Reviews of ’07 & a Look to ‘08

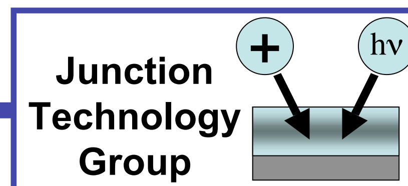
2:00-3:00 **Highlights from Junction-related Conferences in 2007**
IWJT07/Kyoto, Insight07/Napa: Michael Current, Current Scientific
RTP07/Catania, IEDM07/ Washington DC: Paul Timans, Mattson

3:00-3:20 BREAK

3:20-3:50 **Mirco-4PP Measurements of Sheet Resistance Uniformity**
Daniel Kjaer, CAPRES

3:50-4:20 **Dynamic-SIMS Protocols for Dopant Profiling**
Gary Mount, EAG

4:20-4:50 **Upcoming JTG Activities and Related Conferences in 2008:**
MRS S08/San Francisco, March
JTG Spring meeting (TBD)
IWJT08/Shanghai, May
ECS08/Phoenix, May
IIT08/Monterey, June
Semicon West 08 / San Francisco, July
RTP08/Las Vegas NV, Sept



IWJT07, June 8-9, 2007 Kyoto U.

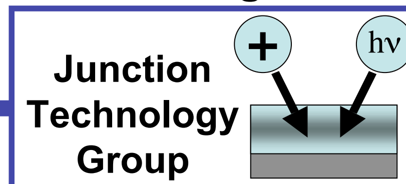
39 papers,
~60 attendees

Takaaki Aoki, Toshio Seki, Jiro Matsuo, Kyoto U.
MD study of damage structures with poly-atomic boron cluster implantation

Akira Mineji, John Borland, Seiichi Shishiguchi, Masami Hane, Masayasu Tanjyo, Tsutomo Nagayama, NEC/JOB/Nissin Ion
Molecular and high mass dopants for halo and extension implantation

Tony Renau, Varian Semiconductor Equipment Associates
A better approach to molecular implantation

S. Endo, Y. Maruyama, Y. Kawasaki, T. Yamashita, H. Oda, Y. Inoue, Renesas
Novel junction engineering scheme using combination of LSA and Spike-RTA



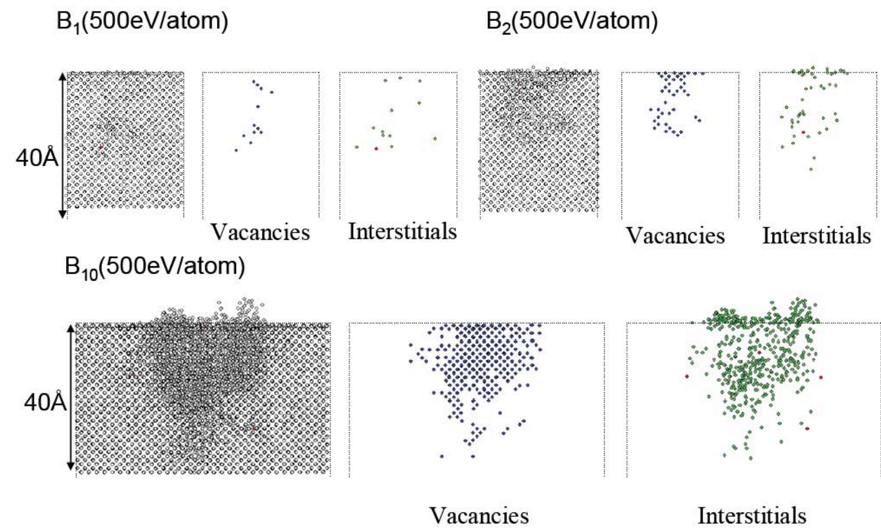
IWJT07

Takaaki Aoki, Toshio Seki, Jiro Matsuo, Kyoto U.

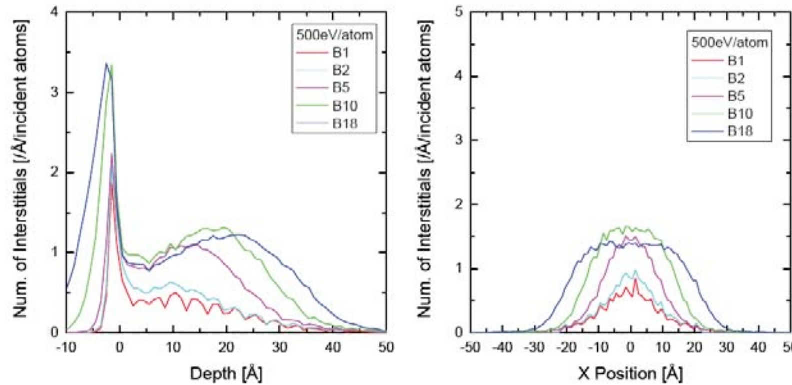
MD study of damage structures with poly-atomic boron cluster implantation

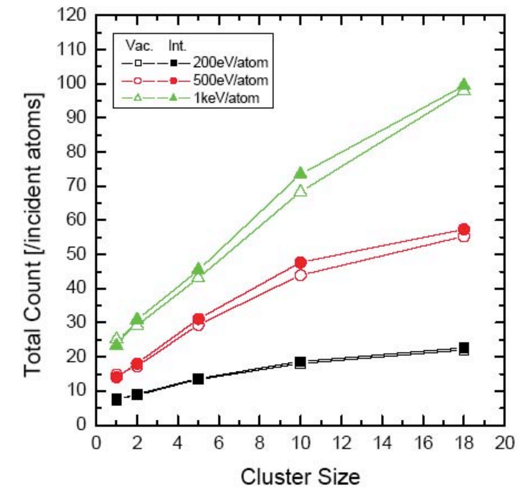
Table 1. Conditions of MD simulations in this study

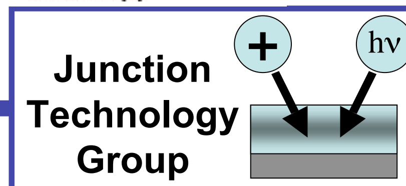
incident energy	B	B_2	B_5	B_{10}	B_{18}
200eV/atom	1000trials (1000 atoms) ↓ Si_{8192} (43Å²×86Å)	1000trials (2000 atoms) ↓ Si_{8192} (43Å²×86Å)	500trials (2500 atoms) ↓ Si_{32768} (86Å²×86Å)	200trials (2000 atoms) ↓ Si_{32768} (86Å²×86Å)	200trials (3600 atoms) ↓ Si_{32768} (86Å²×86Å)
500eV/atom	1000trials (1000 atoms) ↓ Si_{8192} (43Å²×86Å)	1000trials (2000 atoms) ↓ Si_{8192} (43Å²×86Å)	500trials (2500 atoms) ↓ Si_{32768} (86Å²×86Å)	100trials (1000 atoms) ↓ Si_{32768} (86Å²×86Å)	100trials (1800 atoms) ↓ Si_{32768} (86Å²×86Å)
1keV/atom	1000trials (1000 atoms) ↓ Si_{16384} (43Å²×172Å)	1000trials (2000 atoms) ↓ Si_{16384} (43Å²×172Å)	400trials (2000 atoms) ↓ Si_{65536} (86Å²×172Å)	200trials (2000 atoms) ↓ Si_{65536} (86Å²×172Å)	200trials (3600 atoms) ↓ Si_{65536} (86Å²×172Å)



Larger molecules make more damage, deeper, wider.







