Dr. Ariel Ismach

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Personal:

Date of birth: January 12th, 1973
Place of birth: Buenos Aires, Argentina
Arrival in Israel: June 6th, 1988
Army service: August 1992 – August 1995. Sargent (tank commander) in the Armor forces.
Status: Married + 1

Education:

- B.Sc. in Materials Science and Engineering-Electronic Materials Program. Ben-Gurion University, Beer-Sheva, Israel, 10.2001.

- M.Sc in Chemistry. Weizmann Institute of Science, Materials and Interfaces Department, Rehovot, Israel 10.2003.
  Thesis: "Atomic-Step Decoration by Single-Wall Carbon Nanotubes"
  Advisor: Prof. Ernesto Joselevich

- PhD in Chemistry. Weizmann Institute of Science, Materials and Interfaces Department, Rehovot, Israel 10.2008.
  Thesis: "Carbon Nanotube Orientational Epitaxy: Concept, Characterization and Nanoscale Devices"
  Advisor: Prof. Ernesto Joselevich
  Outstanding PhD student prize from the Israel Chemical Society, 03.2008.

Working Exerience:

- Postdoctoral Research Fellow, Lawrence Berkeley National Laboratory and University of California at Berkeley, Berkeley CA, 12.2008 - 03.2011.
  Topic: "Carbon nanotubes and graphene for advanced electronic devices"
  Advisors: Dr. Yuegang Zhang and Prof. Jeffrey Bokor.

- Senior Postdoctoral Fellow, University of Texas at Austin, Austin TX, **04.15.2011** - **Present**.
  Topic: "Synthesis and characterization of graphene and hexagonal Boron Nitride"
  Advisor: Prof. Rodney Ruoff.

- Senior Lecturer (equivalent to Assistant Professor in the US), Dept. of Materials Science and Engineering, Tel Aviv University (Position starts in October 2014).

Research Interests

- Synthesis of nanomaterials
- Developing of synthetic methodologies for the controllable growth of 2D layered materials
- Growth mechanism of atomic-thin films
- Atomic-thin heterojunctions and superlattices
- Nanomaterial - hybrid systems

- Nanofabrication and nanocharacterization
- Electronic, optical and thermal applications

Research and Work Experience

Quality assurance assistance, Applied Materials Ltd., Rehovot, Israel. **04.2000 – 09.2001**

- Designed and performed QA protocols for the system analysis of a wafer inspection machine, called “Excite”, for the microtechnology industry.
- Collaborated with the algorithm team and system engineers during the designing of the QA protocols for the different configurations and applications of the system.

M.Sc. and Ph.D., Weizmann Institute of Science, Materials and Interfaces Department, Rehovot, Israel. **10.2001-10.2008**.

- Developed a new method for the self-assembly of single-wall carbon nanotubes (SWNTs) into complex morphologies. **Research resulted in various publications in highly rated peer reviewed journals**, such as *Nature Nanotechnology*, *Nano Letters, Angewandte Chemie International Edition, Journal of the American Chemical Society, etc.*
- Designed, fabricated nanoscale devices and performed electrical measurements on SWNTs.
- Characterized the SWNT nanostructures by means of scanning probe microscopy methods (atomic force microscopy, AFM, electrostatic force microscopy, EFM, scanning gate microscopy, SGM, etc.).
- Installed and maintained a nanopattern generation system (NPGS-electron beam lithography system). Managed, maintained and trained new researchers and students.
- Worked with a team to develop a new technique for the nanopatterning of nanoparticles and molecules. **Research resulted in a paper and a patent application**.
- Leaded research team: worked with 9 interns and 6 master students in subprojects related to my research plan.

Postdoctoral Research Fellow, Lawrence Berkeley National Laboratory and University of California at Berkeley, Berkeley CA, **12.2008-03.2011**.

- Developed new method for direct chemical vapor deposition (CVD) of graphene on dielectric substrates. ***Research resulted in 3 papers (1 in preparation) and a patent application.***
- Developed new strategies for large-scale graphene nanoribbon fabrication for nanoelectronics.
- Designed, fabricated and characterized graphene-based electronic devices. ***Research resulted in 2 papers.***
- Worked with team to develop new graphene-based materials for energy applications (battery and supercapacitors). ***Research resulted in a paper and patent application.***
- Was in charge of a PECVD system for wafer-scale synthesis of carbon nanotubes and graphene (new capability at the Molecular Foundry). Including synthesis optimization and user training.
- Built and established 2 new low pressure CVD systems for the synthesis of graphene.

