Mark Schvartzman Jun 15, 20

CURRICULUM VITAE

- **Personal Details**

Name:	Mark Schvarztman
Date of birth:	08.04.1974
Work Address:	Department of Materials Engineering, Ben-Gurion University of the Negev, Room 107, Bld. 59, the Marcus Family Campus, Beer-Sheva, 8410501, Israel
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- **Education**

B.A. - 1992 -1995, Technion – the Israel Institute of Technology, Faculty of Chemistry

B.Sc. - 1992 - 1996, Technion – the Israel Institute of Technology, Faculty of Chemical Engineering

M.Sc. - 1999 - 2001, Technion – the Israel Institute of Technology, Faculty of Chemical Engineering
Advisors: Yaron Paz (Chemical Engineering) and Dan Ritter (Electrical Engineering)
Title of Thesis: "Passivation of III-V Semiconductor and their Devices with Organic Self-Assembled Monolayers"

Ph.D. - 2006-2009, Columbia University in the City of New-York, New-York, NY, USA, Department of Chemical Engineering
Advisor: Shalom J. Wind
Title of Thesis: "Nanofabricated Molecular-Scale Devices for the Study of Cytoskeletal Protein Binding Interactions and Their Effect on the Cell Motility"

- **Employment History**

2019 – now	Associate Professor Department of Materials Engineering, Faculty of Engineering Sciences, Ben-Gurion University of the Negev, Beer-Sheva, Israel
2014 - 2019	Senior Lecturer Department of Materials Engineering, Faculty of Engineering Sciences, Ben-Gurion University of the Negev, Beer-Sheva, Israel
2013 - 2014	Senior Intern Department of Materials and Interfaces, Faculty of Chemistry, Weizmann Institute of Science, Rehovot, Israel
2013 - 2014	Postdoctoral Associate Department of Materials and Interfaces, Faculty of Chemistry, Weizmann Institute of Science, Rehovot, Israel
2009 - 2013	Chief Materials Scientist More Energy Ltd, Lod, Israel
2001 - 2004	Process Engineer and Project Leader GWS-Photonics Ltd, Ramat-Gan, Israel

- **Professional Activities**

(a) Positions in Academic Administration

2018 - present	Member of Marketing Committee, Faculty of Engineering, BGU
2016 - present	Member of the Graduate Studies Committee, Dept. of Materials Engineering, BGU
2016 - present	Department Colloquia Coordinator, Dept. of Materials Engineering, BGU
2015 - present	Head of Marketing Committee, Dept. of Materials Engineering, BGU
2014 - present	Member of User Committee, Nanofabrication Center, BGU

(b) Professional Functions outside the University

2020	Grant reviewer – ERA-NET under Horizon 2020
2019	Grant reviewer – Qlife interdisciplinary call – PSL Université Paris
2019	Session Chair - the 63th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication, Minneapolis, MN, USA
2019	Scientific Programme Committee – the 63th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication, Minneapolis, MN, USA
2019	Member of the Organizing Committee and Session Chair - Annual meeting of Israel Chemical Society
2018	Grant Reviewer for Irish Research Council
2018	Session Chair - Nano Israel Conference, Jerusalem, Israel
2018	Scientific Programme Committee – the 62th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication, Puerto-Rico
2017	Israeli representative in European COST Action "Between Atom and Cell: Integrating Molecular Biophysics Approaches for Biology and Healthcare (MOBIEU)" CA15126
2017	Israeli representative in European COST Action "An integrative action for multidisciplinary studies on cellular structural networks" CA15214
2017	Scientific Programme Committee – the 61th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication, Orlando, FL, USA
2016	Grant Reviewer for Israel Science Foundation
2016	Session chair - Annual Meeting of the Israeli Vacuum Society, Beer-Sheva, Israel
2016	Scientific Programme Committee –the 60th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication, Pittsburgh, PA, USA

(c) Significant Professional Consulting

2020	MKS Inc, Ophir Optronics division– Nanoimprinted Antireflective Coatings
2018	Elbit System Ltd – Antireflective Nanostructures on Polymer Lenses
2014 - 2015	RAFAEL, Optical Component Center, Manor – Advanced Defense Technologies: Nanoimprint Lithography for Antireflective Nanostructures

(d) Ad-hoc Reviewer for Journals

- Journal of Vacuum Science and Technology A
- Nanotechnology
- Soft Matter
- RCS Advances
- Chemical Reviews
- Nano letters
- Small
- Nanoscale
- ACS Polymer Materials

(e) Member in Professional/ Scientific Societies

2014 - present	AVS - American Vacuum Society
2014 - present	SPIE - Society of Photo-Optical Instrumentation Engineering
2004 - present	IVS - Israeli Vacuum Society

- **Educational Activities**

(a) Course Taught

- Polymers (Undergraduate)
- Semiconductor Technology (Undergraduate)
- Nanofabrication Processes (Graduate)
- Nanomaterials and their Technologic Uses (Undergraduate)
- Laboratory for Semiconductor Technology (Undergraduate)

(b) Research Students and Postdocs:

Master Students

2014 - 2016	Liran Menahem, Thesis Title: "New Approaches for Hybrid Nano Imprint Lithography Molds"
2015 - 2017	Avichai Markovici, Thesis title: "Directed Assembly of Nanodumbbells via Nano-lithographic Docking"
2015 - 2017	Yossi Keidar, Thesis title: "Nano-Biomimetic Devices for the Regulation and Study of Signal Integration in NK Cells"
2015 - 2018	Netanel Barhanin, Thesis Title: "Surface Functionalization of Nanowires for Biological Applications"
2015 - 2016	Andrey Nazarov, (Jointly supervised with Ibrahim Abdulhalim, Electro-optical Engineering), Thesis title: "Assessment of intraocular pressure sensing using an implanted reflective flexible membrane

2016 - 2018	Dor Yehuda, Thesis Title: "Nanoimprinted Antireflective Micro and Nanostructures on Optical Surfaces of Chalcogenide Glasses"
2017 - 2019	Esti Toledo, Thesis Title: "Multifunctional devices for the regulation of cytotoxic activity of natural killer cells"
2018 - present	Sivan Tzdaka , (expected graduation – summer 2020)
2018 - present	Lital Mordechai , (expected graduation – summer 2020)

PhD Students

2016 - present	Natali Ostrovsky, (expected graduation – fall 2020)
2016 - present	Viraj Bhingadrive, (expected graduation – fall 2020)
2017 - present	Ashish Pandey, Ph.D student (expected graduation – fall 2022)
2017 - present	Esti Toledo, M.Sc. Student (expected graduation – fall 2023)

Postdocs

2106 - present	Guillaume Le Saux, Postdoc

(c) External M.Sc Students (without thesis)

2015 - 2016	Oren Ben-Nun, M.Sc Student (without thesis), Project title: "Air Gap Structures formation Using PECVD"
2015 - 2016	Natali Ashkenazi, M.Sc Student (without thesis), Project title: "Lithography methods for fabricating "Moth-eye" antireflective structures on curved surfaces"
2106 - 2017	Tsoof Sivan, M.Sc Student (without thesis), Project title: "Plasma Etching of Three-Dimensional Curved Silicon"
2017-2018	Angela Irmiyahu, M.Sc. Student (without thesis), Project Title: "Nano Probing To Identify Failure Root Cause of Electronic Devices"

- **Awards and Fellowships**

2019	Toronto Prize for Excellent Researchers in the Early Stage of Academic Career
2013	Ultratech/Cambridge NanoTech Best Paper Award for the year 2013
2009	Dean Fellowship - Faculty of Chemistry, Weizmann Institute of Science
2008	Best Invited Poster Award - The 52nd Int. Conference of Electron, Ion and Photon Beam Technology and Nanofabrication
1995	Dean List, Faculty of Chemistry, Technion

- **Scientific Publications**
  (a) H-index : 13 (ISI), 13 (Google Scholar),
  (b) Total # of Citations : 748 (ISI), 926 (Google Scholar),
  (c) Total # of Citation Excluding Self-Citations: 695 (ISI), 873 (Google Scholar),
  (d) Referred Articles in Scientific Journals:

[S] - *Student*, [PD] - *Postdoc*, [T] - *Technician*, [C] - *Collaborator*, [PI] - *Principal Investigator*

1. S. Gosh-Mukerji[PD], H Haick[S], **M Schvartzman**[S], and Y Paz[PI], " Selective Photocatalysis by means of molecular Recognition" **J. Am. Chem. Soc.,** 123 (43), 10776 (2001) [times cited: 68, IF = 14.4; 6/449; Q1]
2. **M. Schvartzman**[S], V. Sidorov[S], D. Ritter[PI], and Y. Paz[PI], "Surface Passivation of (100) InP by Organic Thiols and Polyimide as Characterized by Steady-State Photoluminescence" **Semicond. Sci. Technol**., 16, L68 (2001) [times cited: 32, IF = 2.28; 51/503]
3. **M. Schvartzman**[S], V. Sidorov[S], D. Ritter[PI], and Y. Paz[PI], " Passivation of InP Surfaces of Electronic Devices by Organothiolated Self-Assembled Monolayers" **J. Vac. Sci. Technol. B**, 21 (1), 148 (2003) [times cited: 30, IF = 1.3; 108/317, Q2]
4. **M. Schvartzman**[S], A. Mathur[S], Y. Kang[T] , C. Jahnes[C], J. Hone[PI], and S.J. Wind[PI], "Fluorinated Diamondlike Carbon Templates for High Resolution Nanoimprint Lithography" **J. Vac. Sci. Technol. B**, 26 (6), 2394 (2008) [times cited: 14, IF = 1.3; 108/317, Q2]
5. **M. Schvartzman[S]**, A. Mathur[S], J. Hone[PI], C. Jahnes [C], and S.J. Wind[PI], "Plasma Fluorination of Carbon-Based Materials for Imprint and Molding Lithographic Applications" **Appl. Phys. Lett.**, 93 (15), 153105 (2008) [times cited: 22, IF=3.5; 125/1731; Q1]
6. **M. Schvartzman[S]**, K.Nguyen[PD] , M. Palma[PD], J. Abramson[S], J. Sable[C], J.Hone[PI], M.P. Sheetz[PI] , and S.J. Wind[PI], "Fabrication of Nanoscale Bioarrays for the Study of Cytoskeletal Protein Binding Interactions Using Nanoimprint Lithography" **J. Vac. Sci. Technol. B**, 27 (1) , 61 (2009) [times cited: 16, IF = 1.3; 108/317, Q2]
7. **M. Schvartzman**[S] and S. J. Wind[PI], "Plasma Fluorination of Diamondlike Carbon Surfaces: Mechanism and Application to Nanoimprint Lithography" **Nanotechnology**, 20 (14), 145306 (2009) [times cited: 32, IF = 3.4; 171/630; Q1]
8. **M. Schvartzman**[S] and S. J. Wind[PI], "Robust Pattern Transfer of Nanoimprinted Features for Sub-5 nm Fabrication", **Nano Lett**., 9 (10), 3629 (2009) [times cited: 37, IF = 12.1; 3/88; Q1]
9. **M. Schvartzman[S]**, M. Palma[PD], J. Sable[C], J. Abramson[S], J. Hu[C], M. P. Sheetz[PI], and S.J. Wind[PI], "Nanolithographic Control of the Spatial Organization of Cellular Adhesion Receptors at the Single-Molecule Level" **Nano Lett**., 11 (3), 1306 (2011) [times cited: 143, IF = 12.1; 3/88, Q1]
10. D. Tsivion[S], **M. Schvartzman[PD],** R. Popovitz-Biro[C], P. von Huth[C], and E. Joselevich[PI], "Guided Growth of Millimeter-Long Horizontal Nanowires with Controlled Orientations" **Science,** 333 (6045), 1003 (2011) [times cited: 161, IF = 37.2; 2/116, Q1]
    * Highlighted in MRS Bulletin 36(10), 734 (2011)
11. D. Tsivion[S], **M. Schvartzman[PD],** R. Popovitz-Biro[C], and E. Joselevich[PI], "Guided Growth of Horizontal ZnO Nanowires with Controlled Orientations on Flat and Faceted Sapphire Surfaces" **ACS Nano**, 6 (7), 6433 (2012) [times cited: 76, *IF = 13.7*; 5/92,; Q1]
12. **M. Schvartzman[PD]**, D. Tsivion[S], D. Mahalu[C], O. Raslin[T], and E. Joselevich[PI], "Self-Integration of Nanowires into Circuits by Guided Growth" **Proc. Nat. Acad. Sci. USA**, 100 (38), 15195

(2013) [times cited: 42, IF = 9.5; 3/116, Q1]
- Highlighted in PNAS Commentary 110 (38), 15171, (2013)
- Received Ultratech/Cambridge NanoTech Best Paper Award for the year 2013

13. L. Goren-Ruck[S], D. Tsivion[S], **M. Schvartzman[PD]**, R. Popovitz-Biro[C], and E. Joselevich[PI], "Guided growth of Horizontal GaN Nanowires on Quartz and their Transfer to Other Substrates" **ACS Nano**, 8 (3), 2838 (2014) [times cited: 19, *IF = 13.7*; 5/92,; Q1]

* 14. L. Menahem[S] and M. **Schvartzman[PI]** "Soft nanoimprint mold with rigid relief features for improved pattern transfer", **J. Vac. Sci. Technol. B** 35, 010602 (2017) [times cited: 2, *IF = 1.3*; 108/317, Q2]

* 15. A. Nazarov[S]. B. Knyazer[C], T Lipfshitz[C], M. **Schvartzman[PI]**, I. Abdulhalim[PI], "Assesment of Intraocular Pressure Sensing Using an Implanted Reflective Flexible Membrane", **J Biomed. Opt.** 22(4) 047001 (2017) [times cited: 2, *IF = 2.9*; 42/503, Q1]

* 16. V. Bhingardive[S] L. Menahem[S], and M. **Schvartzman[PI]**, "Soft Thermal Nanoimprint Lithography by Nanocomposite Mold", **Nano Research** 11(5) 2705 (2018) [times cited: 5, *IF = 8.0*; 16/92, Q1]

* 17. G. Le Saux [PD], A. Edri [S], Y. Keidar [S], U. Hadad [C], A. Porgador [C], **M. Schvartzman** [PI], "Spatial and Chemical Surface Guidance of NK Cell Cytotoxic Activity, **ACS Appl. Mater. Interfaces** 10(14) 11486 (2018) [times cited: 4, *IF = 8.1*; 15/92; Q1]

* 18. D. Yehuda [S], E. Kassis [C], S. Joseph [C], **M. Schvartzman** [PI], "Direct Soft Imprint in Chalcogenide Glasses", **J. Vac. Sci. Technol. B**., 36 031602 (2018) [times cited: 5, *IF = 1.3*; 108/317, Q2]

* 19. Y. Keydar [S], G. Le Saux [PD], A. Edri [S], N. Bar-Hanin [S], E. Toledo [S], A. Pandey [S], V. Bhingardive [S], U. Hadad [C], A. Porgador [C], **M. Schvartzman** [PI], "Natural Killer Cells Immune Response Requires a Minimal Nanoscale Distribution of Activating Antigens", **Nanoscale,** 10 14652 (2018) [times cited: 6, *IF = 7.2*; 18/92, Q1]

* 20. A. Marcovici[S], G. Le Saux[PD], V. Bhingardive[S], P. Rukenstein[S], K. Flomin[S], K. Shreteh[S], R. Golan[T], T. Mokari[C], **M. Schvartzman[PI]**, "Directed Assembly of Au-tipped 1D Inorganic Nanostructures via Nanolithographic Docking", **ACS Nano,** 12(10) 10016 (2018) [times cited: 6, *IF = 13.7*; 5/92, Q1]

* 21. G. Le Saux* [PD], N. Bar-Hanin* [S], E A. Edri [S,] U. Hadad [C], A. Porgador [C] ,**Schvartzman** [PI], "Nanoscale Mechanosensing of Natural Killer Cells is Revealed by Antigen-Functionalized Nanowires", **Adv. Mater.** 31, 1805954 (2019) [times cited: 3, *IF = 21.95*, 3/92, Q1]