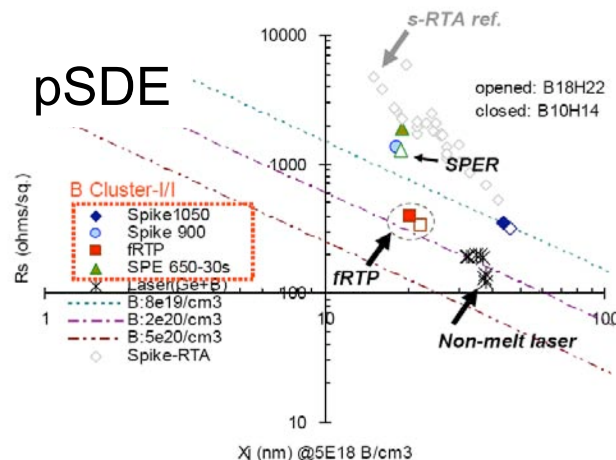
IWJT07

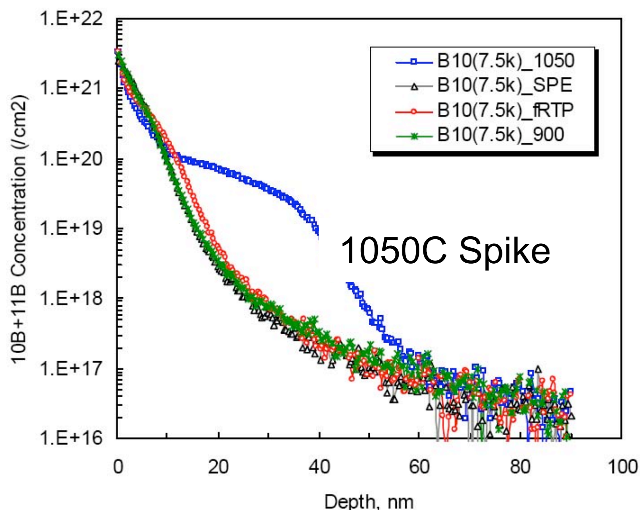
Akira Mineji, John Borland, Seiichi Shishiguchi, Masami Hane, Masayasu Tanjyo, Tsutomo Nagayama, NEC/JOB/Nissin Ion

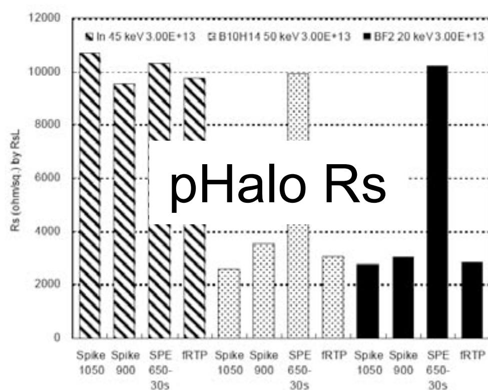
Molecular and high mass dopants for halo and extension implantation

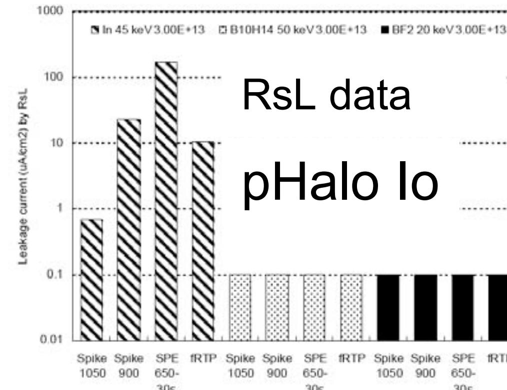
Table 1 : Summary of SDE and HALO implant matrix.

	Ion	Energy	Dose (Equiv.)		Ion	Energy	Dose (Equiv.)
N-SDE	As	3keV	1e15	P-SDE	BF2	3keV	1e15
	As2	6keV	1e15		B10Hx	7.5keV	1e15
	P2	3keV	1e15		B18Hx	15keV	1e15
	Sb	5keV	1e15				1e15
N-Halo	As	40keV	3E13	P-Halo	BF2	20keV	3E13
	As2	80keV	3E13		B10Hx	50keV	3E13
	Sb	65keV	3E13		In	45keV	3E13





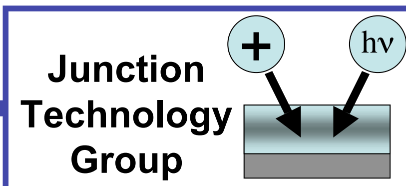




B10 and fRTP are good. More data to come.

Michael Current currentsci@aol.com

Jan 16, 2008



IWJT07

Tony Renau, Varian Semiconductor Equipment Associates

A better approach to molecular implantation

Carborane ($C_2B_{10}H_{12}$ AMU = 144)

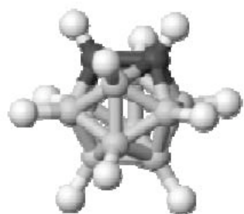


FIGURE 1. Molecular structure of Carborane.

"Cool" arc source

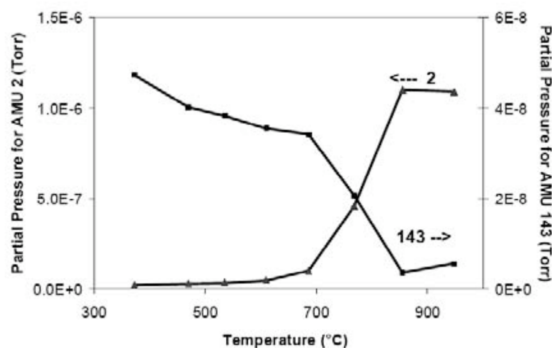


FIGURE 2. Carborane thermal stability. RGA data is shown for the partial pressures of carborane (AMU 143) and hydrogen (AMU 2) as the ion source arc chamber is heated.

