Curriculum Vitae – Yaakov Sharabani

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Personal:

Date of Birth: May 1971; Place of Birth: Rechovot, Israel.

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Professional Expertise:

- Device level simulation using TCAD (Sentaurus by Synopsys)
- Microelectronic device fabrication technologies
- Material and device level electrical and electro-optical characterization
- R&D group leader
- Electronic circuit design

Current Position, 2004 – Present: Department of solid-state physics, Applied physics division, Soreq Nuclear Research Center, Yavne, Israel.

2018 – 2019: Visiting scientist at the Department of Electrical and Computer engineering, Boston University, Boston MA, USA.

Research of GaN power devices via TCAD device simulations. First-principal results from Monte-Carlo and DFT (density functional theory) were used to infer the macroscopic behavior of the GaN-oxide interface, and its effect on GaN based vertical trench MOSFET's. More specifically, studying the effects of Mg incomplete ionization and the presence of prevalent defects, V_N (donor - nitrogen vacancies) and C_N (acceptor - carbon in nitrogen site), in p-GaN on the charge dynamics in the GaN-oxide interface, i.e. the channel area. The underlying physical mechanism governing the observed hysteresis in GaN trench MOSFET transfer characteristics was elucidated. Also, the fact that deep Mg acceptor level does not affect the transistor characteristics was showed and explained. The results of this research were published in Phys. Rev. App.

2009 – 2018: Research group leader.

Leading a group of researchers in an R&D effort of a unique solid-state device for fast switching, in the pulsed-power realm. The device performance requirements dictated developing a broad set of expertise in the group and included acquiring and constructing infrastructure. In order to experimentally

demonstrate a proof of concept, R&D in several parallel paths was performed simultaneously:

- Theoretical study of semiconductor device physics, with an emphasis on transient analysis. In large, this was performed using computer device simulations. Setting a knowledge base in solid-state devices for power switching.
- Development of a wide range of microelectronic manufacturing processes.
- Defining needs and purchasing required process tools (diffusion furnaces, RTP, etc.)
- Developing characterization capabilities, purchasing required tools (probe station, reflectometer, etc.) and building setups.
- Construction of clean laboratories and supporting structures (handling hazardous gas sources etc.)

While preforming this activity, the group developed set the basis for allowing to bridge the 'valley of death' between theoretical research and readiness for manufacturing in the department of solid-state physics in Soreq.

This activity results are summarized in nearly 40 internal reports. Shortly after I started my sabbatical year (mid 2018), the activity evolved from R&D - proof of concept phase to an engineering oriented project.

2012 – 2017: Head of a program, incorporating several other R&D groups.

Director of several R&D activities for the IAEC, by different research groups in Soreq (subordinate to the VP). Responsible for annual and multi-year work-plans, goals setting, resources allocation. Control of goal execution and resource utilization. Interface to the division, Soreq and IAEC headquarters.

2012 – 2017: Researching the charge dynamics of drift step recovery diodes (DSRDs) used for ultra wide band (UWB) pulse generation. This study was the basis for my PhD thesis, and included:

- Theoretical study, using TCAD device simulation, for analyzing the time-domain charge dynamics in the epitaxial grown devices.
- Experimental validation of the theory by constructing devices and characterizing them in a dedicated self-made driving circuit which allow controlling different driving parameters separately.

- Characterizing the material quality and gain understanding of the effect of threading dislocation on the electrical performance of the device. For that purpose I have developed a method for characterizing the defect depth distribution in the sample.

The main results of this study were: showing the validity of epitaxial based, abrupt junction DSRD. Generating 230 V pulses with rise time <300 ps. High current density, x10 (~1 kA/cm^2) comparing to previously published. Explaining the physical mechanism governing the fast switching. The results were published in two papers in Phys. Rev. Appl. and in IEEE Electron. De. Lett.

2006 – 2008: Researcher at the Solid-State Physics Department (equivalent to PI).

Main research topic: using the lattice matched n-GaSb/n-InAsSb hetero-structure for high temperature mid-infrared photodetector. This rectifying junction has a type II band alignment in which the difference in materials work functions cause in turn to the formation of barrier for electrons. In this experimental study I showed that the transport in this junction is controlled by majority carriers is a similar manner to Schottky diode. However in this case the barrier height is modulated by the current through the junction. This property was used to achieve MWIR detection with gain. This work results were published in appl. Phys. Lett.

2008-2011: Additionally in this period I was in charge of the infra-red detector characterization laboratory.

2004 – 2008: Electrical engineer at the Electro-Optical Systems department.

Electronic circuits design for several projects, including: pulsed laser diode driver, pulse shaping, low noise trans-impedance amplifiers for optical detectors, PWM thermal control circuits, etc.

