



1999 IEEE Workshop on  
Charge-Coupled Devices and Advanced Image Sensors

June 10-12, 1999  
Karuizawa Prince Hotel, Karuizawa, Nagano, Japan



Sponsored by IEEE Electron Devices Society

In cooperation with:

The Institute of Image Information and Television Engineers(ITE)  
NHK Science & Technical Research Laboratories  
NEC Silicon Systems Research Laboratories

## Welcome to Karuizawa

Welcome to the 1999 IEEE Workshop on Charge-Coupled Devices and Advanced Image Sensors in Karuizawa, Nagano, Japan. The purpose of the workshop is to discuss recent research results, provide in-depth discussion of common technical issues, and stimulate thinking about new research directions and activities.

This workshop is the seventh in a series that started in 1986 in Harriman, New York USA followed by Harriman, New York, USA in 1990(2nd), Waterloo, Ontario, Canada in 1991(3rd) and 1993(4th), Dana Point, California, USA in 1995(5th) and Bruges, Belgium in 1997. Now it is well established that it continues in various locations on a biannual basis. This, the 7th Workshop, is the first time to be held in Japan, where most of image sensors are being produced.

The 1999 Workshop is sponsored by the IEEE Electron Devices Society in cooperation with the Institute of Image Information and Television Engineers(ITE), NHK Science & Technical Research Laboratories, and NEC Silicon Systems Research Laboratories.

The Workshop on CCD and AIS is truly an international workshop. This time 20 papers of the 65 accepted papers are from North America, 17 papers from Europe, 24 papers from Asia and 4 papers by intercontinental collaborations. The program includes 17 papers on CCD, 36 on CMOS, active pixel sensors and smart sensors, 6 on non-visible sensors and 6 on common technical issues.

The Walter Kosonocky Award is started for the memorial of the great contribution to CCD and image sensors by Dr. Walter F. Kosonocky, who passed away on November 2, 1996. The first Walter Kosonosky Award is awarded during the 1999 Workshop on CCD and AIS.

On behalf of 1999 IEEE Workshop on Charge-Coupled Devices and Advanced Image Sensors Committee, we would like to thank the workshop committee members for their rewarding job they have done in planing and organizing the 1999 Workshop on CCD and AIS. The authors are commended for their interesting papers. The participants are welcome for their contribution to the exciting and interesting discussion.

Nobukazu Teranishi  
General Chairman

## 1999 IEEE Workshop on Charge-Coupled Devices and Advanced Image Sensors

### Organizing Committee

Nobukazu Teranishi (General Chairman, NEC Corporation, Japan)  
Junichi Nakamura (Technical Program Chairman, Olympus Optical Co., Ltd., Japan)  
Eric R. Fossum (Photobit Corporation, USA)  
Savvas Chamberlain (DALSA Inc., Canada)  
Albert Theuwissen (Philips Imaging Technology, The Netherlands)

### Technical Program Committee

Junichi Nakamura (Technical Program Chairman, Olympus Optical Co., Ltd., Japan)  
Richard Bredthauer (Semiconductor Technology Associates, USA)  
Barry E. Burke (MIT Lincoln Labs., USA)  
Savvas Chamberlain (DALSA Inc., Canada)  
Peter Denyer (VLSI Vision Ltd., United Kingdom)  
Bart Dierickx (IMEC, Belgium)  
Eric R. Fossum (Photobit Corporation, USA)  
Jerry Hyncek (ISETEX, Inc., USA)  
Takao Kuroda (Matsushita Electronics Corp., Japan)  
Paul P. K. Lee (Eastman Kodak Company, USA)  
R. Dan McGrath (Atmel Corporation, USA)  
Orly Yadid-Pecht (Ben-Gurion University of the Negev, Israel)  
Peter Seitz (Swiss Center for Electronics and Microtechnology (CSEM) Zurich, Switzerland)  
Kenkichi Tanioka (NHK, Japan)  
Nobukazu Teranishi (NEC Corporation, Japan)  
Albert Theuwissen (Philips Imaging Technology, The Netherlands)  
Philip Wong (IBM, USA)  
Kazuya Yonemoto (Sony Corp., Japan)