Senior Postdoctoral Fellow, University of Texas at Austin, Austin TX, **04.15.2011** - **Present**.

- Developing new synthetic methods for the production of large-scale and high-quality graphene thin films **(*Ongoing research with 2 papers submitted*)**.

- Synthesis of large-scale hexagonal Boron Nitride (h-BN) and h-BN / graphene stacked layers for electronic and optoelectronic applications **(*Ongoing research with 1 published paper and another 2 in preparation*)**.
- Thermal and electrical characterization of graphene and h-BN films.
- Study of 2D materials growth mechanism.
- Supervising 1 visiting scientist, 3 graduate and 5 undergraduate students.
- In charge of several systems, including 2 hot-wall low-pressure CVD systems.
- Writing proposals and reports as needed (leaded the efforts of four groups at UT Austin in the writing of a white paper to the Office of Naval Research, participated in the writing of proposals and reports for a variety of projects and presented results in on-site reviews).

Associations and Awards

- Dean's List of Excellency, 1999 (2^{nd} year of B.Sc.).
- Student best poster presentation, Israel Vacuum Society, 2004.
- Student best poster presentation, Israel Chemical Society, 2006.
- Student best poster presentation, Israel Chemical Society, 2007.
- Student best poster presentation, Israel Vacuum Society, 2007.
- Outstanding Ph.D. student prize, Israel Chemical Society, 2008.
- Member of the Materials Research Society.

Languages

- Spanish (mother tongue)
- Hebrew (mother tongue)
- English (fluent)

Peer Reviewing Journals and Proposal Evaluation

- *Journal of the American Chemical Society*
- *Nano Letters*
- *ACS Nano*
- *Scientific Reports*
- *Journal of Vacuum Science and Technology*
- *Carbon*
- *Journal of Materials Science*
- *Materials Science and Engineering B*
- *MRS Proceedings*
- *Proposal evaluation for the Austrian Science Fund*

Patents

1 PRODUCING AN ARRAY OF NANOSCALE STRUCTURES ON A SUBSTRATE SURFACE VIA A SELF-ASSEMBLED TEMPLATE
Inventors:
E. Joselevich, R. Gabai and **A. Ismach**.
Weizmann Institute of Science, through Yeda Ltd., Rehovot 76100, Israel, **2007**.

2 DIRECT CHEMICAL VAPOR DEPOSITION OF GRAPHENE FILMS ON INSULATING SUBSTRATES
Inventors: Y. Zhang and **A. Ismach**.
Patent number 8,709,881, issued on April 29, 2014. Lawrence Berkeley National Laboratory.

3 METHOD TO PREPARE GRAPHENE/SILICON MULTILAYER STRUCTURES FOR ENHANCED LITHIUM STORAGE
Inventors: Y. Zhang, L. Ji and **A. Ismach**.
Patent application number US2012/029274, filed March 15, 2012. Lawrence Berkeley National Laboratory.

Participation in Scientific Meetings

Conference Abstracts

1 **2004** *Materials Research Society Fall Meeting* (Boston, USA).
Atomic-Step-Templated Formation of SWNTs Patterns (talk).

2 **2005** *Scanning Probe Microscopy Israel* (Holon, Israel).
Atomic-Step Templated Formation of SWNTs Patterns (poster).

3 **2005** *Israel Chemical Society Meeting* (Tel-Aviv, Israel).
Atomic-Step Templated Formation of SWNTs Patterns (poster).

4 **2005** *Israel Vacuum Society Meeting* (Tel-Aviv, Israel). Atomic-Step Templated Formation of SWNTs Patterns (poster - student poster award).

5 **2006** *The Jubilee Nanotechnology Symposium.* (Ramat Gan, Israel)**.**
Carbon Nanotube Graphoepitaxy (poster).

6 **2006** *Israel Vacuum Society Meeting* (Tel-Aviv, Israel).
Carbon Nanotube Graphoepitaxy (poster).

7 **2006** *France-Israel Symposium on Diamond, Carbon Nanostructures and Related Materials* (Ein Bokek, Israel). Carbon Nanotube Graphoepitaxy (poster).

8 **2006** *Israel Chemical Society Meeting* (Tel-Aviv, Israel).
Carbon Nanotube Graphoepitaxy (poster - student poster award).

9 **2007** *The 13th Israel Materials Engineering Conference* (Technion, Haifa, Israel).
Nanotube Epitaxy (talk).