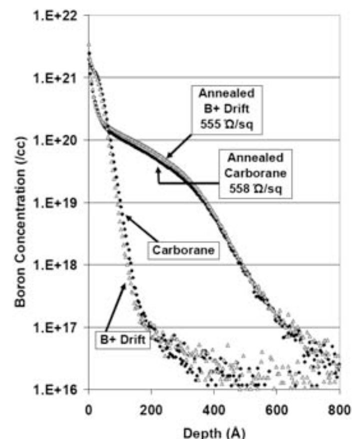
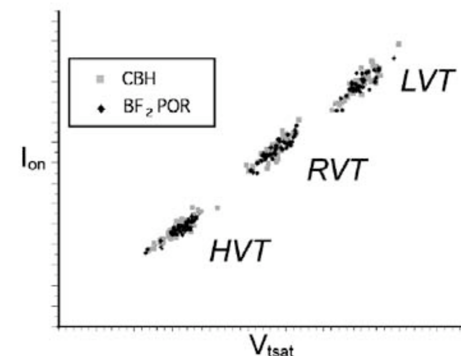
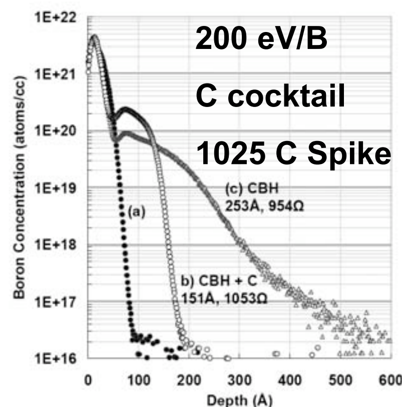


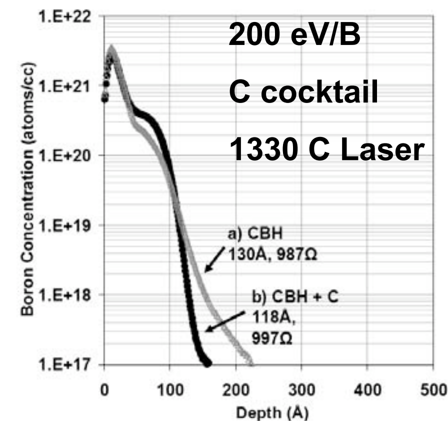
FIGURE 4. Comparison of boron SIMS profiles for 6.5keV carborane and 500eV B+ (drift) implants. Both as implanted and (1050°C) spike anneal profiles are shown.



65 nm LP Logic

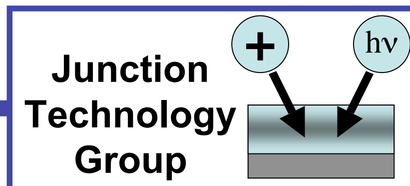
5 keV BF_2 POR





Michael Current currentsci@aol.com

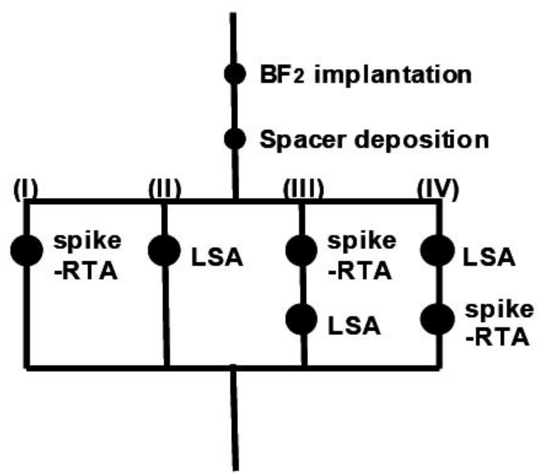
Jan 16, 2008

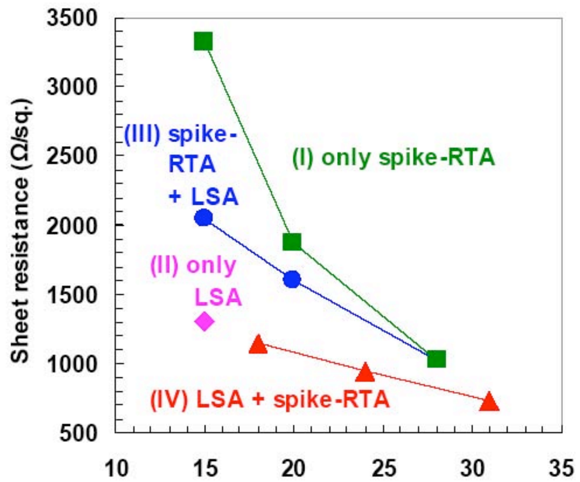


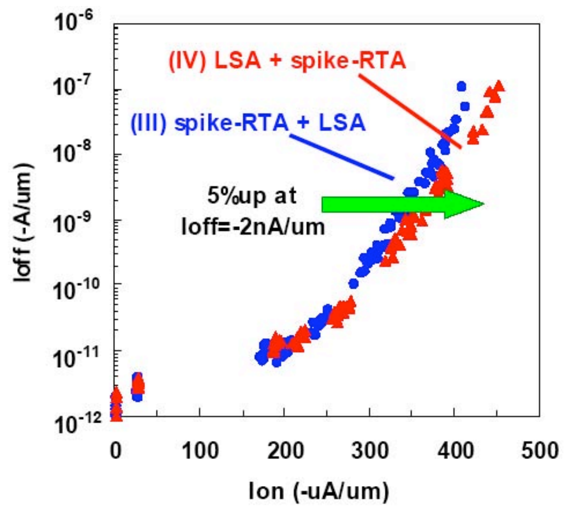
IWJT07

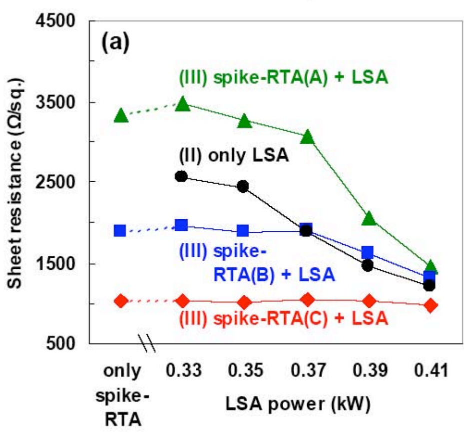
S. Endo, Y. Maruyama, Y. Kawasaki, T. Yamashita, H. Oda, Y. Inoue, Renesas