# PROGRAM

## 1999 IEEE Workshop on Charge-Coupled Devices and Advanced Image Sensors

Thursday, June 10

8:30 am	<b>Opening Remarks</b>	N. Teranishi J. Nakamura	
<b>Session 1.</b>	<b>CCD Image Sensors (I)</b>	Chairman N. Teranishi (NEC)	
8:45 am	<b>A 2/3-in. 2,200k-pixel FIT-CCD for DTV 1080i</b>		1
<b>R1</b>	S. Suzuki, T. Yamaguchi, T. Torikai, N. Iwawaki, M. Yamanaka, K. Hirata, H. Tanaka, K. Yokozawa, M. Tamura and T. Imanishi CCD Division, Matsushita Electronics Corporation, Japan		
9:10	<b>BCD-A New High Performance Nondestructive Charge Detection Concept for</b>		5
<b>R2</b>	<b>CCD Image Sensors</b> J. Hyneczek and H. Shibuya* ISETEX Inc, U.S.A. *Texas Instruments Japan Limited, Japan		
9:35	<b>Influence of Sensor Settings and Doping Profile on Dark Current in FT-CCD's</b>		9
<b>R3</b>	H. O. Folkerts, A. Heringa, H. Peek, D. Verbugt and L. Korthout Philips Semiconductors Image Sensors, The Netherlands		
10:00	<b>Dynamic Range Improvement by Narrow-Channel Effect Suppression and</b>		13
<b>R4</b>	<b>Smear Reduction Technologies in Small Pixel IT-CCD Image Sensors</b> A. Tanabe, Y. Kudoh, Y. Kawakami, K. Masubuchi, S. Kawai, T. Yamada, M. Morimoto*, K. Arai, K. Hatano**, M. Furumiya**, Y. Nakashiba**, N. Mutoh, K. Orihara and N. Teranishi Silicon Systems Research Labs., NEC, Japan *System Micro Division, NEC, Japan **ULSI Device Development Labs. NEC, Japan		
10:25	<b>COFFEE BREAK</b>		

<b>Session 2.</b>		<b>CMOS Image Sensors (I)</b>	
		Chairman J. Nakamura (Olympus)	
10:55 am	<b>256 x 256 Pixel CMOS Imager with Linear Readout and 120dB Dynamic Range</b>		17
<b>R5</b>			
	M. Schanz, C. Nitta, T. Eckart, B. J. Hosticka and R. Wertheimer*		
	Fraunhofer Institute of Microelectronic Circuits and Systems, Germany		
	*Center of Research and Engineering, BMW, Germany		
11:20	<b>692 x 504 CMOS APS Imager with Extended Dynamic Range and On-Chip 12-bit ADC</b>		
<b>R6</b>			<b>WITHDRAWN</b>
	G. W. Hughes, N. J. McCaffrey, D. S. Sauer*, F-L. Hsueh, P. A. Levine, and F. S. Pantuso		
	Sarnoff Corporation, U.S.A.		
11:45	<b>A 1/3" VGA CMOS Imaging System on a Chip</b>		21
<b>R7</b>			
	S. Agwani, R. Cichomski, M. Gorder, A. Niederkorn, M. Skow and K. Wanda		
	Digital DNA Systems Architecture Laboratory, Motorola Inc., U.S.A.		
12:10	<b>Low Dark Current Pinned Photo-Diode for CMOS Image Sensor</b>		25
<b>R8</b>			
	I. Inoue, H. Ihara, H. Yamashita, T. Yamaguchi, H. Nozaki and R. Miyagawa		
	Microelectronics Eng. Lab., Toshiba Corp., Semiconductor Company, Japan		
12:10	LUNCH		
<b>Session 3.</b>		<b>CMOS Image Sensors (II)</b>	
		Chairman B. Dierickx (IMEC)	
1:50 pm	<b>A Smart CMOS Imager with On-Chip High-Speed Windowed Centroiding Capability</b>		29
<b>R9</b>			
	C. Sun, G. Yang, C. Wrigley, O. Y. Pecht* and B. Pain		
	Center for Space Microelectronics Technology, JPL, U.S.A.		
	*Electrical and Computer Eng. Dept., Ben-Gurion University, Israel		
2:15	<b>Time-Domain Correlation Image Sensor: First CMOS Realization of Demodulator Pixels Array</b>		33
<b>R10</b>			
	S. Ando and A. Kimachi		
	Dept. Mathematical Eng. and Information Physics, Univ. of Tokyo, Japan		