* Equal contribution

* 22. G. Le Saux [PD] ,M. **Schvartzman** [PI] "Advanced Materials and Devices for the Regulation and Study of NK Cells", **Intl. J. Mol. Sci** , 20 (3) , 646, 2019 [times cited: 0, *IF = 3.687*, 52/171, Q2]

* 23. A. Pandey[S], S. Tzadka[S] , M. **Schvartzman** [PI], "Soft Thermal Nanoimprint with 10 nm feature size", **Soft Matter** , 15, 2897 (2019) [times cited: 6, IF = 3.7, 64/285, Q1]

* 24. R. Ben-Zvi[S], H. Burrows[S], **M. Schvartzman** [C], O. Bitton [C], I. Pinkas [T], I. Kaplan-Ashiri [C], O. Brontvein [T], E. Joselevich [PI], "In-Plane Nanowires with Arbitrary Shapes on Amorphous Substrates by Artificial Epitaxy" **ACS Nano** , 13 , 5572 (2019) [times cited: 2, *IF = 13.7*; 5/92, Q1]

* 25. N. Ostrovsky [S], D. Yehuda [S], S. Tzdaka [S], E. Kassys [C], S. Joseph [C], **M. Schvartzman[PI]**, "Direct Imprint of Optical Functionalities on Free-Form Chalcogenide Glasses", **Adv. Opt. Mater.**, 1900652 (2019*)* [times cited: 1, *IF = 7.35*, 11/436, Q1]

* 26. E. Michman [S], M . Langenberg, [S] R . Stenger [S], M . Oded[S], **M. Schvartzman** [C], M. Mueller[C], R. Shenhar[PI], "Controlled spacing between nano-patterned regions in block copolymer films obtained

by utilizing substrate topography for local film thickness differentiation", **ACS Appl. Mater. Interfaces,** 11(38), 35247, (2019) [times cited: 0, *IF = 8.1*; 15/92; Q1]

* 27. M. Rosenberg [S], **M. Schvartzman** [PI], "Direct Resistless Soft Nanopatterning of Freeform Surfaces", **ACS Appl. Mater. Interfaces,** 11, 43494, (2019) [times cited: 0*IF = 8.1*; 15/92; Q1]

* 28. G. Le Saux[PD], M. C. Wu[S], E.Toledo[S], Y.-Q. Chen[S], Y.-J. Fan[T], J.-C. Kuo[C], and **M. Schvartzman[PI]**, Cell-Cell Adhesion Driven Contact Guidance and its Effect on hMSC Differentiation, **ACS Appl. Mater. Interfaces**, 12 (20), 22399–22409 (2020) [times cited: 0, *IF = 8.1*; 15/92; Q1]

(e) Conference Proceedings

1. L. Menahem[S], M. Schvartzman[PI], "Soft-substrate rigid-feature (SSRF) mold for nanoimprint lithography ", **Proc. SPIE** 9919, Nanophotonic Materials XIII, 99190P (2016)

- **Lectures and Presentations at Meetings and Invited Seminars**

(a) Invited Lectures at Conferences/ Meetings

2016	"Soft-Substrate/ Rigid-Feature for Nanoimprint Lithography", Annual Conference of Israel Polymer and Plastic Society, Jerusalem, Israel
2017	"Nano-Lithographically Directed Organization at the Molecular Scale: from Inorganic Nano-Architectures to Bio-Interfaces" Annual meeting of Israeli Chemical Society, Tel-Aviv, Israel
2017	"Soft Thermal Nanoimprint Lithography", 7th Annual Congress on Materials Research and Technology", Berlin, Germany
2018	"Directed Assembly of Nanodumbbells via Nano-Lithographic Docking", The 18th Israel Materials Engineering Conference, Dead Sea, Israel
2018	"Nanodevices for the Study of Natural Killer (NK) Cell Function" , **keynote lecture**, TNT 2018 – Trends in Nanotechnology Conference, Lecce , Italy
2018	Nanoimprint lithography: novel applications in direct 3D nanostructuring and controlled nanoscale assembly, 36th Annual conference of Israel Vacuum Society, Ramat-Gan, Israel
2019	Multifunctional devices for teh regulation of cytooxic activity of natural killer cells, IIS-ISCR Special Conference - The Cutting Edge of Immunology, Cancer and Immunoncology Research**,** Tel-Aviv, Israel
2020	Nanoscale mechanosensing of natural killer cells is revealed by antigen-functionalized nanowires, 9th ILANIT/FISEB conference, Eilat, Israel.

(b) Presentations of Papers at Conferences/ Meetings

* - presenting author

1. M. Schvartzman*, V. Sidorov, D. Ritter, and Y. Paz, Annual Conference of the Israeli Chemical Engineers Association, Apr. 2001, "Passivation of InP Surfaces of Electronic Devices by Organothiolated Self-Assembled Monolayers" (proceeding ref. unavailable) – oral presentation

2. M. Schvartzman*, V. Sidorov, D. Ritter, and Y. Paz, Eastern Mediterranean Chemical Engineering Conference, Ankara, Turkey, May 2001, "Passivation of InP Surfaces of Electronic Devices by Organothiolated Self-Assembled Monolayers" (proceeding ref. unavailable) - oral presentation

3. M. Schvartzman*, V. Sidorov, D. Ritter, and Y. Paz, Annual Conf. of the Israel Vacuum Society, Jun 2001, "Passivation of InP Surfaces of Electronic Devices by Organothiolated SAMs" (PB-4) - oral presentation

4. M. Schvartzman*, K. Nguyen, J. Abramson, J. Hone, M. Sheetz, and S. Wind, The 52nd Int. Conference of Electron, Ion and Photon beam Technology and Nanofabrication, May 2008 - "Fabrication Of Nanoscale Bioarrays For The Study Of Cytoskeletal Protein Binding Interactions Using Nano-Imprint Lithography" (5A-4) - oral presentation

5. M. Schvartzman*, S. Wind, The 52nd Intl. Conference of Electron, Ion and Photon beam Technology and Nanofabrication, Portland, OR, May 2008, "Fluorinated Diamond Like Carbon (DLC) Templates For Ultra-Small Features NIL" (P-3A-03) - oral presentation

6. M. Schvartzman*, K. Nguyen, J. Abramson, J. Hone, M. Sheetz, and S. Wind, Gordon Research Conference - Nanostructure Fabrication, Tilton, NH, Jul 2008, "Nanoscale Bioarrays for the Study of Cytoskeletal Protein Binding Interactions Using Nano-Imprint Lithography" (proceeding ref. unavailable) - oral presentation

7. M. Schvartzman*, K. Nguyen, J. Abramson, J. Hone, M. Sheetz, and S. Wind, AVS 55th Intl. Symposium, Boston, MA, Nov 2008, "Fabrication of Nanoscale Bioarrays for the Study of Cytoskeletal Protein Binding Interactions Using Nano-Imprint Lithography" (BO+NS+BI+NC+ThA1) - oral presentation

8. M. Schvartzman*, K. Nguyen, J. Abramson, J. Hone, M. Sheetz, and S. Wind, MRS Annual Meeting, Boston, MA, Dec 2008, "Fabrication of Nanoscale Bioarrays for the Study of Cytoskeletal Protein Binding Interactions Using Nano-Imprint Lithography" (FF8.9) - oral presentation

9. M. Schvartzman* and S. Wind, The 53rd Intl. Conference of Electron, Ion and Photon beam Technology and Nanofabrication, Marco Island, FL, May 2009, "Fabrication of Sub-5nm Nanoscale Arrays by Nanoimprint Lithography Combined with an Angle-Evaporated Hard Mask and Lift-off" (5D-1) - oral presentation

10. M. Schvartzman*, D. Tsivion, and E. Joselevich The 3rd Nano Israel Conference, March 2012, "Nanowire based logic devices and circuits" (proceeding ref. unavailable) - poster presentation

11. M. Schvartzman*, D. Tsivion, and E. Joselevich, The 56th Intl. Conference of Electron, Ion and Photon beam Technology and Nanofabrication, Waikoloa Beach, HW, May 2012, "Nanowires with controlled location and direction by surface-guided growth from patterned catalyst" (P17-16) – oral presentation