Novel junction engineering scheme using combination of LSA and Spike-RTA









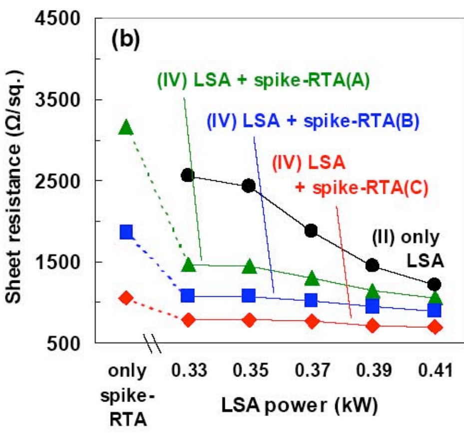
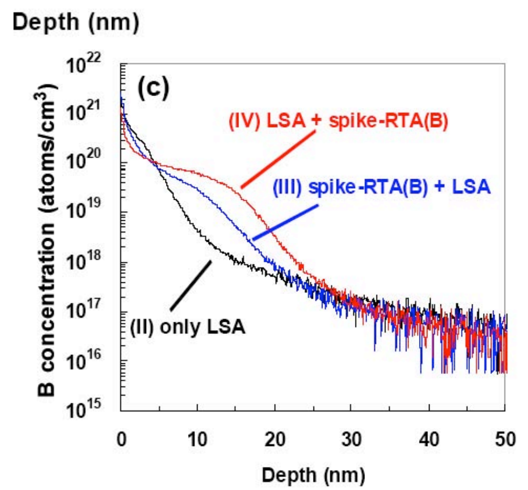
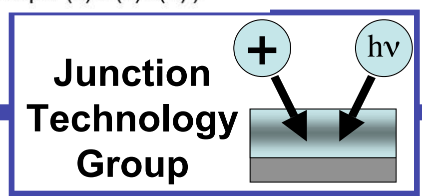


Fig. 2. Dependence of sheet resistance on laser power of LSA for (a) spike-RTA+LSA and (b)LSA+spike-RTA. (spike-RTA temp. : (A) < (B) <(C))



LSA-RTA sequence matters.

LSA-first is better.



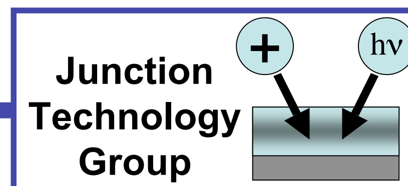
Insight07 (USJ07), May 6-9,07 Napa CA

(76 papers, ~130 attendees)

Susan Felch, B.J. Pawlak, T. Hoffmann, E. Collart, S. Severi, T. Noda, V. Parihar, P. Eyben, W. Vandervorst, S. Thirupapuliyur, R. Schreutelkamp (AMAT, NXP, IMEC, Matsushita)
USJ formed by C co-implantation with spike plus sub-melt laser annealing

Michael Gribelyuk, A.G. Domenicucci, P.A. Ronsheim, J.S. McMurray, O. Gluschenkov (IBM, Hopewell Junction NY)
Electron holography of submicron structures

Diane Hickey, Z.L. Bryan, Kevin Jones (U. Florida)
Defect formation and evolution in (011)Ge



Insight07

S.B. Felch, B.J. Pawlak, T. Hoffmann, E. Collart, S. Severi, T. Noda, V. Parihar, P. Eyben, W. Vandervorst, S. Thirupapuliyur, R. Schreutelkamp (AMAT, NXP, IMEC, Matsushita)

USJ formed by C co-implantation with spike plus sub-melt laser annealing

B and P diffusion reduced with C cocktail with spike.

Laser anneal improves activation and Idsat.

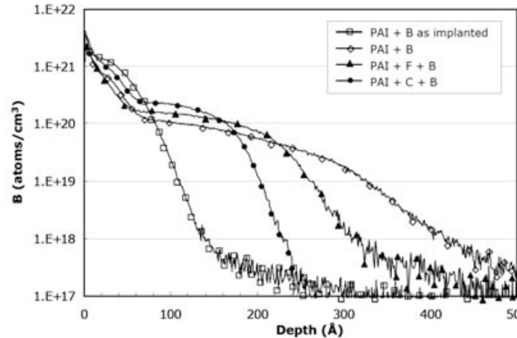
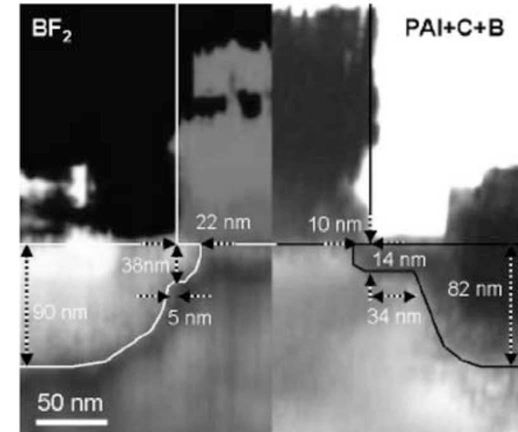
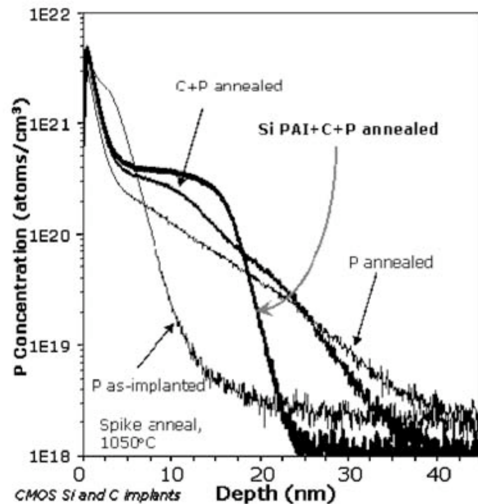
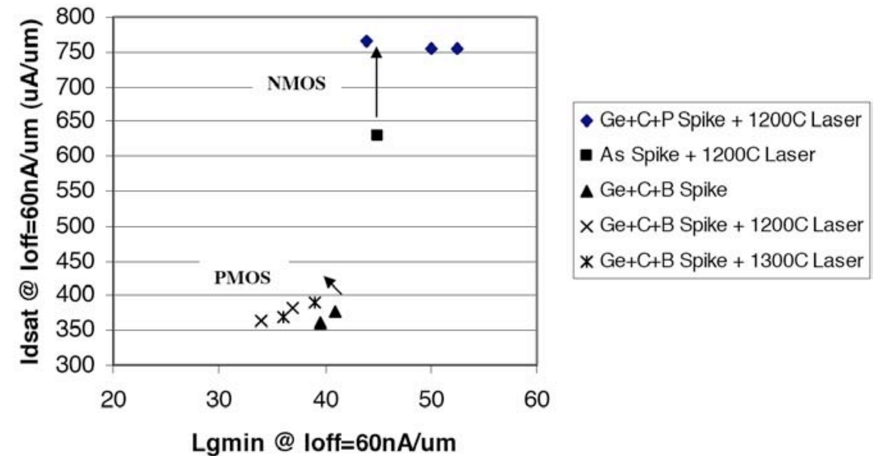
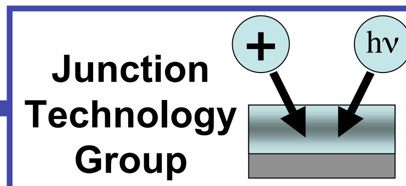


Figure 1. SIMS profiles of boron as-implanted with Ge pre-amorphization and after 1050°C spike anneal with Ge PAI and F or C co-implant.