2:40	<b>Spatially Variant Flexible Sampling Control Integrated on a Sensor Focal Plane</b>	37
R11	Y. Ohtsuka, T. Hamamoto and K. Aizawa Dept. Electrical Engineering, University of Tokyo, Japan	
3:05	<b>Image Transmission with a Retina-Like CMOS Camera</b>	41
R12	G. Sandini, P. Questa*, A. Mannucci*, F. Ciciani*, D. Scheffer**, and B. Dierickx** LIRA-Lab, DIST, University of Genova, Italy *Unitek Consortium, Italy **IMEC-Leuven, Belgium	
3:30	COFFEE BREAK	
<b>Session 4.</b>	<b>Poster Session</b>	
	Chairman            J. Hyneczek (ISETEX) K. Orihara (NEC)	
4:00 pm	<b>A Digital Pixel Image Sensor with 1-bit ADC and 8-bit Pulse Counter in Each Pixel</b>	44
P1	F. Andoh, M. Nakayama, H. Shimamoto and Y. Fujita* Science & Technical Research Laboratories, NHK, Japan *Engineering Administration Department, NHK, Japan	
4:05	<b>A 128 x 128 Photo-Gate CMOS-APS with 10-bit Successive Approximation ADC</b>	52
P2	J. Solhusvik, J. Bjornsen* and S. Eikedal* Electronic Systems Dept., ABB, Norway *Physical Electronics Dept., NTNU, Norway	WITHDRAWN
4:10	<b>CMOS APS with Autoscaling and Customized Wide Dynamic Range</b>	48
P3	O. Y. Pecht and A. Belenky Electrical and Computer Eng. Dept., Ben-Gurion Univ. of the Negev, Israel	
4:15	<b>A CMOS Image Sensor Integration Gamma Correction and Gain Control Functions</b>	52
P4	M. Sasaki, S. Kawahito* and Y. Tadokoro* Sendai National College of Technology, Japan *Toyohashi University of Technology, Japan	

4:20 P5	<p><b>An a-Se HARP Layer for a Solid-State Image Sensor</b></p> <p>W. D. Park, Y. Takiguchi*, M. Kosugi*, M. Kubota*, Y. Ohkawa*, K. Miyakawa*, S. Suzuki*, K. Shidara*, K. Tanioka*, A. Kobayashi**, and T. Hirai**</p> <p>Dongyang University, Korea</p> <p>*Science and Technical Research Laboratories, NHK, Japan</p> <p>**Hamamatsu Photonics K.K., Japan</p>	56
4:25 P6	<p><b>Buried Double Junction Pixel Using Green and Magenta Filters</b></p> <p>K. M. Findlater, P. B. Denyer*, R. K. Henderson*, J. E. D. Hurwitz*, J. M. Raynor* and D. Renshaw</p> <p>Dept. of Electronics and Electrical Engineering, The Univ. of Edinburgh , UK</p> <p>*VLSI Vision Ltd., UK</p>	60
4:30 P7	<p><b>A Vertically Integrated High Resolution Active Pixel Image Sensor for Deep Submicron CMOS Processes</b></p> <p>S. Benthien*, M. Wagner*, M. Verhoeven*, M. Bohm* **, B. Schneider**, B. van. Uffel*** and F. Libreicht***</p> <p>*Silicon Vision GmbH, Germany</p> <p>**IHE, Universitat-GH Siegen, Germany</p> <p>***AGFA Gevaert N.V., Belgium</p>	64
4:35 P8	<p><b>On-Chip Offset Calibrated Logarithmic Response Image Sensor</b></p> <p>S. Kavadias, B. Dierickx and D. Scheffer</p> <p>IMEC, Belgium</p>	68
4:40 P9	<p><b>128 x 64 Pixels Adaptive-Integration-Time Image Sensor</b></p> <p>T. Hamamoto, Y. Ino and K. Aizawa*</p> <p>Dept. of Elec. Eng., Science University of Tokyo, Japan</p> <p>*Dept. of Elec. Eng., University of Tokyo, Japan</p>	72
4:45 P10	<p><b>Characterization of CMOS Photodiodes for Image Application</b></p> <p>C. C. Wang, I. L. Fujimori and C. G. Sodini</p> <p>Department of Elec. Eng. and Computer Science, MIT, U.S.A.</p>	76
4:50 P11	<p><b>Design and Simulation of a CMOS Sensor Array</b></p> <p>Z. J. Wang and H. L. Kwok</p> <p>Dept. of Electrical and Computer Engineering, University of Victoria, Canada</p>	80

