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IEDM 2004: Postmortem

Which company presented the most papers at IEDM 2004? How productive were other companies, academic and research institutions?

To answer this question, the following rules were applied. Only those sessions relevant to the mainstream IC industry were included in this tally. This means out of total 42 sessions and a late news session, 13 sessions were excluded from the tally. For each paper, one point was given to the lead author company or institution and a half point was given to each co-author company or institution.

Now the tally is in.

Samsung tops the list with 21.5 point, easily surpassing number two IBM, which scored 16.5 points. Samsung's score came from 21 papers of its own and one jointly authored paper with IBM. STMicro and Toshiba take the next two spots with 12 and 11 points, respectively. Intel, the largest IC manufacturer, is ranked 5th with a score of 8.

So, what's the correlation between the revenue and the productivity at the IEDM? Or is there a correlation? The table below shows a list of 2004 top-10 semiconductor manufacturers based on IC Insights 2004 revenue projection and the number of papers they presented at IEDM 2004.

1. Intel	8
2. Samsung	21.5
3. TI	3
4. Renesas	3
5. Infineon	7.5
6. Toshiba	11
7. STMicro	12
8. TSMC	4.5
9. NEC	5.5
10. Freescale	4.5

IBM is missing in the above table because its Microelectronics division is not ranked among the top-10 merchant semiconductor manufacturers. Between the 11th and 20th rankings, Philips (ranked 11 th) got 11, Fujitsu had 5 and Sony scored 2.5. Other notables: AMD/Spansion got 0.5, Hynix also scored 0.5. Micron did not score. Overall, there does not seem to be much correlation between the revenue and productivity at IEDM. However, you can tell which companies take it more seriously to present research results in conferences such as IEDM.

Among research and academic institutions, European research institutions were most productive with CEA-LETI and IMEC leading the chart with scores of 7.5 and 7 respectively (see chart below.) A strong performance by National University of Singapore earned them a score of 6, an indication of government support and emphasis on semiconductor research in this Southeast Asian city state. See below for a score chart (in random order) for selected research and academic institutions.

CEA-LETI (France)	7.5
IMEC (Belgium)	7
ISMT (US)	2
ASET (Japan)	3
AIST (Japan)	2
Selete (Japan)	4
National University of Singapore	6
Stanford University	4.5

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University of California, Berkeley	3
University of Texas, Austin	5
Purdue University	3.5
National Chia Tung University	4.5

The overall top-10 list for the number of papers presented at IEDM 2004 looks like this.

1. Samsung	21.5
2. IBM	16.5
3. STMicro	12
4. Toshiba	11
5. Intel	8
6. Infineon	7.5
6. CEA-LETI	7.5
8. IMEC	7
9. National University of Singapore	6
10.NEC	5.5

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Analysis and comments on key presentations

65nm Logic Technology by Intel (p.657)

Intel continues its trend of record-breaking transistor performance at the 65nm node. The saturated drain currents are 1.46mA/um for NMOS and 0.88mA/um for PMOS at V_{dd}=1.2V and at I_{off} of 100nA/um. After having scaled its gate oxide thickness aggressively in the past, Intel hit a wall because of gate leakage. Physical nitrided gate oxide thickness remains at 1.2nm, same as that of 90nm node. This allows Intel to continue using V_{dd}=1.2V at 65nm node, which is good for performance, but it now needs a better power management. Despite good transistor performance, ring oscillator stage delay was not disclosed, suggesting there's more work to do to integrate NFET and PFET together. This paper, as in the past, did not reveal much technical details, making it look more like a marketing material.

Customer Oriented Foundry Technology by SMIC (p.673)

This is an invited paper from SMIC on its 130nm and 90nm technology. Who would have imagined a company founded in April 2000 in China would deliver an invited paper at IEDM 2004? SMIC did just that and in doing so, SMIC declared China has officially entered sub-100nm era. As SMIC put it, this is a result of good planning, execution and a close collaboration with an established company. Customer-oriented technology portfolio includes copper backend processing for IDMs that do not have copper process capability, either with FSG or low-k. SMIC noted majority in its customer survey did not have an interest in low-k for copper processing.

Dual Stress Liner Process by IBM and AMD (p.1075)

For the first time, IBM and AMD demonstrated NFET and PFET improvement using tensile (for NFET) and compressive liner (for PFET). Performance improvement is impressive considering this is a lower-cost alternative to the strained-silicon channel using SiGe. Because of this, this late paper received some media attention. Saturated drain current improved by 11% for NFET and 20% for PFET. This process is used in 90nm production at IBM and AMD. Despite performance improvement, it lags Intel 90nm transistor performance.

8Gb MLC Flash Memory Technology by Samsung (p.873)

Continuing its leadership position in NAND flash memory, Samsung presented 8Gb MLC NAND, the first in the industry. It features the smallest cell size reported, 0.0164um**2. Patterened by ArF lithography and PSM, the line and space of word line are 63nm each, letting Samsung call it a 63nm technology, beating industry-standard technology node 65nm by 2nm. This is essentially a 65nm technology that Samsung plans to bring into production in 2006.

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**IEDM 2004 celebrates 50th anniversary.
STOL, Nov. 2004**

This year marks the 50th anniversary of International Electron Devices Meeting (IEDM). To celebrate 50th anniversary, IEDM features special events when it holds an annual meeting from Dec. 13 to 15 in San Francisco. Conference attendees will receive a DVD containing the technical digest contents for the past 50 years. There will be a special reception and historic-paper poster exhibit on Monday evening. On Dec. 14, Dr. Richard E. Smalley, Rice University Professor and 1996 Nobel laureate in Chemistry will speak at the IEDM Tuesday Luncheon.

During the past 50 years IEDM has served as a premier forum for the semiconductor technology innovation. 1950's was the dawn of the solid state electronics after the invention of transistor in 1948 by Bardeen, Brattain and Shockley at Bell Labs. The invention of the integrated circuits in 1958 by Jack Kilby at TI ushered in an era of the integrated circuits in 1960's that has since revolutionized the electronics industry. 1970's brought in the proliferation of MOS technology. As a result of continued innovation in MOS technology, integrated circuits evolved since 1980's from LSI to VLSI to USLI.

As IEDM celebrates 50 th anniversary this year, we are at a critical juncture in silicon technology innovation. It used to be that the scaling of MOS technology increased circuit density and device performance simultaneously. Every 18 months or so, the number of transistors in a single chip increased by two-folds along with improved transistor switching speed – commonly known as Moore's law.

Not any more though, or at least it has become difficult to achieve performance improvement as MOS devices approach scaling limits. Strained silicon and high k gate dielectric are the hottest agenda today to overcome this difficulty. Strained silicon research is yielding good results and are being implemented in manufacturing process. High k dielectric is still a work in progress. Development of manufacturing-worthy high k dielectric has not been easy as it deals with heart and soul of MOS transistor - gate dielectric. In fact, the whole gate stack needs to be re-engineered in conjunction with high k dielectric development.

IEDM 2004 program reflects these current technological challenges. Two sessions have been set up for strained silicon and also for high k. In addition, there's a one session dedicated to metal gate engineering. Flash memory technology, another hot item in recent years, also gets two sessions.

For short summaries of each paper, visit IEDM home page at www.ieee.org/conference/iedm.

To post your technical questions or to share opinions on IEDM 2004 conference papers, click on "Go to Open Forum."

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