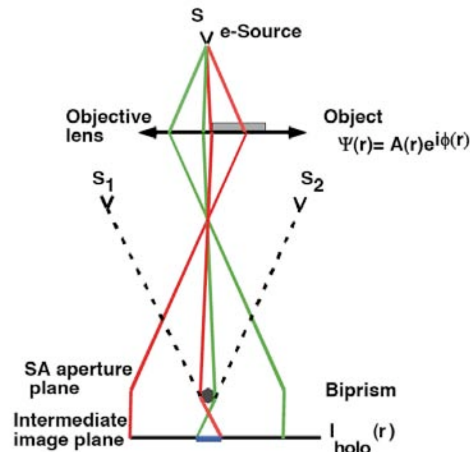


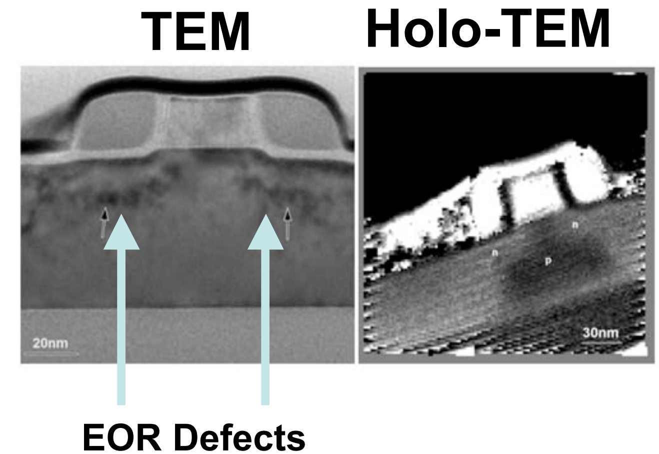
Insight07

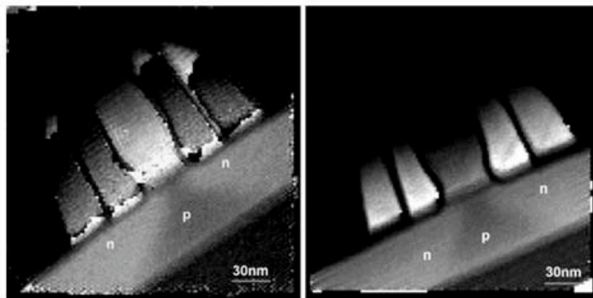
Michael Gribelyuk, A.G. Domenicucci, P.A. Ronsheim, J.S. McMurray,
O. Gluschenkov (IBM, Hopewell Junction NY)

Electron holography of submicron structures

Complementary TEM method to image doped and depletion layers in devices.







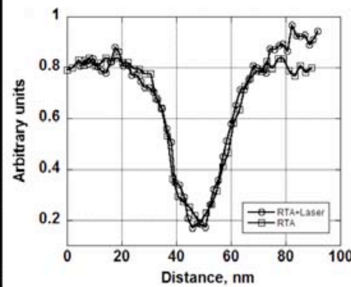


Fig. 6. Phase map of n-FET device after RTA (left), RTA + laser (center). Comparison of lateral profiles derived from phase maps (right).

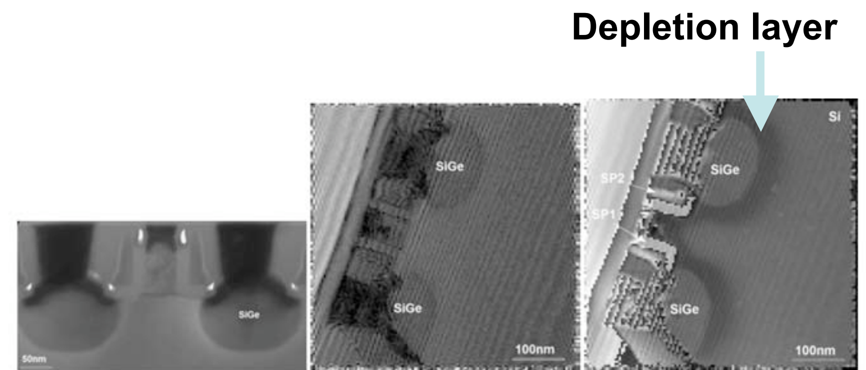
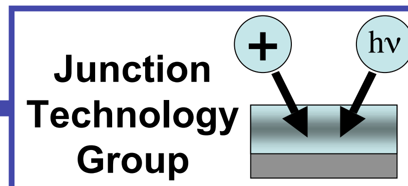


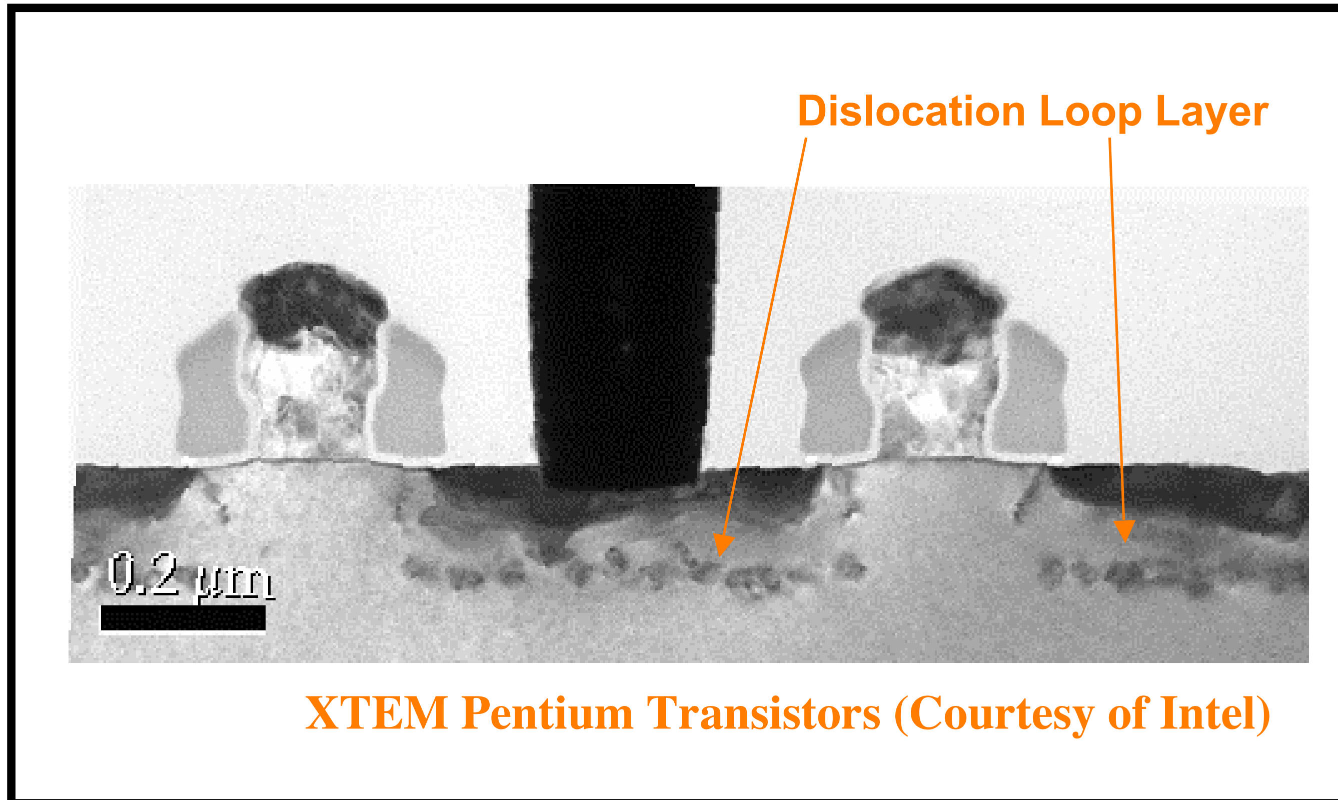
Fig. 8. Conventional TEM image (left), amplitude map (center) and potential map (right).