4:55 P12	<b>A Passive Photodiode Pixel with Memory</b> J. Melander, M. Gokstorp* and R. Forchheimer IVP, Integrated Vision Products AB, Sweden *Photobit Corporation, U.S.A.	84
5:00 P13	<b>Focal Plane Processing for a Fast Detection of 2D Motion Vectors</b> Z. Li and K. Aizawa Dept. of Electrical Engineering, University of Tokyo, Japan	88
5:05 P14	<b>Fast Square-area Detection Algorithm Using Automata for VLSI Implementation</b> J. Akita, K. Maeda, A. Kitagawa and M. Suzuki Dept. of Electrical and Comp. Eng., Kanazawa University, Japan	92
5:10 P15	<b>Non-Linear AD Conversion, Tolerant for Pixel Offset Errors</b> B. Dierickx IMEC, Belgium	96
5:15 P16	<b>A CCD-CMOS Image Sensor for Ultra-High Speed Image Capturing</b> T. Etoh, H. Mutoh* and K. Takehara Kinki University, Japan *Link Research Corporation, Japan	99
5:20 P17	<b>The Ideal Response Curve of Colored Photodiodes</b> G. Meynants and B. Dierickx IMEC, Belgium	103
5:25 P18	<b>3-D Wave Optical Simulation of Inner-Layer Lens Structure</b> H. Mutoh Link Research Corporation, Japan	106
5:30 P19	<b>Novel pH Imaging Sensors Based on CCD Technology</b> K. Sawada, S. Mimura*, K. Tomita*, T. Nakanishi*, H. Tanabe*, M. Ishida, and T. Ando** Dept. of Electrical and Electronic Eng., Toyohashi Univ. of Technology, Japan *HORIBA, Ltd., Japan **Research Institute of Electronics, Japan	110



5:35 P20	<b>High Performance Schottky Photodiode Based on Polycrystalline ITO Deposited at Room Temperature</b> Q. Ma and A. Nathan Dept. of Electrical and Computer Engineering, Univ. of Waterloo, Canada	114
5:40 P21	<b>A Study for Image Pickup over Nyquist Rate Using Digital Signal Processing</b> T. Kimura, N. Takatsuka, T. Arano and H. Shiraki Dept. of Systems Engineering, Faculty of Engineering, Ibaraki Univ., Japan	118
5:45 P22	<b>CCD and APS - Both Together to the Comet P/Wirtanen</b> T. Behnke, H. Michaelis, M. Tschentscher and S. Mottola Institute of Planetary Exploration, German Aerospace Center, Germany	122
5:50 P23	<b>Correlation Between Leakage Current and Overlap Capacitance in a-Si:H TFTs</b> A. Nathan, D. Pereira, M. Austin Electrical and Computer Engineering, University of Waterloo, Canada	126
5:55 P24	<b>Measurement of Substrate Impurity Fluctuation in CCD Image Sensors</b> H. Shiraki, T. Kimura, T. Arano and N. Takatsuka System Dept., Faculty of Engineering, Ibaraki University, Japan	130
6:00 P25	<b>A Family of High Performance TDI Image Sensors</b> G. Weale, C. Flood, M. Ledgerwood, J. G. Mihaychuk, S. Kamasz, H. Siefken, D. Deering and G. Ingram DALSA Inc., Canada	134
6:05 P26	<b>Technology and Performance of VGA-Format Progressive IT-CCD Imagers with Double Transfer Gate Four-Phase Pixel Structure</b> Y. J. Yu and K. K. Kwon CCD R&D Lab., System IC Group, LG Semicon Ltd., Korea	136

6:10 pm -9:00 pm **POSTER VIEWING, RECEPTION**

Friday, June 11

**Session 5. CMOS Image Sensors (III)**

Chairman P. Wong (IBM)

8:15 am **Analysis and Enhancement of Low-Light-Level Performance of Photodiode-** 140  
**R13** **type CMOS Active Pixel Imagers Operated with Sub-Threshold Reset**  
B. Pain, G. Yang, M. Ortiz, C. Wrigley, B. Hancock and T. Cunningham  
Jet Propulsion Laboratory, California Institute of Technology, U.S.A.

