

NRI TPG/GC internal use only – do not distribute

NRI TPG Teleconference

Wednesday, September 1, 2010

4:00-6:00p Eastern / 3:00-5:00p Central / 2:00-4:00p Mountain / 1:00-3:00p Pacific

Attendees:

Jeff Welser (NRI)

Allison Hilbert (NRI)

Steve Kramer (Micron)

Luigi Colombo (TI)

Andrew Marshall (TI)

Zoran Krivokapic (GF)

C.Y Sung (IBM)

Tak Ning (IBM)

Steve Hillenius (SRC)

Robert Chau (Intel)

*****Please refer to charts shown in WebEx. They are on the NRI website, under Advisory Boards on right nav, click on Technical Program Group, then click on Meeting Results tab*****

Agenda:

GIT & UCLA Disclosure Review

Self-aligned formation of graphene waveguided structure

IP-1060 / GIT-5332: Y. Yang, R. Murali

Using a doping technique that results in a pnp wave guide

- Implementation: GNR with rough-edges covered by HSQ in the middle region and by weakly cross-linked HSQ at the edges
- Advantages
 - Avoids the use of multiple masking steps
 - Self-aligned method means no need for expensive alignment techniques
 - Method is applicable not only for pn waveguide structures but also for creation of passivated edges (e.g. by using hydrogenation)
- Disadvantages
 - Unclear timeline of when pn waveguides in graphene will become relevant (don't want to patent too early)
 - Tough to enforce patents of this nature (how to prove that a competitor is using resist-trimming to create wave-guided graphene ribbons?)
- Claims
 - Novel structures (graphene waveguides) can be created by using a previously known process (resist trimming)
 - pnp graphene waveguides are not novel, but the structure with hydrogenated/fluorinated edge regions is novel, as are some of the design parameters and specific e-beam/photo-resist interactions

Discussion:

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Technique was found potentially interesting, and one company expressed interest in patenting, but others were concerned about uniqueness as well as defensibility (it is a process patent that would be very hard to detect, as pointed out by the authors as well).

Jeff: Not hearing strong opinions one way or the other, and given the concerns on whether it would be patentable and defensible, we should pass on this one and encourage the authors to publish it instead.

Epitaxial Growth Of Single Crystalline MgO On Germanium

P-1187 / UCLA-2010-244: K. Wang & Y. Zhou; R. Kawakami & W. Han (UCR)

- **Background:**
 - Ge surface has large density of dangling bonds which creates traps and degrades the Ge MOSFET performance.
 - MgO is known as a good tunneling oxide for spin injection due to the special symmetry induced spin filtering.
 - There is no previous demonstration of epitaxy of MgO on Ge. Spin injection in Ge has remained elusive.
- **Implementation:**
 - Epitaxial growth of MgO on Ge using molecular beam epitaxy. An optimal growth condition yields single crystalline, atomically smooth MgO on Ge, with a unique 45 degree rotation of the MgO unit cell with respect to that of Ge.
- **Advantages:**
 - The MgO reduces the density of dangling bonds at Ge, depins the Fermi level [Y. Zhou et al. APL 96, 102103 (2010)] and forms a homogenous, high-k passivation layer for Ge MOSFET application.
 - In combination with the use of bcc ferromagnetic metals (Fe, Co) with single crystal MgO, spin injection efficiency will be enhanced due to symmetry induced spin filtering. [We have recently achieved spin injection into Ge for the first time at room temperature. The manuscript to be submitted.]
- **Disadvantages:**
 - Requires an ultrahigh clean system to have good epitaxial growth.
- **Claims:**
 - A successful demonstration of epitaxial growth of single crystalline and atomically smooth MgO on Ge
 - A successful demo of passivating the Ge surface by using as-grown MgO.
 - The use of Ferromagnetic film(s)/MgO/Ge for spin injection for Ge
 - Layered Ge substrate in combination of FM/MgO for efficient spin injection
 - A successful demonstration of spin injection into Ge by using as grown Fe/MgO junction on Ge.

Discussion:

Luigi sent several documents expressing concern that (1) it may have already been disclosed by a subset of the authors in 2006 and (2) not clear it is patentable as just an MgO/Ge layer structure, since there are already related patents as well as very similar publications.

Much discussion on how unique and patentable this really is – most agreed it would only be patentable if it were linked to a specific device structure or had much more specific process claims. Note a provisional has already been filed by UCLA, which expires in October.

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Jeff will get back to Kang this afternoon, sending Luigi's documents and all the questions on the prior art & disclosures; other similar patents; and a request to send in a more narrow set of specific claims, likely linked to a device structure. Will send a note to the TPG with the responses so we can decide by email before the next meeting.

New NRI-NSF Liaison Teams

Received new liaison team members from Intel and IBM already. During and just after the meeting, also got responses from Micron and GF. All teams now have leaders, but still need liaisons assigned from TI & and NIST.

Jeff will follow-up by email.

Want teams to have WebEx meetings before the Annual Review. The new PI's are all coming and it would be nice if they knew their team ahead of time.