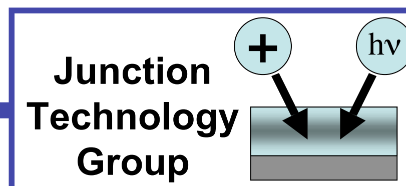


Insight07

Diane Hickey, Z.L. Bryan, Kevin Jones (U. Florida)

Defect formation and evolution in (011)Ge



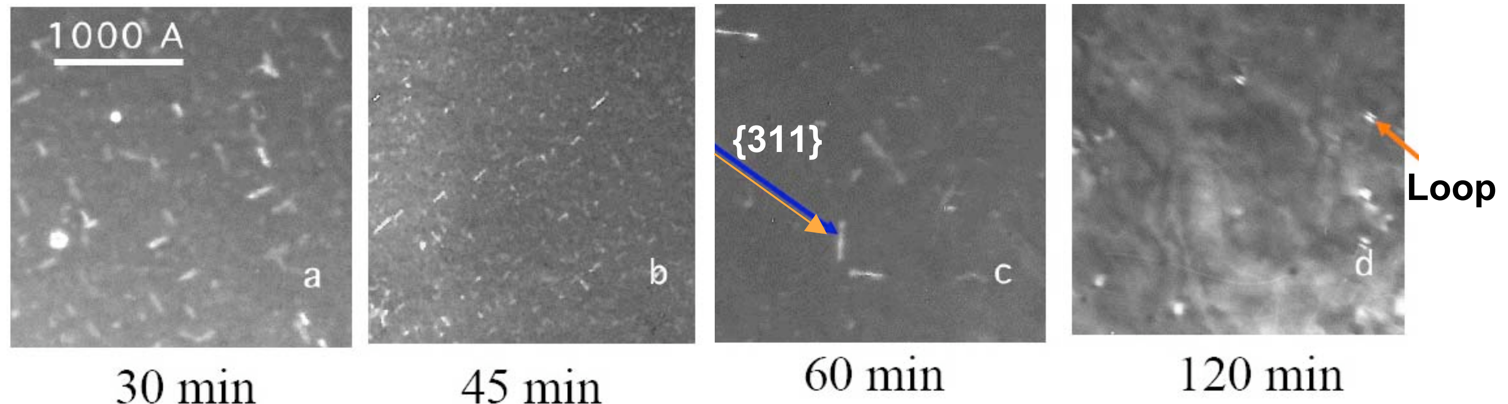


Defects in Si_xGe_{1-x} solid solution?

Energy: **40 keV** Dose: **$1x10^{14}$ cm^{-2} Si^+** Anneal Temperature: **750˚ C**

$Si_{.98}Ge_{.02}$

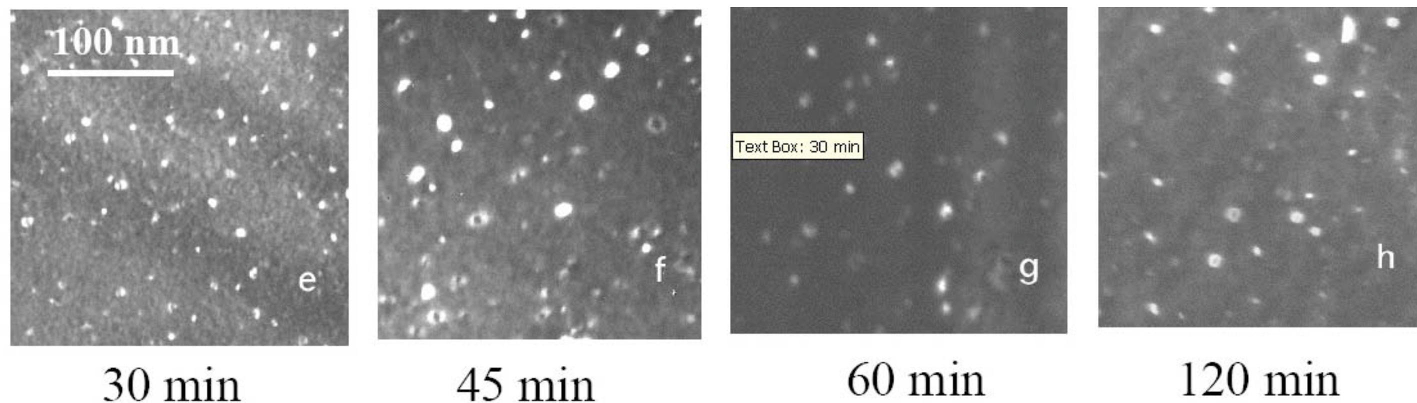
Conc. Of 0, 2, and 5% Ge do form {311}s



In a 2% Ge solid solution, {311} defects form, coarsen and unfault into loops over time.

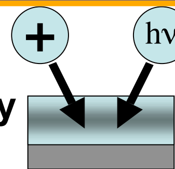
$Si_{.75}Ge_{.25}$

Conc. of 25, 35, and 50% Ge do not form {311}s



In a 25% Ge solid solution, stable dislocation loops evolve (no {311} defects).

