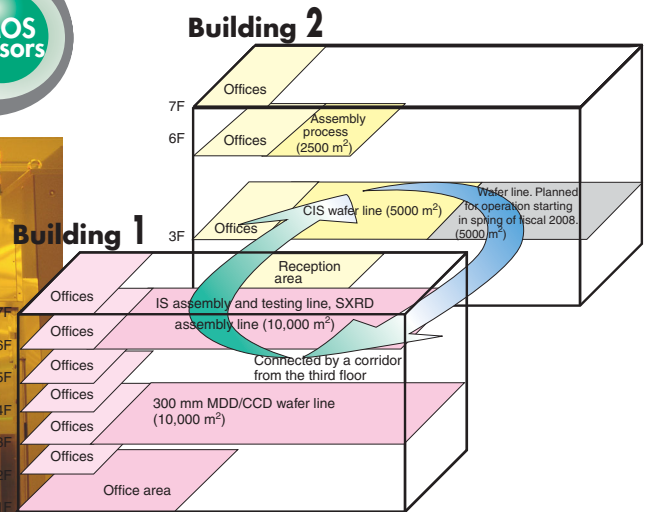
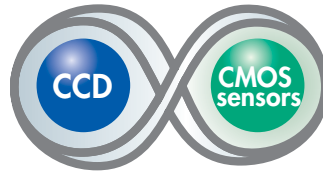
- (1) Construction area: 5000 m<sup>2</sup> for the Building 2 clean room area increase and improved manufacturing equipment
- (2) Amount of investment: Approximately 60,000,000,000 Yen
- (3) Construction start date: July 2007
- (4) Start of operations: May 2008 (planned)
- (5) Main products: CMOS sensor (wafer line)



**High-Speed CMOS Sensor (IMX021)**

\* See the related article on New Products IMX021.

## Borderless Production



Building 2 wafer line. Space efficiency is improved by laying out the equipment for the same process collected together in the "Job Shop Layout". This layout is not specialized for the CMOS sensor manufacturing process.

### CCD and CMOS Sensors: Supporting Market Needs with Borderless Production

Sony continues to maintain its industry-leading share in the CCD market. In contrast, we are expecting a significant increase in demand for Sony CMOS sensors, which combine previously unavailable high-speed imaging performance and high picture quality. As the industry's top supplier of image sensors, we have introduced the concept of "borderless production" at Kumamoto Technology Center to appropriately and flexibly respond to market needs. Basically, we have positioned the existing Building 1 as our CCD production line and Building 2 as our CMOS sensor production line. However, we have implemented a large number of innovations and technical devices so that if required CMOS sensors can be produced in Building 1 and CCDs can be produced in Building 2. Thus even though there are two buildings, the facility functions as a single line.

#### Facility Sharing

Although CCD and CMOS sensors have different device structures and operating principles, many of the several hundred process steps required for their manufacture are similar. Sony made an effort to reduce the number of manufacturing equipment units that were unique to either CCD or CMOS sensor production, and created a system in which

approximately 80% of the equipment can be shared.

#### Moving between Buildings

The connecting corridor between Building 1 and Building 2 is maintained at the same level of cleanliness as the clean rooms, and workers can come and go between the buildings while wearing their clean suits. The wafer transporters can also be used and operation as a single line is possible.

#### Creating a Common Production Management System

When we introduced the latest production management system, which supports automated lines, in Building 2, we replaced the system in the existing Building 1 with a new system that is the same as that in Building 2.

Sony has made the decision to invest an additional 60 billion Yen in Building 2 over the 2007 to 2009 fiscal years, in particular, increasing the clean room area by another 5000 m<sup>2</sup> and improving the manufacturing equipment as well.

### Fully Automated Production Line that Covers Equipment Management and Inspection

In addition to automated wafer transport, Sony is pushing forward with full automation of

production line operation in Building 2 so that the whole line can be operated with as few staff as possible. This will make it possible to quickly grasp variations in the manufacturing processes and is intended to prevent the occurrence of rejects in advance and suppress variations in product quality.