8:40 **An Improved Digital CMOS Imager** 144  
**R14** O. B. Kwon\*, K. N. Park\*, D. Y. Lee\*, K. J. Lee\*, S. C. Jun\*, C. K. Kim\*, J. W.  
Eom\*, A. S. Choi\*, Y. B. Lee\* and W. Yang\* \*\*  
\*Image Sensor Dev. System I·C R&D, Hyundai Electronics Inc, Korea  
\*\*Harvard University, U.S.A.

9:05 **A Low-Light to Sunlight, 60 Frames/s, 80k Pixel CMOS APS Camera-on-a-** 148  
**R15** **Chip With 8b Digital Output**  
S. L. Barna, L. P. Ang, B. Mansoorian and E. R. Fossum  
Photobit Corp., U.S.A.

9:30 **A Linear-Response, High-Dynamic Range CMOS Imager Suitable for** 151  
**R16** **Spectroscopic Applications**  
D. Qian and W. Yang  
Division of Engineering and Applied Sciences, Harvard University, U.S.A.

9:55 COFFEE BREAK

**Session 6. Non-Visible Image Sensors**

Chairman D. McGrath (MIT)

10:25 am **Current Skimming-Based CMOS Readout Architectures for Quantum Well** 155  
**R17** **Infrared Photodetectors**  
C. Friedman, A. Arbel and R. Ginosar  
VLSI Systems Research Center, Israel Institute of Technology, Israel

10:50 R18	<b>A Stacked CMOS APS for Charge Particle Detection and its Noise Performance</b> I. Takayanagi, J. Nakamura, H. Yurimoto*, T. Kunihiro*, K. Nagashima*, and K. Kosaka** Olympus Optical Co., Ltd., Japan *Tokyo Institute of Technology, Japan **Tokyo Technology, Inc., Japan	159
11:15 R19	<b>Charge Loss in the Channel Stop Regions of the X-ray CCD</b> G. Prigozhin, M. Pivovarov, S.Kissel, M. Bautz and G. Ricker Center for Space Research, MIT, U.S.A.	163
11:40 R20	<b>A Partially Overlapped X-ray Imaging Pixel with Low Leakage and High Sensitivity</b> B. Park and A. Nathan Electrical and Computer Engineering Dept., University of Waterloo, Canada	167
12:05 R21	<b>A Model for Object Detectability Close to Defective Columns in X-Ray Imaging Arrays</b> R. Dyck and M. Sayag Lockheed Martin Fairchild Systems, U.S.A.	<b>WITHDRAWN</b>
12:30	LUNCH	
<b>Session 7.</b>	<b>Large Format Image Sensors</b> Chairman R. Bredthauer (Semiconductor Tech. Associates) T. Kuroda (MEC)	
1:45 pm R22	<b>Performance Characteristics of a 9216 x 9216 Pixel CCD</b> D. Wen, R. Bredthauer, P. Bates, P. Vu and R. Potter Lockheed Martin Fairchild Systems, U.S.A.	171
2:10 R23	<b>An 8M-CCD for an Ultra High Definition TV Camera</b> C. Smith, M. Farrier, K. Mitani*, Q. Tang and G. Ingram DALSA Inc., Canada *NHK, Japan	175

2:35	<b>Large Format CCD Image Sensors Fabricated on High Resistivity Silicon</b>	179
R24	S. E.Holland, D. E. Groom, M. E. Levi, N. P. Palaio, S. Perlmutter, R. J. Stover* and M. Wei* Lawrence Berkeley National Laboratory, University of California, U.S.A. *Lick Observatory, University of California Observatories, U.S.A.	
3:00	<b>A Page Width CMOS Image Sensor Array</b>	183
R25	J. Tandon Xerox Corporation, U.S.A	
3:25	COFFEE BREAK	
 <b>Session 8. CMOS Image Sensors (IV) and Image Sensor Characterization</b>		
	Chairman O. Yadid-Pecht (Ben-Gurion Univ. of Negav) T. Tanioka (NHK)	
3:55 pm	<b>First Multispectral Diode Color Imager with Three Color Recognition and</b>	187
R26	<b>Color Memory in Each Pixel</b> M. Sommer*, P. Rieve*, M. Verhoeven*, M. Bohm* **, B. Schneider**, B. van. Uffel*** and F. Librecht*** *Silicon Vision GmbH, Germany **IHE, Universitat-GH Siegen, Germany ***Agfa-Gevaert N.V., Belgium	
4:20	<b>Self-Calibrating Logarithmic CMOS Image Sensor with Single Chip Camera</b>	191
R27	<b>Functionality</b> M. Loose, K. Meier and J. Schemmel IHEP, Heidelberg University, Germany	
4:45	<b>A Novel CMOS-APS Configuration with an Extremely Low Fixed Pattern</b>	195
R28	<b>Noise</b> T. I. Watanabe Corporate Research Labs., Fuji Xerox Co., Ltd., Japan	
5:10	<b>CCD Requirements for Digital Photography</b>	199
R29	R. L. Baer Hewlett-Packard Laboratories, U.S.A.	