12. M. Schvartzman*, D. Tsivion, and E. Joselevich, Annual Conf. of the Isr. Vac. Society, Oct 2012, "Nanowires with Controlled Location and Direction by Surface-Guided Growth from Nanopatterned Catalyst" (VT-02) - oral presentation

13. M. Schvartzman*, D. Tsivion, and E. Joselevich, Annual Conf. of the Isr. Vac. Society, Oct 2013, " Self-integration of Nanowires into Circuits and Logic Devices via Guided Growth" (DW-03) - oral presentation

14. M. Schvartzman*, D. Tsivion, and E. Joselevich, Nanowire 2013 Conference, Weizmann Institute, Rehovot, Nov 2013, "Self-Integration of Nanowires into Circuits via Guided Growth" (proceeding ref. unavailable) - poster presentation

15. L. Menachem, M. Schvartzman*, The 60th Intl. Conference of Electron, Ion and Photon Beam Technology and Nanofabrication, Pittsburgh, PA, May 2016, "Soft-Substrate Rigid-Features Nanoimprint Mold" (proceeding ref. unavailable) - poster presentation

16. L. Menachem, M. Schvartzman*, SPIE Nanoscience and Engineering Conference, San-Diego, CA, Aug 2016, "Soft-Substrate Rigid-Feature Mold for Nanoimprint Lithography" - oral presentation

17. V. Bhingardive, M. Schvatzman*, The 61th Intl. Conference of Electron, Ion and Photon Beam Technology and Nanofabrication, Orlando, FL, May 2017, "Soft Thermal Nanoimprint Lithography" – oral presentation

18. Avichai Marcovici, Guillaume Le Saux, Pazit. Rukenstein, Taleb Mokari, Mark Schvartzman*, MNE – International Conference on Micro and Nanoengineering, Braga, Portugal, Sep 2017, "Directed Assembly of Nanodumbbells via Nano-Lithographic Docking"- oral presentation

19. Y. Kedar, G. Le Saux, A. Edri, U. Hadad, O. Yahalom-Gershuni, A. Porgador, M. Schvartzman*, "Natural Killer Cells Immune Response Requires a Minimal Nanoscale Distribution of Activating Antigens", the 2nd COST Action ARBRE-MOBIEU Plenary Meeting, Warsaw, Poland, March 2018 – poster presentation
20. Y. Kedar, G. Le Saux, A. Edri, U. Hadad, O. Yahalom-Gershuni, A. Porgador, M. Schvartzman*, "Natural Killer Cells Immune Response Requires a Minimal Nanoscale Distribution of Activating Antigens", the 62th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication, Puerto-Rico, May 2018 – poster presentation

21. Y. Keydar, G. Le Saux, N Bar-Hanin, A. Edri , U. Hadad , A. Porgador , M. Schvartzman*, Regulation and mechanism of the immune function in Natural Killer (NK) cells: nanotech approach, EMBO workshop on Lymphocyte Antigen Signaling, Sienna, Italy, Aug 2018 – poster presentation

22. G. Le Saux, N. Bar-Hanin, E A. Edri , U. Hadad , A. Porgador ,M. Schvartzman* , "Nanoscale Mechanosensing of Natural Killer Cells is Revealed by Antigen-Functionalized Nanowires", the 3rd COST Action ARBRE-MOBIEU Plenary Meeting, Zagreb, Croatia, March 2019 – oral presentation

23. G. Le Saux, N. Bar-Hanin, E A. Edri , U. Hadad , A. Porgador ,M. Schvartzman* , "Nanoscale Mechanosensing of Natural Killer Cells is Revealed by Antigen-Functionalized Nanowires", International Symposium of Interface Biology, Rostock, Germany, May 2019 – poster presentation

24. D. Yehuda, N. Ostrovsky, S. Tzdaka, E. Kassys, S. Joseph, M. Schvartzman*, Direct Nanoimprint of Chalcogenide Glasses for Optical Applications, The 62nd Intl. Conference of Electron, Ion and Photon Beam Technology and Nanofabrication, Minneapolis, MN, May 2019, oral presentation

25. M. Schvartzman* , "Biomimetic Molecular-Scale Devices for the Spatial Control and Study of Activating-Inhibitory Balance in Natural Killer Cells", MRS Fall meeting, BOSTON, MA, Dec 2019 – oral presentation

26. M. Schvartzman*,"Nanowire-Based Spatio-Mechano-Chemical Guidance of the Cell Immune Activity, MRS Fall meeting, BOSTON, MA, Dec 2019 – oral presentation
27. M. Schvartzman*, Biomimetic Molecular-Scale Devices for the Spatial Control and Study of Activating-Inhibitory Balance in Natural Killer Cells", the 4th COST Action ARBRE-MOBIEU Plenary Meeting, Prague, Czech Republic, Feg 2019 – poster presentation

(c) Presentations at Conferences/ Meetings by Group Members

* - presenting author

1. L. Menachem*, M. Schvartzman, Annual Conf. of the Isr. Vac. Society, Rehovot, Israel , Sep 2015, "Soft-Substrate Rigid-Features Nanoimprint Mold" , - poster presentation

2. L. Menachem*, M. Schvartzman, Israel Materials Engineering Conference (IMEC), Ramat-Gan, Israel, 2016, "Soft-Substrate Rigid-Features Nanoimprint Mold" - poster presentation

3. Viraj Bhungardive*, Liran Menahem, Mark Schvartzman, Annual Conf. of the Isr. Vac. Society, Beer-Sheva, Israel Sepn2016, “Soft Thermal Nanoimprint Lithography” - poster presentation
4. Yossi Keydar*, Guillaume Le Saux, Orly Gershoni, Angel Progador, Mark Schvartzman, Annual Conf. of the Isr. Vac. Society, Beer-Sheva, Israel, Sep 2016, “Heterogeneous sub-20nm nano-arrays by nanoimprint lithography” - poster presentation
5. Avichai Marcovici*, Guillaume Le Saux, Pazit. Rukenstein, Taleb Mokari, Mark Schvartzman, 2017, The 61th Intl. Conference of Electron, Ion and Photon Beam Technology and Nanofabrication, Orlando, FL, May 2017, “Directed Assembly of Nanodumbbells via Nano-Lithographic Docking”- oral presentation
6. Yossi Kedar*, Guillaume Le Saux, Avishay Edri, Uzi Hadad, Orly Yahalom-Gershuni, Angel Porgador, Mark Schvartzman, Annual Conf. of the Isr. Vac. Society, Rehovot, Israel, Sep 2017, ”Nanofabricated devices for the molecular - level study of immune activation” – poster presenaton
7. Avichai Marcovici*, Guillaume Le Saux, Pazit. Rukenstein, Taleb Mokari, Mark Schvartzman, Annual Conf. of the Isr. Vac. Society, Rehovot, Israel, Sep 2017, “Directed Assembly of Nanodumbbells via Nano-Lithographic Docking”- poster presentation
8. Natanel Barhanin*, Cuillaume Le Saux, Mark Schvartzman, Annual Conf. of the Isr. Vac. Society, Rehovot, Israel, Sep 2017, “Surface Functionalizatin of Nanowire Tips for Self-Assembly and Biological Applications”- poster presentation
9. Natalie Ostrovsky*, Mark Schvartzman, Annual Conf. of the Isr. Vac. Society, Rehovot, Israel, Sep 2017, “Antirefelective Nanostructures on Curved Optical Surfaces of Lenses”- poster presentation
10. Dor Yehuda*, Eviatar Kassis, Shay Joseph, Mark Schvartzman, Annual Conf. of the Isr. Vac. Society, Rehovot, Israel, Sep 2017, “Nanoimprinted Antireflective Nanostructures on the Optical Surfaces of Chalcogenide Glasses” – poster presentation
11. Viraj Bhungardive*, Liran Menahem, Mark Schvartzman, Annual Conf. of the Isr. Vac. Society, Rehovot, Israel, Sep 2017, “Soft Thermal Nanoimprint Lithography” - oral presentation
12. Yossi Kedar*, Guillaume Le Saux, Avishay Edri, Uzi Hadad, Orly Yahalom-Gershuni, Angel Porgador, Mark Schvartzman, MNE 43 – International Conference on Micro and Nanoengineering, Braga, Portugal, Sep 2017,”Nanofabricated devices for the molecular - level study of immune activation” – poster presenaton
13. Dor Yehuda*, Eviatar Kassis, Shay Joseph, Mark Schvartzman, MNE 43 – International Conference on Micro and Nanoengineering, Braga, Portugal, Sep 2017, “Nanoimprinted Antireflective Nanostructures on the Optical Surfaces of Chalcogenide Glasses” – poster presentation –***BEST POSTER AWARD***
14. Natalie Ostrovsky*, Mark Schvartzman, The 18th Israel Materials Engineering Conference, Dead Sea, Israel, Feb 2108, “Antirefelective Nanostructures on Curved Optical Surfaces of Lenses”- poster presentation
15. Guillaume Le Saux*, Avishai Edri, Yossi Keydar, Uzi Hadad, Angel Porgador, Mark Schvartzman, The 18th Israel Materials Engineering Conference, Dead Sea, Israel, Feb 2108, “Spatial and Chemical Guidance of the Cell Immune Function” - oral presentation
16. Viraj Bhungardive*, Liran Menahem, Mark Schvartzman, The 18th Israel Materials Engineering Conference, Dead Sea, Israel, Feb 2018, “Soft Thermal Nanoimprint Lithography” - oral presentation
17. Guillaume Le Saux*, Avishai Edri, Yossi Keidar, Uzi Hadad, Angel Porgador, Mark Schvartzman, European Materials Research Society (E-MRS), Strasbourg, France. Jun “Spatial and Chemical Guidance of the Cell Immune Function” – oral presentation
18. Yossi Keidar, Guillaume Le Saux*, Avishai Edri, Uzi Hadad, Angel Porgador, Mark Schvartzman, European Materials Research Society (E-MRS), Strasbourg, France. Jun “Regulation of the immune synapse and cytotoxic activity of natural killer (NK) cells by nanolithographic ligand patterning ” – poster presentation