Crosby, et al. JVST-B 22 (1), 468-470 (2004).



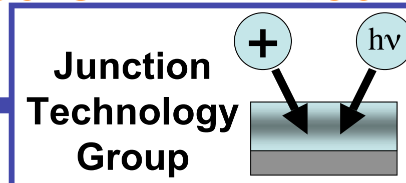
1MeV, $1x10^{14}$ Si^+ cm^{-2}

	Si 750˚C (53% MP)	800˚C (56% MP)	850˚C (60% MP)	950˚C (67% MP)
Si 1 MeV (T_i=303K) $1x10^{14}$ Si^+ cm^{-2} Annealed, 10 min WBDF XTEM	(e)	(f)	(g)	(h)
Ge 1 MeV (T_i=303K) $1x10^{14}$ Si^+ cm^{-2} Annealed, 10 min WBDF XTEM	(a)	(b)	(c)	(d)
	Ge 350˚C (38% MP)	450˚C (48% MP)	650˚C (70% MP)	750˚C (80% MP)

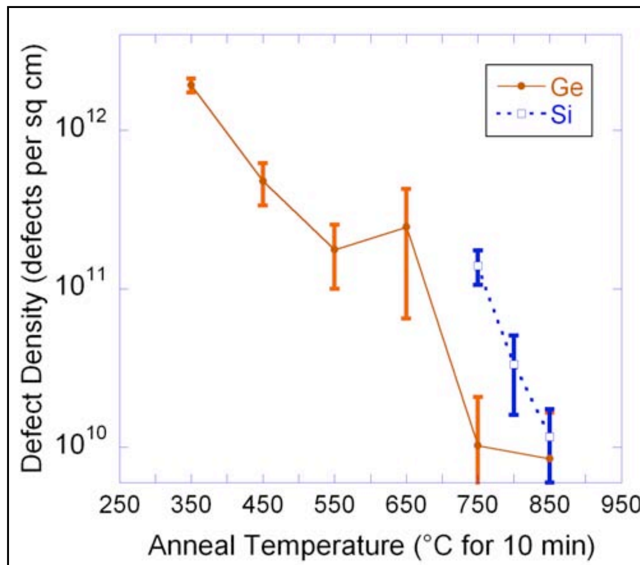
Surface, R_D, R_P, 500nm, 5 µm

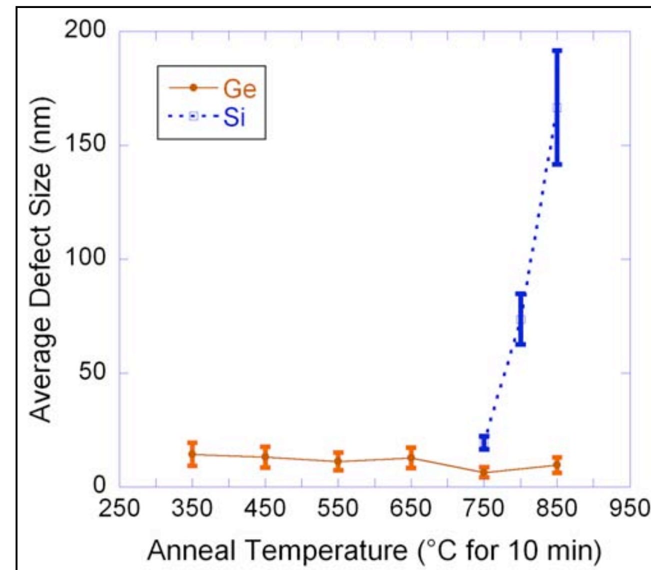
Ave. Ge Defect Size: 10-12 nm

D. Hickey Insight07

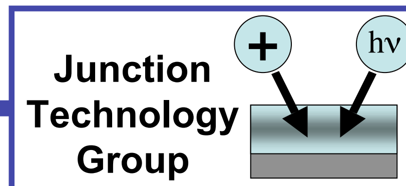


Defect Annealing in Si and Ge





Large extended defects do not form in Ge



A Look Ahead to 2008 JTG Meetings

Upcoming JTG Activities and Related Conferences in 2008:

MRS08/San Francisco, CA, March 24-27, 2008

JTG Spring meeting (TBD)

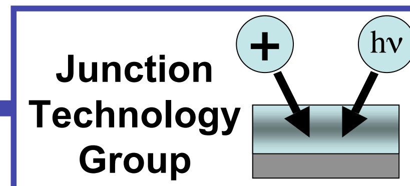
IWJT08/Shanghai, May 15-16, 2008

ECS08/Phoenix, AZ, May 18-23, 2008

IIT08/Monterey, CA, June 8-13, 2008

Semicon West 08 /San Francisco, CA, July 17, 2008

RTP08 /Las Vegas, NV, Sept 30-Oct 3, 2008



MRS S08, March 24-27, San Francisco

Moscone West & Marriott Hotel

Doping Engineering for Front-End Processing

March 24 - 27, 2008

Chairs

Bartek J. Pawlak	NXP Semiconductors
Mark Law	University of Florida
Kyoichi Suguro	Toshiba Corporation
M. Lourdes Pelaz	University of Valladolid

Symposium E
55 papers

Materials and Devices for "Beyond CMOS" Scaling

March 27, 2008

Chairs

Shriram Ramanathan	Harvard University
George Bourianoff	Intel Corporation
Adrian Ionescu	Swiss Federal Institute of Technology

Symposium Support

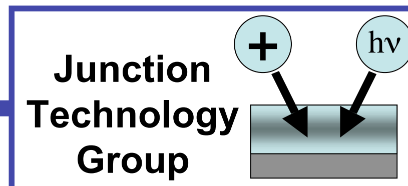
Intel Corporation

Symposium B
24 papers

Exhibit:

March 25-27, Moscone West

www.mrs.org



IWJT08, May 15-16, 08, Shanghai

- **Doping Technology** --- Ion implantation, plasma doping, gas and solid doping
- **Annealing Technology** --- Rapid thermal process, laser annealing, flash annealing, SPE, lattice damage and defects
- **Junction Technology for Novel CMOS Device Structures** --- Junction for SOI, strained Si, SiGe, Ge, and Schottky barrier S/D MOSFET
- **Silicides and Contact Technology for CMOS** --- Silicide materials and salicide technology, elevated S/D, low barrier contact, surface pre-treatment
- **Junction and Contact Technologies for Compound Semiconductors and Quantum Devices** --- Schottky and ohmic contacts to wide bandgap compound semiconductors, junction and contact technologies for carbon nanotube and other nano-, quantum devices, hetero-junction devices
- **Characterization for Shallow Junction** (1D, 2D) --- Physical and electrical characterization of ultra-shallow junction formation, dopant incorporation/activation, dopant profiling/mapping, novel characterization techniques
- **Modeling and Simulation** --- Modeling and simulation of ultra-shallow junction formation, modeling of novel junction-structure CMOS devices and non-Si based devices
- **Equipment, Materials and Substrates for Junction Technology**