5:35            **Test Methodologies for Digital CMOS Camera-on-a-Chip Image Sensors**            239  
R30            G. Waligorski, M. B. Kaplinsky, V. Berezin and E. R. Fossum  
                 Photobit Corporation, U.S.A.

**Session 9. Discussion Session**

Chairman E. Fossum (Photobit)

6:10 pm -7:20 pm

7:20 pm -9:30 pm DINNER

Saturday, June 12

**Session 10. Walter Kosonocky Award**

Chairman Albert Theuwissen (Philips)

8:15 am -8:45 am **Walter Kosonocky Award Presentation**

**Session 11. CMOS Image Sensors (V)**

Chairman P. Denyer (VVL)

8:45 am            **Area Auto Focus CMOS Sensor**            203  
R31            H. Takahashi, T. Ezaki, M. Shinohara, S. Furudate, H. Nakamura, T. Ichise,  
                 and S. Sugawa  
                 Device Development Center, Canon Inc., Japan

9:10            **On Chip Focal Plane Filtering for CMOS Imagers**            207  
R32            J. Huppertz, T. Kneip, M. Schwarz and B. J. Hosticka  
                 Fraunhofer Institute of Microelectronic Circuits and Systems, Germany

9:35            **CMOS Image Sensor Overlaid with a HARP Photoconversion Layer**            211  
R33            T. Watabe, H. Ohtake, K. Yamano, M. Yamauchi, T. Tajima, Y. Takiguchi,  
                 Y. Ishiguro, T. Hayashida M. Kosugi, H. Kokubun, T. Watanabe and M. Abe  
                 NHK Science and Technical Research Laboratories, Japan

10:00	<b>LARS II -A High Dynamic Range Image Sensor with a-Si:H Photo Conversion Layer</b>	215
<b>R34</b>	T. Lule*, H. Keller*, M. Wagner* and M. Bohm* ** *Silicon Vision GmbH, Germany **IHE, Universitat-GH Siegen, Germany	
10:25	<b>COFFEE BREAK</b>	
<b>Session 12.</b>	<b>CCD Image Sensors (II)</b>	
	Chairman K. Yonemoto (Sony) N. Mutoh (NEC)	
10:55 am	<b>Performance of FT-CCD Image Sensor with Single Layer Poly-Silicon Electrode</b>	219
<b>R35</b>	Y. Okada, Y. Ohtsuru, S. Izawa, N. Taino and M. Hamada CCD Development Dept., MOS-LSI Division, SANYO Electric Corp., Japan	
11:20	<b>Evaluation of Subsampling in a 2/3" 2-M Pixel FT-CCD</b>	223
<b>R36</b>	J. T. Bosiers, A. C. Kleimann, M. Horemans and L. L. Cam Philips Semiconductors Image Sensors, The Netherlands	
11:45	<b>Technology to Eliminate Yield-Limiting Elements in CCD Imagers</b>	227
<b>R37</b>	H. Peek, D. Verbugt, H. Stoldt and A. D. Veirman Philips Semiconductors Image Sensors, The Netherlands	
12:10	<b>1/2" 2Mpixel Full Frame CCD Sensor for Digital Photography</b>	231
<b>R38</b>	Z. Pektas, J. Toker and S. Bencuya Image Sensor Technology Division, Polaroid Corporation, U.S.A.	
12:35	<b>A 1/4-inch 630k-pixel IT-CCD Image Sensor with High-Speed Capture Capability</b>	235
<b>R39</b>	M. Kimura, H. Yoshida, I. Hirota, A. Yamamoto, K. Ezoe, Y. Okazaki, Y. Takamura, H. Mori* and Y. Fujita* Semiconductor Company, SONY Corporation, Japan *SONY Kokubu Corporation, Japan	
13:00	<b>CLOSING REMARKS</b>	