19. Viraj Bhingardive*, Avishai Marcovici, Guillaueme Le Saux, Pazit Rukenstein, Kobi Flomin, Karam Shreteh, Roxana Golan, Taleb Mokari, Mark Schvartzman, Annual Conf. of the Isr. Vac. Society, Beer-Sheva, Israel, Sep 2018, Nano Lithographically Templated Assembly of 1D Nanostructures – poster presentation
20. Sivan Tzadka*, Ashish Pandey, Dor Yehuda, Mark Schvartzman, Annual Conf. of the Isr. Vac. Society, Beer-Sheva, Israel, Sep 2018, **Thermal Nanoimprint and Resolution Limits of Hybrid H-PDMS/PDMS Mold – poster presentation - *BEST POSTER AWARD***
21. Esti Toledo*, Guillaume Le Saux, Avishai Edri, Uzi Hadad, Angel Porgador, Mark Schvartzman, Annual Conf. of the Isr. Vac. Society, Ramat-Gan, Israel, Sep 2018, Multifunctional Nanodevices for the Regulation of Cytotoxic Activity of Natural Killer Cells – poster presentation
22. Lital Mordechay*, Guillaume Le Saux, Dor Yehuda, Uzi Hadad, Avishay Edri, Angel Porgador, , Mark Schvartzman, Annual Conf. of the Isr. Vac. Society, Ramat-Gan, Israel, Sep 2018,-Bio-Nano Devices for Ultra-High Resolution Study of Mechanical Forces in Immune Cells – poster presentation
23. Ashish Pandey*, Guillaume Le Saux, Avishai Edri, Uzi Hadad, Angel Porgador, Mark Schvartzman, Annual Conf. of the Isr. Vac. Society, Ramat-Gan, Israel, Sep 2018, **Controlling Cytotoxic Activity of Natural Killer (NK) Cells by Nanolithographic Molecular-scale Devices** – poster presentation
24. Guillaume Le Saux*, Avishay Edri, Yossi Keydar, Uzi Hadad, Angel Porgador, Mark Schvartzman, Annual Conf. of the Isr. Vac. Society, Ramat-Gan, Israel, Sep 2018, **Spatial and Chemical Surface Guidance of NK Cell Cytotoxic Activity** – poster presentation
25. Netanel Bar Hanin*, Guillaume Le Saux, Nano-Israel 2018 Conference Ramat-Gan, Israel, Surface Functionalization of Semiconductor Nanowires for Biological Application – poster presentation
26. Nataly Ostrovsky*, Mark Schvartzman, **Nano-Israel 2018 Conference, Jerusalem, Israel,** Nanolithographic fabrication of curves substrates – poster presentation
27. Viraj Bhingardive*, Avishai Marcovici, Guillaueme Le Saux, Pazit Rukenstein, Kobi Flomin, Karam Shreteh, Roxana Golan, Taleb Mokari, Mark Schvartzman, Nano-Israel 2018 Conference, Jerusalem, Israel, Nano Lithographically Templated Assembly of 1D Nanostructures – poster presentation - ***BEST POSTER AWARD***
28. Sivan Tzadka*, Ashish Pandey, Dor Yehuda, Mark Schvartzman, Nano-Israel 2018 Conference, Jerusalem, Israel, "Thermal Nanoimprint and Resolution Limits of Hybrid H-PDMS/PDMS Mold" – poster presentation
29. Esti Toledo*, Guillaume Le Saux, Avishai Edri, Uzi Hadad, Angel Porgador, Mark Schvartzman, Nano-Israel 2018 Conference, Jerusalem, Israel,– poster presentation
30. Lital Mordechay*, Guillaume Le Saux, Dor Yehuda, Uzi Hadad, Avishay Edri, Angel Porgador, Mark Schvartzman, Nano-Israel 2018 Conference, Jerusalem, Israel, Sep 2018,-Bio-Nano Devices for Ultra-High Resolution Study of Mechanical Forces in Immune Cells – poster presentation
31. Ashish Pandey*, Guillaume Le Saux, Avishai Edri, Uzi Hadad, Angel Porgador, Mark Schvartzman, **Nano-Israel 2018 Conference, Jerusalem, Israel**, **Controlling Cytotoxic Activity of Natural Killer (NK) Cells by Nanolithographic Molecular-scale Devices** – poster presentation
32. Guillaume Le Saux*, Avishay Edri, Yossi Keydar, Uzi Hadad, Angel Porgador, Mark Schvartzman, **Nano-Israel 2018 Conference, Jerusalem, Israel**, **Spatial and Chemical Surface Guidance of NK Cell Cytotoxic Activity** – poster presentation
33. N. Ostrovsky*, D. Yehuda, S. Tzdaka, E. Kassys, S. Joseph, M. Schvartzman, EMRS conference 2019, Nice France , Direct Imprint of Optical Functionalities on Free-Form Chalcogenide Glasses
34. Esti Toledo*, Guillaume Le Saux, Avishai Edri, Uzi Hadad, Angel Porgador, Mark Schvartzman, EMRS conference 2019, Nice, France – poster presentation