10 **2007** *Israel Vacuum Society Meeting* (Hertzlia, Israel).
Self-Organized Nanotube Serpentines (poster - student poster award).

11 **2007** *Euroconference on Electronic Properties of Nobel Materials- Molecular Nanostructures* (Kirchberg, Austria). Carbon Nanotube Epitaxy (poster).

12 **2007** *Israel Chemical Society Meeting* (Tel-Aviv, Israel).
Nanotube Serpentines (poster - student poster award).

13 **2007** *Israel Vacuum Society Meeting* (Hertzlia, Israel).
Carbon Nanotube Epitaxy (talk).

14 **2007** *Minerva Symposium in Nano-Macro and Supra-Molecular Materials and Phenomena for outstanding PhD. students* (Chafetz Haim, Israel).
Carbon Nanotube Epitaxy (talk).

15 **2008** *Israel Chemical Society Meeting* (Jerusalem, Israel).
Nanotube Epitaxy (poster).

16 **2008** *Materials Research Society Spring Meeting* (San Francisco, CA, USA).
Self-Organization of Complex Nanotube Structures by Combined Epitaxial Growth and External Forces (talk).

17 **2008** *RBNI Winter School: Topics in Nanoscience and Nanotechnology* (Dead Sea, Israel).
Nanotube Epitaxy (poster).

18 **2010** *American Physical Society March Meeting* (Portland, OR, USA).
Direct Chemical Vapor Deposition of Graphene Films on Dielectric Substrates (talk).

19 **2011** The South West Academy of Nanoelectronics (SWAN) *Project on-site Review.* (Austin, TX, USA)
Towards Large Area CVD Synthesis of Hexagonal Boron Nitride (h-BN) Films (talk).

20 **2012** The South West Academy of Nanoelectronics (SWAN) *Project on-site Review.* (Austin, TX, USA)
Towards Large Area CVD Synthesis of Hexagonal Boron Nitride (h-BN) Films (poster).

21 **2013** Materials Research Society Spring Meeting (San Francisco, CA, USA).
Growth Studies of Thin h-BN and Stacked h-BN/Few-Layer Graphene Films: Towards Large-Scale Functional Devices (talk).

Invited Talks and Keynote Speaker

1 **2012** *American Vacuum Society, Texas Chapter.* (Dallas, TX, USA)
The Synthesis of 2D Materials: The case of Graphene and h-BN. (**Keynote speaker**).

2 **2012** *2D Materials Beyond Graphene Workshop.* (Columbus, Ohio, USA)
The Synthesis of 2D Materials: The case of Graphene and h-BN (**Invited Talk**).

3 **2013** The Minerals, Metals and Materials Society. (San Antonio, TX, USA)
Graphene-Based and Graphene-Derived Materials (**Invited Talk**).

4 **2014** IEEE Nano. (Toronto, Canada)
Synthesis and Characterization of 2D Materials: The case of h-BN (**Invited Talk**).

Seminars

1 **2008** *Basel University, Nanoelectronics Group (Swizterland).*
Epitaxial Approaches to Nanotube Organization.

2 **2008** *Caltech, Division of Chemistry and Chemical Engineering, (Pasadena, USA).*
Epitaxial Approaches to Nanotube Organization.

3 **2008** *IBM, Watson Research Center, Nanoscience and Technology Group (New York, USA).*
Epitaxial Approaches to Carbon Nanotube Organization.

4 **2009** *Lawrence Berkeley National Laboratory, MSD, Molecular Foundry, Nanofabrication Group (Berkeley, USA).*
Carbon Nanotubes and Graphene: Assembly and Devices.

5 **2010** *Graphenea, NanoGUNE Research Center (San Sebastian, Spain).*
From Chemical Vapor Deposition of Continuous Graphene Layers to nanostructures.

6 **2011** *University of Texas at Austin.*
Direct Chemical Vapor Deposition of Graphene Films on Dielectric Substrates.

7 **2011** *Weizmann Institute of Science, Materials and Interfaces Department Seminar.*
Graphene: From Continuous Layers to Nanostructures.