#### Automation of the Inspection Process

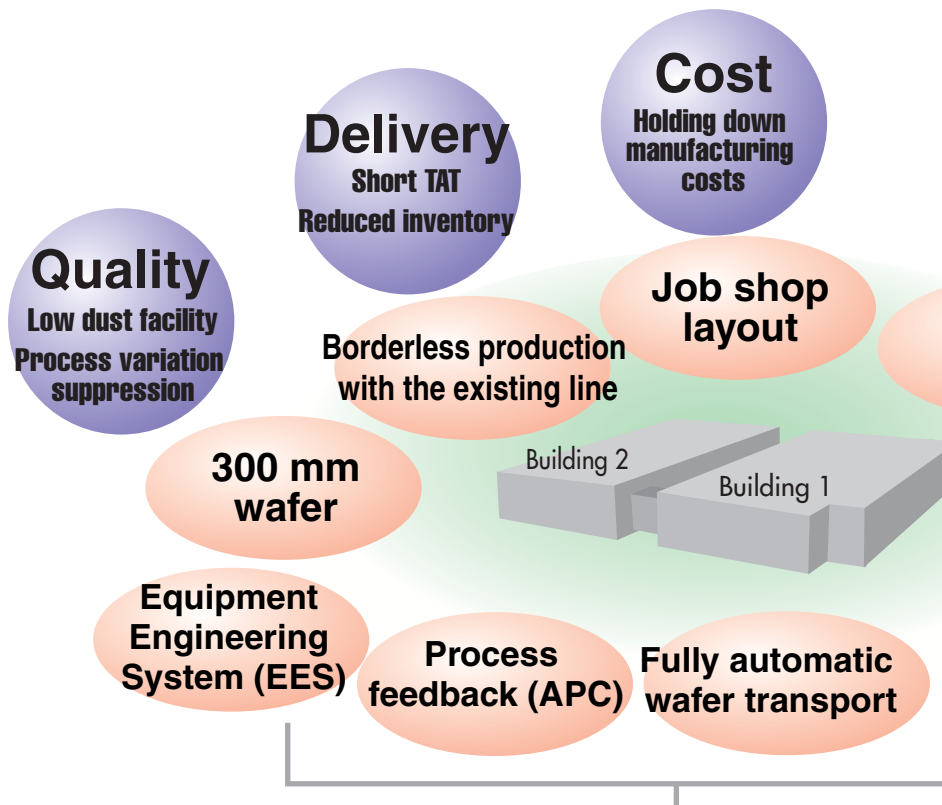
Sony has also introduced equipment that can make automatic judgments for the inspections that were previously performed visually. This increases the precision and efficiency of the inspection process.

#### Equipment Engineering System (EES)

Previously, the presence or absence of faults was detected in the completion of the manufacturing process for film thickness or machining dimensions. That is, problems in manufacturing were recognized from the results of the process. However, with the Equipment Engineering System (EES), it is possible to become aware of abnormal indications even more quickly by monitoring, with an external server in real time, measurement values from sensors (such as temperature, gas flow, pressure, and valve operation sensors) installed in the production units. This system is also useful as an analysis tool for quickly the basic causes of abnormalities due to equipment.

# Kumamoto Technology Center Building 2 Concepts

## Leading-edge Fab that Targets the Industry's Top QDCSE Level



Furthermore, we are now introducing technologies that can perform predictive detection even for undetected faults by applying multivariate analysis to the sensor data, which consist of an enormous number of measurements.

### ■ Process Feedback (APC)

Sony is adopting technology that, if a variation in a manufacturing process is recognized, adjusts that process automatically for the next lot based on the result of analysis and thus stabilizes the quality.

APC: Advanced Process Control

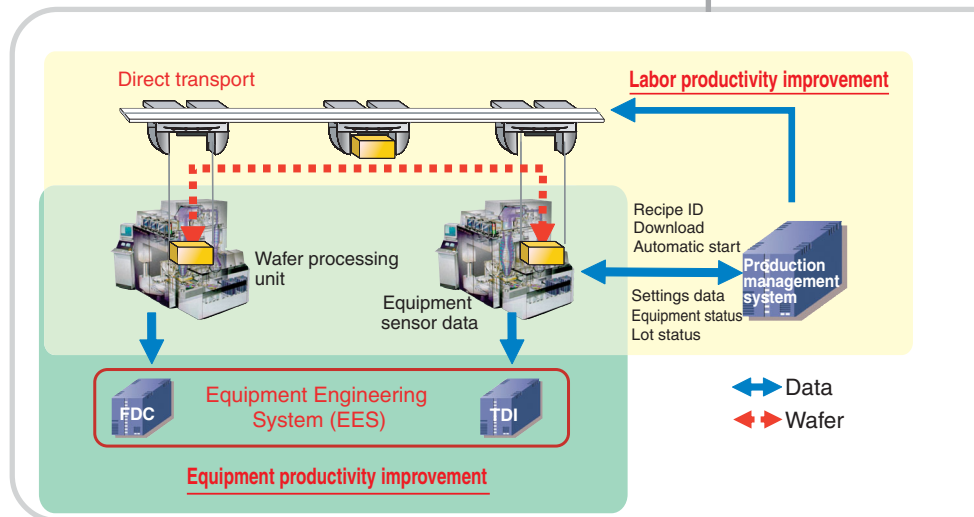
### ■ Establishing Intelligent Production Plans

Which lots should be processed and with what timing to respond appropriately to changing market needs? Sony is introducing a system that formulates daily production plans at high precision.