35. G. Le Saux* N. Bar-Hanin, E A. Edri , U. Hadad, A. Porgador ,Schvartzman, "Nanoscale Mechanosensing of Natural Killer Cells is Revealed by Antigen-Functionalized Nanowires", EMRS conference 2019, Nice, France – oral presentation
36. Lital Mordechay*, Guillaume Le Saux, Dor Yehuda, Uzi Hadad, Avishay Edri, Angel Porgador, Mark Schvartzman, the annual meeting of the Israeli Medical and Biological Engineering Society (ISMBE), Haifa, 2019-Bio-Nano Devices for Ultra-High Resolution Study of Mechanical Forces in Immune Cells – poster presentation
37. S. Tzdaka*, N. Ostrovsky, , E. Kassys, S. Joseph, M. Schvartzman, Annual Conf. of the Isr. Vac. Society, Haifa, Israel, Sep 2019, Direct Nanoimprint on Chalcogenide Glasses substrate for Optical Applications – poster presentation- ***BEST POSTER AWARD***
38. V. Bhingardive*, Le Saux, A. Edri , A. Porgador ,M. Schvartzman, Annual Conf. of the Isr. Vac. Society, Haifa, Israel, Sep 2019, Site Selective Functionalization of Nanowires For Biological Studies″ – poster presentation
39. A. Pandey*, S. Tzdaka, D. Yehuda, M. M. Schvartzman, Annual Conf. of the Isr. Vac. Society, Haifa, Israel, Sep 2019, "Soft thermal nanoimprint with a 10 nm feature size"- poster presentation
40. N. Ostrovsky*, D. Yehuda, S. Tzdaka, E. Kassys, S. Joseph, M. Schvartzman, Annual Conf. of the Isr. Vac. Society, Haifa, Israel, Sep 2019, Direct Imprint of Optical Functionalities on Free-Form Chalcogenide Glasses – poster presentation
41. L. Mordechay*, G. Le Saux, U. Hadad, A. Edri, A. Porgador, M. Schvartzman, Annual Conf. of the Isr. Vac. Society, Haifa, Israel, Sep 2019, Novel devices for the regulation of cytotoxic activity of natural killer cells – poster presentation
42. E. Toledo*, G. Le Saux, A. Edri, U. Hadad, A. Porgador, M. Schvartzman, Annual Conf. of the Isr. Vac. Society, Haifa, Israel, Sep 2019, "Multifunctional devices for the regulation of cytotoxic activity of natural killer cells" – poster presentation - ***BEST POSTER AWARD***
43. G. Le Saux* N. Bar-Hanin, E A. Edri , U. Hadad, A. Porgador ,M. Schvartzman, Annual Conf. of the Isr. Vac. Society, Haifa, Israel, Sep 2019, "Nanoscale Mechanosensing of Natural Killer Cells is Revealed by Antigen-Functionalized Nanowires" - oral presentation
44. E. Toledo*, G. Le Saux, A. Edri, U. Hadad, A. Porgador, M. Schvartzman, The Joint Meeting of the Israeli Immunological Society and the Israeli Society for Cancer Research, Tel Aviv, Israel, Sep 2019, "Multifunctional devices for the regulation of cytotoxic activity of natural killer cells" – poster presentation -

(d) Seminar Presentations at Universities and Institutions

1. 2019, Department of Chemical Physics, Tel-Aviv University, "Nanodevices for the Study of Immune Cell Function
2. 2012, School of Engineering and Applied Science, Columbia University in the City of New-York, "Nanowire based logic devices and circuits by guided growth from Nanoimprinted Catalyst"
3. 2014, Faculty of Materials Engineering, Technion, "Lithographically Guided Organization of Nanostructures: a New Route to Functional Nanosystems and Biointerfaces"
4. 2014, Department of Applied Physics, Hebrew University of Jerusalem, "Lithographically Guided Organization of Nanostructures: a New Route to Functional Nanosystems and Biointerfaces"
5. 2014, Department of Chemical Engineering, Ben-Gurion University, "Lithographically Guided Organization of Nanostructures: a New Route to Functional Nanosystems and Biointerfaces"
6. 2014, Department of Chemistry, Ben-Gurion University "Lithographically Guided Organization of Nanostructures: a New Route to Functional Nanosystems and Biointerfaces"

7. 2014, Department of Chemistry, Tel-Aviv University, “Lithographically Guided Organization of Nanostructures: a New Route to Functional Nanosystems and Biointerfaces”
8. 2014, Faculty of Chemical Engineering, Technion, “Lithographically Guided Organization of Nanostructures: a New Route to Functional Nanosystems and Biointerfaces”
9. 2014, Department of Materials Engineering, Ben-Gurion University, “Lithographically Guided Organization of Nanostructures: a New Route to Functional Nanosystems and Biointerfaces”
10. 2014, Department of Chemistry, Bar-Ilan University, “Lithographically Guided Organization of Nanostructures: a New Route to Functional Nanosystems and Biointerfaces”
11. 2014, Faculty of Electrical Engineering, Technion, “Self-Integration of Nanowires into Circuits via Guided growth”
12. 2015, Intel, Kiriat-Gat, "Nano-Electronics from the Bottom-Up"
13. 2017, Department of Materials Engineering, Tel-Aviv University, “Lithographically Driven Nanoscale Assembly”
14. 2018, Faculty of Materials Science and Engineering, Technion, “Lithographically Guided Organization of Nanostructures: a New Route to Functional Nanosystems and Biointerfaces”
15. 2018, Department of Solar Energy & Environmental Physics, Jacob Blaustein Institute for Desert Research, Ben-Gurion University of the Negev, Sde Boker, “Nanodevices for the Study of Immune Cell Function”

- **Patents**

	Patent Title	Inventors	Serial No.	File Date
1.	A Nanocomposite Mold for Thermal Nanoimprinting and Method for Producing the Same	Viraj Bhingardive, Liran Menahem, Mark Schvartzman	PCT/IL2019 /050738	03-07-2019
2.	Radiation Assisted Direct Nanoimprint of Chalcogenide Glass	Shay Joseph, Evyatar Kassis, Mark Schvartzman, Dor Yehuda	PCT/IL2020 / 050574	26-05-2020
3.	Nanochip for Personalized Assessment of Checkpoint Immunotherapy	Angel Porgador, Mark Schvartzman	62/977,823	18-02-2020
4.	Direct Resistless Soft Nanoimprint of Freeform Polymers	Maor Rosenberg, Mark Schvartzman	62/925,241	24-10-2019

- **Research Grants**

	Project Title	Funding source	Annual $US	Total $US	Period
1.	Polymer solar cells with heterojunction morphology nanoimprinted at the scale of exciton diffusion length (Collaborative grant, PI 1- Mark Schvartzman, PI 2- Nir Tessler, Technion)	Adelis Foundation for Research in Renewable Energy	25,000	50,000	05.2015 - 05.2016
2.	Templated organization of 1D nanostructures	Israel Science Foundation – Personal Grant	77,000	308,000	10.2015 - 09.2019
3.	Templated organization of 1D nanostructures	Israel Science Foundation - New Faculty Equipment Grant		562,500	06.2015 - 09.2017
4.	Molecular-scale biomimetic devices for the study of adhesive cross-talk and its effect on stem cell motility and differentiation (Collaborative grant, PI 1- Mark Schvartzman, PI 2- J.C. Kuo, National Yang Ming University, Taiwan)	MOST- Israel-Taiwan Scientific Research Cooperation	35,000	70,000	11.2015 - 10.2017
5.	Nanoimprinted Anti-Reflective Nanostructures on	PAZY Foundation	75,000	300,000	06.2016 - 06.2020

	the Curved Optical Surfaces of Chalcogenide Glasses				
6.	Institutional equipment grant for SEM-FIB dual-beam tool - **leading PI** (2 other PI's - Gabi Sarussi and Daniel Gitler)	Israel Science Foundation		290,000	09.2016
7.	Investigating Spatial Signal Integration in CAR- NK Cells by Molecular-Scale Nanodevices (Collaborative grant, PI 1- Mark Schvartzman, PI 2- Angel Porgador, BGU)	Israel Science Foundation – BIKURA Program	73,000	146,000	09.2018 - 08.2020
8.	Institutional equipment grant for electron-beam lithography tool - **leading PI** (Two other PI's - Ibrahim Abdulhalim and Ron Folman)	Israel Science Foundation		256,000	08.2018
9.	Nanowire Based Antireflective Coating on lenses of III-V semiconductors	Ministry of Defense (MAFAT)	67,000	134,000	11.2018 - 10.2020
10.	Nanochip for the personalization of the immune checkpoint blockade	Israel Cancer Association	10,000	20,000	04.2020 - 03.2022
11.	Directly imprinted antireflective coatings on polymer optical components	Israel Innovation Authority (KAMIN)	61,000	122,000	05.2020- 04.2022
12.	Nanocomposite surface coatings for the prevention of contact-induced transmission of the Corona Virus (together with Angel Porgador)	Israel Innovation Authority (KAMIN)	60,000	60,000	05.2020 - 04.2021