8 **2011** *Tel Aviv University, Chemistry Department Seminar.*
The Synthesis of 2D Materials: The case of Graphene and h-BN

9 **2011** *Tel Aviv University, Electronic Engineering Department Seminar.*
The Synthesis of 2D Materials: The case of Graphene and h-BN

10 **2011** *Technion, Physical Chemistry Department Seminar.*
The Synthesis of 2D Materials: The case of Graphene and h-BN

11 **2011** *Hebrew University, Chemistry Department Seminar.*
The Synthesis of 2D Materials: The case of Graphene and h-BN

12 **2011** *Technion, Materials Engineering Department Seminar.*
The Synthesis of 2D Materials: The case of Graphene and h-BN

13 **2011** *Ben Gurion University, Nanocenter Seminar.*
The Synthesis of 2D Materials: The case of Graphene and h-BN

14 **2013** *Tel Aviv University, Faculty of Engineering.*
2D Atomic Films: Synthesis and Characterization

List of Publications

Refereed Journals: Total citations: 861, h-index: 14

1 M. Souza, A. Jorio, C. Fantini, B. R. A. Neves, M. A. Pimenta, R. Saito, **A. Ismach**, E. Joselevich, V. W. Brar, Ge. G. Samsonidze, G. Dresselhaus and M. S. Dresselhaus.
Single- and double-resonance Raman *G*-band process in carbon nanotubes
Physical Review B, **2004**, *69*, 241403-241407 **(IF= 3.767, 29 citations)**

2 **A. Ismach**, L. Segev, E. Wachtel & E. Joselevich.
Atomic Step-Templated Assembly of Single-Wall Carbon Nanotube Patterns
Angewandte Chemie International Edition, **2004**, *43*, 6140-6143 **(IF= 13.734, 139 citations)**
(Cover of *Angewandte Chemie*, November 17th; Press release by *Angew. Chem.*; Highlights in *Chemistry World* and *Small*)

3 **A. Ismach**, D. Kantorovich and E. Joselevich.
Carbon Nanotube Graphoepitaxy: Highly Oriented Growth by Faceted Nanosteps
Journal of the American Chemical Society **2005**, *127*, 11554-11555 **(IF= 10.677, 78 citations)**

4 **A. Ismach** and E. Joselevich.
Orthogonal Self-Assembly of Carbon Nanotube Crossbar Architectures by Simultaneous Graphoepitaxy and Electric Field-Directed Growth
Nano Letters **2006**, *6*, 1706-1710 **(IF= 13.025, 64 citations)**

5 R. Gabai, **A. Ismach** and E. Joselevich
Nanofacet Lithography: A New Bottom-Up Approach to Nanopatterning and Nanofabrication by Soft Replication of Spontaneously Faceted Crystal Surfaces
Advanced Materials **2006**, *19*, 1325-1330 **(IF=14.829, 13 citations)**

6 N. Geblinger*****, **A. Ismach*** and E. Joselevich.
Self-Organized Nanotube Serpentines
Nature Nanotechnology **2008**, *3,* 195-200 **(IF=31.170, 55 citations)**
(Cover of *Nature Nanotechnology*) * These authors contributed equally to this work.

7 L.G Cancado, A. Jorio, **A. Ismach**, E. Joselevich, A. Hartschuh, L. Novotny
Mechanism of Near-Field Raman Enhancement in One-Dimensional Systems
Physical Review Letters **2009,** 106, 186101-186104 **(IF=7.943, 26 citations)**

8 X. Liang, V. Giacometti, **A. Ismach**, B.D. Harteneck, D.L. Olynick, and S. Cabrini
Roller-Style Electrostatic Printing of Prepatterned Few-Layer-Graphenes
Applied Physics Letters **2010**, 96, 0131091-0131093 **(IF=3.844, 4 citations)**

9 **A. Ismach,** C. Druzgalski, S. Penwell, M. Zheng, A. Javey, J. Bokor, Y. Zhang
Direct Chemical Vapor Deposition of Graphene on Dielectric Surfaces.
Nano Letters **2010,** 10, 1542-1548 **(IF=13.025, 140 citations)**
One of the top 20 most accessed articles in Nano Letters during 2010.

10 X. Liang, Y. Jung, S. Wu, **A. Ismach**, D.L. Olynick, S. Cabrini, and J. Bokor
Formation of Bandgap and Subbands in Graphene Nanomeshes with Sub-10 nm Ribbon Width Fabricated via Nanoimprint Lithography
Nano Letters **2010,** 10, 2454–2460 **(IF=13.025, 89 citations)**

11 J. Soares, A. P. Barboza, P. Araujo, N. B. Neto, D. Nakabayashi, N. Shadmi, T. Yarden, **A. Ismach**, N. Geblinger, E. Joselevich, C. Vilani, L. Cançado, L. Novotny, G. Dresselhaus, M. S. Dresselhaus, B. R. A. Neves, M. S. C. Mazzoni, A. Jorio.
Modulating the Electronic Properties Along Carbon Nanotubes via Tube-Substrate Interaction
Nano Letters **2010**, 10 (12), 5043–5048 **(IF=13.025, 16 citations)**