### Thermal Efficiency is 2.4 Times the Normal Level. Sony Also Leads in Energy Efficiency.

Through the adoption of equipment with good energy efficiency and overall control, Sony achieves, in Building 2, a yearly average of 7.5 in Coefficient of Performance (COP: (output energy) ÷ (input energy)), an index of energy efficiency. This corresponds to a COP value approximately 2.4 times that for a typical heat generating system.

Sony also collects rainwater from the roof of Building 2 and uses it for toilets and other uses, thus reducing annual water consumption by 1400 m<sup>3</sup>.



**Hiromi Suzuki**  
Senior General Manager  
IS Products Div.  
Sony Semiconductor Kyushu  
Corporation

In the new building, we have adopted the latest leading-edge equipment optimized for image sensor manufacturing and we will supply high-performance, high-quality image sensors to our customers.

Although other companies have adopted systems such as EES and APC, Sony's unique know-how is infused into the core section, which consists of discovering relationships between the large amount of data acquired from the equipment and product quality and product characteristics, and determines to what extent this can contribute to improving final product quality. The key to differentiation in future semiconductor

manufacturing lines will lie in intelligent systems in which automation and this sort of quality improvement support system and high-precision production management system are organically connected, and in the skills of manufacturing staff and engineers who can make full use of these systems.

At Sony, we are making steady progress in nurturing such human resources, and will continue to strive to create manufacturing lines that will define the industry's top level.

# Thoroughgoing Quality Management Using Knowledge from Innovative Manufacturing



**Shinichi Tanemo**  
President  
Representative Director  
Sony Semiconductor Kyushu Corporation

Image sensors are positioned as a strategic area for Sony semiconductor business. It is our mission, I think, to refine our technologies even further, to promote product differentiation, and to be of use to our customers in this area which is our specialty.

It is not only in the areas of design and development that we must further refine our special skills. In the area of manufacturing as well, I recognize that we must continually accumulate new innovations to assure a stable supply of products so that our customers can purchase with confidence.

For the last few years, I have been away from the semiconductor field, gaining experience in end products. By standing in the shoes of people who use semiconductors, I have become aware of the importance of quality management in semiconductor products. I think my role can be said to be to provide stimulation to the semiconductor manufacturing field based on my experience in end products.

It is also the case in borderless production between lines that this idea will not exhibit its full effects without quality assurance. It is only when stable production is possible, that is, when it is possible to reduce margins, that the flexible response of being able to reallocate surplus capacity to the manufacture of other

products will become possible.

Thus we must ask, what is it that is required for quality assurance? What I see as most important is the "concentration of characteristic features." We must suppress sample-to-sample variations, not only for device characteristics, but for equipment parameter control as well, and increase the degree of concentration. This is analogous to a baseball pitcher being able to throw the ball where intended. If the customer's requirements are the strike zone, it is not adequate for the result to be that the product is merely somewhere in that zone, but rather we must learn to achieve precise control within the strike zone. Variations must be eliminated. If the pitcher achieves that, then he'll never walk a batter. Semiconductor manufacturing is the same. By increasing the concentration of characteristics, it naturally follows that the quality will increase and yields improve.

We must now bring forth our knowledge of innovative manufacturing. I hope that we will use this knowledge to contribute to our customers' business.

**Safety**

Zero accidents

**Environment**

Zero emissions

**Re-use system**

**Saving equipment costs**

**Intelligence analysis environment**

## Achieving a Fully Automated Line

1. Automation of wafer transport and equipment operation
2. Automation of the inspection processes
3. Equipment Engineering System (EES)
4. Process feedback (APC)
5. Establishing intelligent production plans

## Environment Protection Activities Based on Regional Characteristics

### Groundwater Recharging Program

Returning the water we use to nature.

Since May 2003, Kumamoto Technology Center has been operating a groundwater recharging program in cooperation with local environmental NGOs, farming groups, farmers' cooperatives, and other groups.

The rice fields in the area around Kumamoto Technology Center are so permeable to water that they are called "sieve fields." Using this property, water is returned to the local aquifer by redirecting water from the Shirakawa river to rice paddies during seasons rice is not grown and to fields that are not being used. In fiscal 2006, the amount of groundwater in the aquifer reached 1.9 million tons and exceeded Kumamoto Technology Center's annual water usage (1.45 million tons).

#### Winning the Fourth "The Asahi Corporate Citizen Award"

The Sony Semiconductor Kyushu Corporation groundwater recharging program received The Asahi Shimbun Company's fourth "The Asahi Corporate Citizen Award", which recognizes corporate activities that contribute to society. This award was created in 2004 to commemorate the 125th anniversary of the founding of The Asahi Shimbun Company and of the 171 candidates that responded to call for participation, four companies and organizations were selected.

### The First Effort of this Type by a Corporation in Japan!