- **Present Academic Activities**

(a) Research in progress

Project 1: Antireflective nanostructures on lenses of chalcogenide glasses.
- Participants: Natalie Ostrovsky (PhD Student), Sivan Tzadka (M.Sc. student)
- Estimated End: Aug 2020

Project 2: Directly imprinted antireflective nanostructures on polymeric optical components.
- Participants: Natalie Ostrovsky (PhD Student), Sivan Tzadka (M.Sc. student)
- Estimated End: June 2022

Project 3. Multifunctional nanodevices for the regulation and study of activating-inhibitory balance in the immune synapse
- Participants: Ashish Pandey (PhD student), Guillaume Le Saux (postdoc)
- Estimated End: Dec 2020

Project 4. Nanochip for the personalization of the immune checkpoint blockade
- Participants: Esti Toledo (Ph.D.. Student),
- Estimated End: Dec 2022

Project 5: Novel nano-materials and devices to study cell mechanosensing and mechanotransduction
- Participants: Lital Mordechai (M.Sc. Student), Guillaume Le Saux (postdoc)
- Estimated End: Dec 2022

Project 6: Nanocomposite surface coatings for the prevention of contact-induced transmission of the Corona Virus (together with Angel Porgador)
- Participants: Esti Toledo (Ph.D.. Student), Guillaume Le Saux (postdoc)
- Estimated End: Dec 2022

(b) Books and articles to be published:

In preparation:

1. Natali Ostrovsky, Mark Schvartzman, *Lithographic templating of the kinetically controlled self assembly of nanoparticles*.

Submitted for publication:

1. E.Toledo, G. Le Saux, L. Li, M. Rosenberg, Y. Keidar, V.j Bhingardive, A. Edri, U. Hadad, C. Di Primo, T. Buffeteau, A.-S. Smith, A. Porgador, and M. Schvartzman, *Molecular Scale Spatio-Chemical Control of the Activating-Inhibitory Signal Integration in NK Cells*, submitted to **Science Advances**
2. L. Mordechay, G. Le Saux, A. Edri, U. Hadad, A. Porgador, and M. Schvartzman, Mechanical Regulation of the Cytotoxic Activity of Natural Killer Cells, submitted to **ACS Biomat. Sci. Eng.**
3. M. H. Shor, E. Toledo, S. Shital, A. Maity, Y. Sivan, M. Schvartzman, and A. Niv, *Second-Harmonic Generation from Nano-Scaled Heterodimer*s, submitted to **Opt. Exp**.
4. V. Bhingardive, Guillaume Le Saux, Avishay Edri, Angel Porgador, and M. Schvartzman, *Nanowire Based Guidance of the Morphology and Cytotoxic Activity of Natural Killer Cells*, submitted to **ACS Nano**
5. S. Tzadka, N. Ostrovsky, E. Toledo, G. Le Saux, E. Kassis , S. Joseph, M. Schvartzman, *Surface plasticizing of chalcogenide glasses: a novel route for direct patterning with multifunctional antireflective and self-cleaning microstructures*, submitted to **Opt. Exp**.

- **Synopsis of Research**

General

My research focuses in the following themes related to nanomaterial and nanofabrication engineering:

- Development of novel approaches for nanoimprint lithography, with the emphasis on sub-10 nm feature size and resolution, and pattern fabrication on unconventional non-planar surfaces.
- Application of nanoimprint lithography in the fabrication of optical micro- and nanostructures, such as antireflective nano-morphologies.
- Development of novel nanoscale platforms for the regulation and study of molecular interaction at interfaces, with the current emphasis on understanding the molecular mechanism of the immunological synapse.

Most of the experimental work described herein is carried out in my lab, which is equipped with a state-of- the-art Chemical Vapor Deposition System for dry synthesis of nanomaterials, as well as with facilities for nanocharacterization and chemical- and bio-functionalization. My lab also includes complete infrastructure for biological studies described herein, most of which is done by today by my group. These infrastructure incudes facilities for cell culturing, and stat-of-the-art biological microscope. A great part of my research relies on nanofabrication and nanocharacterization, most of which is done at the shared facilities of BGU Nano Center.

Project 1: Antireflective nanostructures on lenses of chalcogenide glasses.

This is a collaboration with RAFAEL company, which is funded by PAZY Foundation. Its goal is to develop and study sub-wavelength antireflective "moth-eye" nanostructures on the lenses of chalcogenide glasses. Here, we develop several novel techniques based on direct nanoimprint of chalcogenide glasses with soft stamps, including confinement assisted imprint, radiative imprint, and direct solvent assistant imprint. We intend to continue this project, depending on future finding (research proposal to the Ministry of Defense is currently in preparation). We recently applied two provisional patents based on the inventions that came from this project.

- Relevant Publications: #6 *Yehuda et al*, #1 *Pandey et al., Ostrovsky et al*

Project 2: Directly Imprinted "Moth-Eye" Antireflective Nanostructures on Polymeric Lenses

This project is funded by Elbit Ltd., and is carried out in the collaboration with Avionics Division of Elbit. The project is aimed at exploring new technological approaches for the fabrication of broadband and omnidirectional antireflective nanostructures on plastic optical components such as lenses. We started this project only recently, but have already achieved several promising results. In particular, we developed direct solvent-assisted soft imprint of polymeric substrates with sub-wavelength nanostructures. We consider this development as a major breakthrough in nanoimprint lithography, which will produce a great impact on the field of nanofabrication, as well as on the rapidly emerging field of polymer optics. In these days, we are preparing a provisional patent on this invention, and writing a research paper. We also submitted, together with Elbit Ltd a research proposal for funding of this project to the Ministry of Science and Technology (Magneton).

Project 3. Multifunctional Nanodevices for the Regulation and Study of Activating-Inhibitory Balance in the Immune Synapse

In this project, which is funded by ISF Bikura, we develop novel nanodevices that mimic the molecular order in the immune synapse – the functional interface between lymphocytes and target cells. Here, we aim at reproducing a multifunctional assembly of activating and inhibitory ligands on the chip surface,

by controlled positioning of different ligands. This positioning is possible by selective immobilization of the ligands onto heterogeneous bi-metallic patterns of sub-10 nanodots, which are fabricated by nanoimprint lithography. The multifunctional pattern formed by the ligands encodes the assembly of individual receptors within the membrane of cells, which are stimulated on the chip surface. We systematically vary the geometry of the ligand pattern across the chip surface, and track the immune response of the studied lymphocytes to these geometrical variations, to elucidate the role of the receptor organization in the cell immune activity. We closely collaborate on this project Angel Porgador from the department of Microbiology, Immunology, and Genetics. It is important, however, to note, that most of the experimental work has been done by the students of our group, including the experiments with cells. So far, we have realized a chip to control organization of activating receptors in Natural Killer cells (lymphocytes of the innate immune systems), and used it to discover the minimal spatial conditions for NK cell activation (published in *Nanoscale*, 2018). We have also developed a novel biofunctionalization approach that allows selective positioning of different biomolecules onto bi-metallic pattern patterns – a methodology essential for the realization of our multifunctional nanodevice (published in *ACS Appl. Mat. Interfaces*, 2018)

- Relevant Publications: #5 *Keydar et al*, # 7 *Le Saux et al*.
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Project 4: Nanochip for personalized assessment of immune checkpoint immunotherapy

This project is a clinical spin-off of Project 5, which is carried out in collaboration with Prof. Nir Peled – the Head of Oncology Division in Soroka Medical Center, and Prof. Angel Porgador from the Department of Microbiology, Immunology and Genetics at BGU. Immune checkpoint blockade is a new promising antitumor therapy, yet it is largely challenged by toxicity, poorly predicable response of the treated patients, as well as natural and acquired resistance – all vary among cancer patients. These challenges, alongside the progressively growing variety of checkpoint-based therapies, create an urgent need for a facile and reliable methodology to assess personalized responsivity to each type of immune checkpoint blockade. Antitumor activity of cells – white blood lymphocytes that play a central role in cell-mediated immunity – is largely regulated by the nanoscale clustering of activating, costimulatory, and inhibitory receptors in the interface between T cells and target cells, yet the exact nature of this regulation is still unclear. In this research, we ask the following questions:

- Whether and how the regulation of T cell immune response by TCR and PD-1 clustering is tumor dependent, and patient dependent?
- Furthermore, does this regulation correlates with the patient sensitivity to PD-1 blockade?
- If it does, can it be exploited to predict patient responsivity to the checkpoint blockade?