New Potential NSF-NRI Partnership

- NRI-NSF preparing a joint solicitation to support the NNI's Signature Initiative on "Nanoelectronics for 2020 and Beyond"
 - Three NSF Directorates: Engineering (ENG), Mathematical and Physical Sciences (MPS), and Computer & Information Science & Engineering (CISE)
 - Three primary thrusts, building off NRI's mission and recent NSF workshop on "*Interdisciplinary Challenges beyond the Scaling Limits of Moore's Law.*"
 - Exploring New Chemistries and Materials for Nanoelectronics
 - Exploring Alternative State Variables and Heterogeneous Integration for Nanoelectronic Devices and Systems
 - Exploring Novel Paradigms of Computing
- Awards will be for Nanoscale Interdisciplinary Research Teams (NIRTs)
 - NIRT is typically a small university team (3-4 PI's) working on a joint research project, where the members must come from more than one discipline
 - Total funding: \$20.1M over 4 years
 - NSF funds: \$18.1M
 - NRI funds: \$2M grants (replaces NSEC supplements for 2011-12)
 - Award size is ~\$1-2M per team over 4 years (\$250-500K/yr) → 10-15 awards

A great opportunity to be involved with this at only 10% of the cost.

- Solicitation Schedule:
 - Program Solicitation Dissemination September 2010
 - Proposal deadline January 19, 2011
 - Proposal Panels April/May 2011
 - Jackets to DGA June 2011
 - Date of awards August 2011
- NRI-NSF Joint Management Plan for award selection
 - NRI will help identify industry reviewers for the panels
 - NSF Program Officers and NRI Director will consult on recommendations for funding proposals
 - NSF and NRI retain final decisions on where their funds are spent
 - NRI can choose to jointly fund all or some of the proposals selected
- NRI and NSF will jointly oversee the jointly-funded NIRTs

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- Annual reports to be delivered to NSF and NRI
- Submission of all publications to NRI website
- Annual visit from NRI Liaison Team
- Participation in the NRI annual review

This is in process, should come out shortly. Once we see the proposal come out, we want to work with our universities to get them to apply for these.

Discussion:

C.Y: Should we gather more flowers or plant more seeds?

Jeff: probably the latter. Doesn't make sense to have them support what's already going on in the Centers. NSF proposals tend to be more in the "1000 flowers bloom" mode.

Zoran: End of the NSF-NRI supplement to the NSEC/MRSEC centers?

Jeff: The current projects will continue of course, but the NSECs and MRSECs program at NSF will be ending. If they ever want to start them up again, we would be interested.

Since this has not been publicly announced, we need to be careful about talking about it. Jeff will be sending a confidential draft of the NIRT joint solicitation shortly – if you have comments, let Jeff know.

nanoSTAR Center at UVA

VO2 Switch Research Approved

- Will treat it like an MRSEC Center. We will use the same liaison team we have in place. There will be an annual visit to them, they will come to the NRI Annual Review, etc.
- More matching coming from state & university:
 - VO2 Switch Research Program:
 - ~~\$1.2M~~ \$1.6M over 2 years : \$400K NRI / ~~\$800K~~ \$1.2M state & university matching
 - Will be reviewed by UVA Liaison team – combined with nanoSTAR Annual Review

Metrics on NRI Students Graduates/Hires 2007-2009

- The number of NRI graduates increased slightly in the third year of the program to make a total of 33 graduates over the 3 year period. NRI Students are part of all SRC events, TECHCON, etc.
- 72% of NRI graduates have joined member companies, government agencies or universities over the 3 year period – slightly better than the other SRC entities currently.
- *Students by Center.* Seven of the 16 graduates were in the WIN Center, and 5 in the MIND Center. Current students are relatively evenly distributed across the Centers.

Students need to be registered in order to show up, this is a function of the Center and WIN and MIND are better at it than INDEX and SWAN so far – will encourage them all to do better!.

- *Students by Discipline.* 2009 graduates were primarily in EE and Physics/Physical Sciences. The current population is heavily weighted toward EEs with a higher percentage of Physics/Physical Sciences than is typical for SRC student populations.
- *Right-to-Work Status for 2007 -2009 Graduates.* The percentage of graduates with permanent right to work (PRTW) status in the US increased by 19% between 2007 and 2009. The current population at 4/10 is virtually unchanged between 2009 and 2010. NRI does slightly better on this metric than the other programs.

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Discussion:

Luigi: do we know how many graduates went home or to a country outside of the U.S. to work?

Steve H: we probably don't have that info because we don't ask that question.

Jeff will check with Ginny Wiggins on this, and maybe it is something we can ask in the future.

Full set of student metrics is available on the website.

NRI Annual Review Plans

On the NRI Review, the morning of day 3 will be the discussions with the Center Directors on their Phase 1.5 proposals, so please be sure to plan to stay through that day.

Overview of NRI TPG Page

One-stop shopping for all your NRI TPG needs!

<http://www.src.org/program/nri/advisory-board/tpg/>

See PDF for more details on what is contained on this page – and if you have suggestions for additional items, let Allison know.

Open Mic

No comments

Meeting adjourned.

Next NRI TPG meeting is currently scheduled for:

Date: Wednesday, October 6, 2010

Time: 4-6p Eastern / 3-5p Central / 2-4p Mountain / 1-3p Pacific