12 A. Weber-Bargioni, A. Schwartzberg, M. Cornaglia, **A. Ismach**, J.J. Urban, Y. Pang, R. Gordon, D. F. Ogletree, S. Cabrini, P. J. Schuck
Hyperspectral Nanoscale Imaging on Dielectric Substrates with Coaxial Optical Antenna Scan Probes
Nano Letters **2011**, 11 (3), 1201–1207 **(IF=13.025, 45 citations)**

13 L. Ji, **A. Ismach***, H. Zheng*, Z. Tan*, S. Xun, E. Lin, V. Battaglia, and Y. Zhang
Graphene/Silicon Multilayer Structures for Enhanced Lithium Storage
Nano Energy **2012**, 1 (1), 164-171 **(New Journal, 20 citations)**
***** These authors contributed equally to this work

14 **A. Ismach**, H. Chou, D. Ferrer, Y. Wu, H.C. Floresca, S. McDonnell, A. Covacevich, C. Pope, R. Piner, R. Wallace, M. Kim, L. Colombo, R. Ruoff
Towards the Controlled Synthesis of hexagonal Boron Nitride Films
ACS Nano, **2012**, 6 (7), 6378–6385 **(IF=12.062, 25 citations)**
(Highlights in Nanotechweb)

15 C. Hwang, D. Siegel, **A. Ismach**, S.K. Mo, Y. Zhang and A. Lanzara
Fermi velocity engineering in graphene by substrate modification
Scientific Reports 2, 590. DOI:10.1038/srep00590
(Nature Publishing Group - New Journal, IF= 2.927, 18 citations)

16 S. Z. Butler, S.M. Hollen, L. Cao, Y. Cui, J. A. Gupta, H. R. Gutiérrez, T. F. Heinz, S. S. Hong, J. Huang, **A. Ismach**, E. Johnston-Halperin, M. Kuno, V. V. Plashnitsa, R. D. Robinson, R. S. Ruoff, S. Salahuddin, J. Shan, L. Shi, M. G. Spencer, M. Terrones, W. Windl, and J. E. Goldberger
Progress, Challenges, and Opportunities in Two-Dimensional Materials Beyond Graphene
ACS Nano, **2013**, 7 (4), 2898–2926 **(IF=12.062, 98 citations)**

17 X. Kong, H. Ji, R. D. Piner, H. Li, C. W. Magnuson, C. Tan, **A. Ismach**, H. Chou and R. S. Ruoff
Non-destructive and Rapid Evaluation of CVD Graphene by Dark Field Optical Microscopy
Applied Physics Letters, **2013***,* 103, 043119 **(IF=3.817)**

18 R. Piner, H. Li, X. Kong, L. Tao, H. Ji, W. H. Lee, J. W. Suk1, J. Ye, Y. Hao, C.W. Magnuson, **A. Ismach**, D. Akinwande and R.S. Ruoff
Magnetic Inductive Heating, a New Route to Graphene
ACS Nano **(IF=12.062, 2 citations)**

19 N. Shadmi N., N. Geblinger, **A. Ismach** and E. Joselevich
Formation of Ordered vs. Disordered Carbon Nanotube Serpentines on Anisotropic vs. Isotropic Substrates
Submitted to The Journal of Physical Chemistry **(IF=2.771)**

20 Y. Liu, R. Ghosh, D. Wu, **A. Ismach**, R.S. Ruoff and K. Lai
Mesoscale Imperfections in MoS_2 Atomic Layers Grown by Vapor Transport Technique
Submitted to Nano Letters **(IF=13.025)**

Manuscripts in Preparation

1 **A. Ismach**, H. Chou, H. Ji, H.C. Floresca, S. McDonnell, R. Piner, R. Wallace, M. Kim, L. Colombo, R. Ruoff
Direct Synthesis of Few-Layer Graphene/ h-BN Stacks
In preparation

2 **A. Ismach**, H. Chou, P. Mende, S. McDonnell, R. Piner, R. Wallace, R. Feenstra, L. Colombo, R. Ruoff
New Methodologies for the Synthesis and Characterization of mono- and bi-Layer Hexagonal Boron Nitride

3 H. Chou, **A. Ismach** and R. Ruoff
Time of Flight Secondary Ion Mass Spectroscopy as an Effectively Atomic-Probe of Heterostructured Layered Materials