To address these questions, we work today on engineering a novel nanochip, whose surface is patterned with tunable arrays of clustered activating and inhibitory ligands which engage the receptors of T cells. We will use this nanochip as an artificial tumor cell with tunable composition and clustering of the molecules on its surface. We stimulate T cells from different patients on different nanochip arrays, with and without a blocker drug Pembrolizumab (Keytruda ®), and study how the T cells response to different patterns of the ligand clusters correlates with patient sensitivity to PD-1 blockade. *Once established, this correlation will be the base for the future nanochips for the personalized pre-treatment assessment of the sensitivity of patient T cells to specific immune checkpoints blockers*. This research is anticipated to provide an important insight into the fundamental mechanisms of the immune checkpoint blockade, and will pave the way to the novel nanochip technology for the personalization of this promising antitumor immunotherapy.

This project has been recently awarded internal BGU grant for collaboration between Engineering and Health Science Faculties at BGU, as well as a grant by Israel Cancer Association. Also, a provisional patent on the chip has been recently applied.

Project 5: Novel nano-materials and devices to study cell mechanosensing and mechanotransduction. We exploit our unique expertise in the top-down and bottom-up nanofabrication, as well as in selective biofunctionalization, to develop novel experimental platforms for the study of mechanical forces in cells with ultra-fine spatial and mechanical resolution. To demonstrate the functional capabilities of these platforms, we mostly apply them in the study of immune signaling in lymphocytes such as T cells and NK cells, which is a well-established "biological playground" in our group. Yet, these platforms are versatile, and can, in principle, be applied to many other biological systems. Recently, we published in *Advanced Materials* a novel nanoplatform for mechanical stimulation of NK cells, whose surface is structured on vertical nanowires functionalized with activating ligands. Using this platform, we discovered the mechanosensing of NK cells, and its role in their immune activation. In addition, we develop nanodevices with sub-micron elastomeric pillars for imaging mechanical forces in cell with the best possible resolution (on the diffraction limits of optical microscopy).

- Relevant Publications: # 8 *Le Saux et al*.

Project 6: Nanocomposite surface coatings for the prevention of contact-induced transmission of the Corona Virus (together with Angel Porgador)

This is a collaboration with the group of Angel Porgador, which has recently started following the Corona virus outbreak. In this project, are developing a polymer-based nanocomposite coating materials for a faster and durable elimination of the Coronavirus on coated surfaces. At the base of the coating is a polymer film reinforced with nanoparticles that have antiviral activity.The nanoparticles are sized in the range of a few nm to a few microns and are made of metals or metal-based compounds, either in pure form or as alloys. A coating may include nanoparticle of one type or several types. The coating can be applied on a surface from a solution or emulsion, which contain the polymer coating and the nanoparticles. The coating in its final form is then obtained after the polymer dries out. Different polymer materials were found effective for the antiviral coating, which include but are not limited to polyacrylates and their derivatives, as well as epoxy resins. Different metals and their compounds were found for antiviral coating, which include but are not limited to Copper, Copper oxide, Silver, and Zink.

We already demonstrated an efficient "prototype of the coating, and is currently developing formulations of the coating that could be durably applied onto various surfaces, which are most susceptible for the contact-induced transmission of the virus, such as door handles or elevator knobs. The final formulations of the coating (after upscaling) could be sold to various markets as an anti-pathogen agent, which can be used in places with a high degree of infection potential, such as hangouts or hospitals. Furthermore, it could be used in houses, as well as in schools, airports, hotels and public transportation. The main advantage of this coating is in its long-run effectiveness compared to other antiviral and antibacterial materials, such as alcogel or bleach. The project is funded by the Israel Innovation Authority (KAMIN).

- **Teaching Statement**

I have been teaching five classes in the Department of Materials Engineering at the Ben-Gurion University of the Negev. It should be noted, that I joined the department while having a rich background in nanofabrication, microelectronic processing, nanomaterials, and polymer technology. I gained this expertise from my academic period, as well as from my industrial period, in which I worked in a few engineering and management positions. Since I am a lecturer in an engineering department my industrial

experience is of special importance because it helps me provide students with practical aspects of their future profession. The courses I have been teaching, and my contribution to these courses, are listed below:

(1) *Advances in nanofabrication*

This is a new graduate class, which I build when I joined the department. The course includes advanced topics in the top-down nanoscale fabrication: thin-film deposition technology, photolithography, electron beam lithography, nanoimprint lithography, and pattern transfer technologies such as wet etching, plasma etching, and liftoff. The course provides several examples of the applications of these processes in the fabrication of electronic devices and MEMS/NEMS.

(2) *Polymer engineering*

This is a mandatory undergraduate course, which had traditionally included basics of polymer chemistry, polymerization reactions. conformation of polymer, thermodynamics of polymer solutions, gelation, glass transition, elasticity, and mechanical properties. Since I started teaching the course, I added several new topics on more practical, engineering aspects of the polymer technology, focusing on polymer processing technologies, such as injection molding, vacuum forming, blow molding, and extrusion.

(3) *Semiconductor technology.*

This is a mandatory undergraduate course, which I started teaching three years ago. Before then, the course included only two topics: oxidation and diffusion. I completely rebuilt the course and provided it with a new balanced syllabus that encompasses all the major semiconductor fabrication processes. Today, the course is configured from five modules: (iv) Thin film technology, including oxidation, chemical vapor deposition, plasma technology, plasma-enhanced vacuum deposition, vacuum technology, physical vapor deposition, mechanical properties of thin films, and thin-film metrology; (ii) Photolithography (iii) Pattern transfer including wet etching, dry etching, chemical mechanical planarization (CMP), and damascene metallization; (iv) doping processes including diffusion and ion implantation, and (v) process integration in the fabrication of CMOS devices and circuits. To the best of my knowledge, this is the most comprehensive academic course in semiconductor processing technology in Israel.

(4) *Nanomaterials and nanotechnology.*

This is a mandatory undergraduate course, which I largely rebuilt when I started teaching it. The course provides a general introduction into the nanometric scale and scaling laws for various physical and chemical properties. Then, the course gives in introduction into electronic quantum confinement. Further topics include recently discovered nanomaterials: quantum dots, fullerenes, carbon nanotubes, graphene and organic 2D materials, and their electronic optical and mechanical properties, as well as their current and future applications. The last part of the course is dedicated to unconventional top-down and bottom-up nanofabrication, including electron beam lithography, nanoimprint lithography, and self-assembly approaches.

(5) *Lab for electronic materials.*

This is a mandatory student lab, which provides students with practical skills in semiconductor fabrication processes. As in the case of theoretical course on semiconductor technology, this lab initially included very limited topics, which had also little relevance to the modern CMOS fabrication technology. Since I became the lecturer of this lab, I completely rebuilt its syllabus. Today, the lab course is structured as a continuous process flow, through which students fabricate and characterize a few semiconductor devices, including p-n diodes, Schotky diodes, Ohmic contacts, and capacitors. Through the course, students learn and get hands-on experience in oxidation, physical vapor deposition, thin film metrology, photolithography, etching, and liftoff.

My future vision of my educational activities focuses on improving the teaching of semiconductor technology in our department. It must be noted, that the semiconductor industry is very well developed in Israel, and that there is a high demand for materials engineers that specialize in this area. To better suit our

teaching program to the needs of the industry, and prepare our students for their future jobs, I recently established a collaboration with the Intel plant located in Kiriat Gat (a town near Beer Sheva), which is the dominant employer of our graduates. I have been in constant contact with senior engineering personnel from Intel, who provide me with feedback on relevant courses I teach. Furthermore, during the year I led a fundraising campaign for the renovation of our student lab. As a result of this campaign, Intel donated 100K Euros. With these funds, I am currently establishing a new lab for vacuum, plasma, and thin film technology, which will be equipped with brand new high end custom made vacuum system for thin film deposition by evaporation and sputtering. This new lab will open numerous opportunities for many new courses, and will largely contribute to excellence in procession training given by our department.