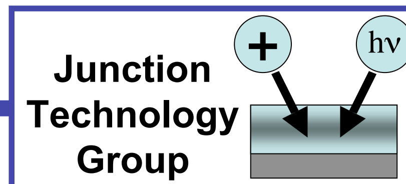
Key Dates:

Jan 15, 08 abstracts

April 1, 08 papers & late news

www.iwjt2008.com

Dr. Yu-Long Jiang
Department of Microelectronics
Fudan University
Shanghai 200433, China
E-mail: yljiang@fudan.edu.cn
Tel: +86-21-65643768
Fax: +86-21-65643768



ECS08, May 18-23,08 Phoenix

The Electrochemical Society

the society for solid-state and electrochemical science and technology

213th Electrochemical Society Meeting
Phoenix Civic Plaza, Phoenix (Arizona)
May 18-23, 2008

Symposium E1

Advanced Gate Stack, Source/Drain and Channel Engineering for Si-Based CMOS: New Materials, Processes and Equipment; 4

- High Mobility Channels (Strain, Ge, III-V, Nanowires, Epitaxial Processes)
- Advanced Gate Stacks (High-K on Si & on Novel Channels, Metal Gates)
- Ultra-Shallow Junctions (Doping & Annealing, Activation, Diffusion, Deposition)
- Contact Engineering (Silicides)

Symposium Organizers

P.J. Timans, Mattson Technology Inc., Fremont, USA
D.-L. Kwong, Institute of Microelectronics, Singapore
H. Iwai, Tokyo Institute of Technology, Japan
E.P. Gusev, Qualcomm MEMS Technologies, San Jose, USA,
F. Roozeboom, NXP Semiconductors, Eindhoven, The Netherlands
M.C. Öztürk, North Carolina State University, Raleigh, USA

Some invited speakers

- **Jeff Welser (SRC)** – The Semiconductor Industry's Nanoelectronics Research Initiative
- **Mark van Dal (NXP Semiconductors)** - SOI FinFET integration
- **Paul Besser (AMD)** - Silicides for 32nm and beyond
- **Karson Knutson (Intel)** - Physical Modeling of Layout-Dependent Transistor Performance
- **Yasuo Nara (Selete)** - Dopant Activation Phenomenon by Flash Lamp Annealing
- **Dave Camm (Mattson)** - Temperature Profiles During Millisecond Processing
- **Hirohisa Kawasaki (Toshiba)** - Sub-15nm FinFET and Reduction of Its Parasitic Resistance

- **......and others covering novel channel materials, nanowires and high-K integration**

http://www.electrochem.org/meetings/biannual/213/213.htm

IIT08, June 8-13, 08, Monterey

- **Doping Processes**
- **Implant Technology**
- **Materials Science**
- **Non-doping applications**
- **Process Control and Yield**
- **Novel Applications** (non-planar CMOS, imaging devices)

Recent advances in ultra-shallow junction formation will be a major application focus, including:

- **Molecular Ion Implantation**
- **Cluster Ion Beams**
- **Plasma Immersion**

Key Dates:

Jan 21, 08 abstracts

www.iit2008.com

IIT School: June 5-7, 08

14 world-class instructors

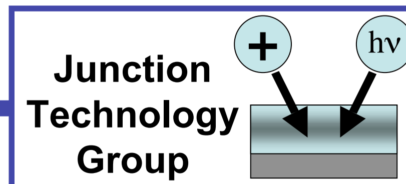
New 700 page textbook

Conference Chairs

General Chair:
Susan Felch, Applied Materials, SFelch@sbcglobal.net

Technical Program Chair:
Amitabh Jain, Texas Instruments, a-jain1@ti.com

Publications Chair:
Ed Seebauer, University of Illinois, eseebaue@uiuc.edu



Semicon West 08, July 17, 2008

JTG Meeting@Scon/W08

Tentative plans:

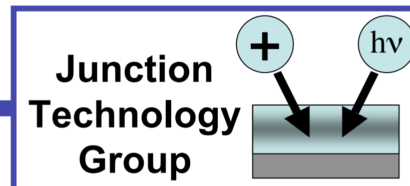
Location: Moscone South Mezzanine (TBA)

Technical Chair: John Borland, JOB

Local Host: Matheson Tri-Gas (with $$ from others)

Topic Choices:

USJ, Metrologies, New Technologies, etc.



RTP08, Sept 30-Oct 3,08, Las Vegas

The RTP Conference Committee and IEEE invite you to submit abstracts for the 16th Annual IEEE International Conference on Advanced Thermal Processing of Semiconductors - RTP2008. This conference will be held in The Platinum Hotel and Spa, Las Vegas, NV on September 30 to October 3, 2008. The conference provides an opportunity for members of the RTP community and academia to share their insight and learn more about Advanced Thermal Processing of Semiconductors. The conference brings together process and equipment engineers, managers, researchers and educators involved in Advanced Thermal Processing of Semiconductors.

The Conference is accompanied by a one day tutorial workshop "Strain-Enhanced Mobility and Advanced Channel Materials" which will be held on September 30, 2008.

Important Dates:

Abstracts: May 31, 08

Final Papers: August 31, 08

http://www.ieee-rtp.org

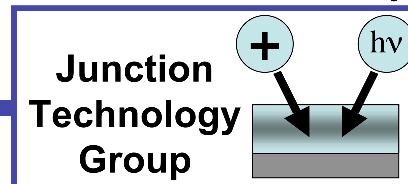
Chairs:

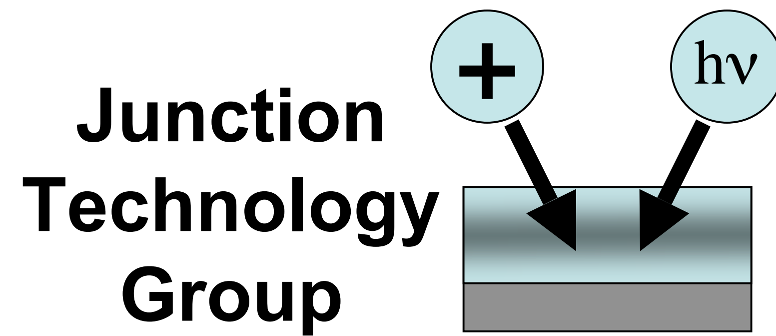
Bo Lojek, Atmel

Vittorio Privitera, IMM CNR

Jeff Gelpy, Mattson

Kyoichi Suguro, Toshiba




Junction
Technology
Group
hν