Positions held:

2003 – 2004 ELTA Systems Ltd.

Integration engineer, large systems integration – airborne early warning and control system.

2000 – 2003 3DV Systems Ltd. Israel.

Member in a multidisciplinary R&D group, developing an electro-optical GaAs chip for fast image shuttering (~ 1 ns rise-time). Main fields of expertise: Fast pulse driving board design, temperature control and stabilization design, both hardware and software, and single device EM simulations.

Education:

2010 – 2017: Ph.D. Physical Electronics department, school of Electrical engineering, Tel-Aviv University and Soreq NRC.

Thesis title: Semiconductor Devices for Generation of Sub-Nanosecond Pulsed Power. Under the supervision of Dr. David Eger, from Soreq, and Prof. Yossi Rosenwaks, Department of Electrical Engineering - Physical Electronics, School of Electrical Engineering, Tel-Aviv University.

2005 – 2008: M.Sc. Physical Electronics department, school of Electrical engineering, Tel-Aviv University and Soreq NRC.

Thesis title: Novel High Temperature MWIR Detector using N-GaSb / n-InAsSb Single Hetero Structure. Under the supervision of prof. Yossi Paltiel (from Soreq), now with the department of applied physics at the Hebrew university of Jerusalem, and Prof. Yossi Rosenwaks, Department of Electrical Engineering - Physical Electronics, School of Electrical Engineering, Tel-Aviv University.

1997 – 2001: B.Sc. Electrical Engineeiring, Technion, Haifa, Israel.

Awards:

2008 Award of excellence for leading the 'HOT detector' research project and for improving detectors characterization capabilities.

2012 Award of excellence for leading R&D team and for attaining TCAD semiconductor device simulations capabilities.

2013 Excellent employee solid-state physics, applied physics division, Soreq NRC.

List of publications:

Journal Papers:

1. Y. Sharabani, Y. Paltiel, A. Sher, A. Raizman, and A. Zussman. "InAsSb / GaSb heterostructure based mid-wavelength-infrared detector for high temperature operation". *Applied Physics Letters*, Vol. 90, pp. 232106 1-3, **2007**.
2. A.S. Kesar, Y. Sharabani, L.M. Merensky, I. Shafir, and A. Sher. "Drift-step-recovery diode characterization by a bipolar pulsed power circuit". *IEEE Transactions on Plasma Science*, Vol. 40(11), pp. 3100-3104, **2012**.

3. Y. Sharabani, Y. Rosenwaks, and D. Eger. "Mechanism of fast current interruption in p-pi-n diodes for nanosecond opening switches in high voltage-pulse applications". *Physical Review Applied.* Vol. 4(1), pp. 014015 1-14, **2015**.
4. Y. Sharabani, I. Shafir, S. Zoran, A. Raizman, A. Sher, Y. Rosenwaks, and D. Eger. "Validation of fast current interruption mechanism in sub-nanosecond high-voltage switching diodes". *IEEE Electron Device Letters.* Vol. 37(8), pp. 1041-1044, **2016**.
5. A.S. Kesar, Y. Sharabani, I. Shafir, S. Zoran, and A. Sher. "Characterization of a drift-step-recovery diode based on all epi-Si growth". *IEEE Transactions on Plasma Science.* Vol. PP(99), pp. 1-5, **2016**.
6. Y. Sharabani, A. Palmieri, A. Kyrtsos, M. Matsubara and E. Bellotti. "Interfacial Charge Dynamics in Metal-Oxide–Semiconductor Structures: The Effect of Deep Traps and Acceptor Levels in GaN", Phys. Rev. Applied. Vol. 13(1) pp. 014007 1-7, **2020.**

Proceedings & Conference papers:

1. Y. Sharabani, Y. Paltiel, A. Sher, and Y. Rosenwaks. "High temperature operation MWIR InAsSb/GaSb detector". *25th IVS Annual Conference, Tel-Aviv Israel,* Oct. **2006**.

2. Y. Sharabani, Y. Platiel, A. Sher, A. Raizman, and A. Zussman. "GaSb / InAsSb heterostructure MWIR detector for high temperature operation", MIOMD - 8th International Conference on Mid Infra-red Optoelectronics: Materials and Devices. Bad Ischl, Austria. May **2007.**

3. Y. Sharabani, Y. Paltiel, A. Sher, A. Raizman, and A. Zussman. " GaSb / InAsSb heterostructure MWIR detector for high temperature operation". *26th IVS Annual Conference, Hertzelia Israel,* Oct. **2007**.

4. Y. Sharabani, Y. Paltiel, A. Sher, A.Raizman, and A. Zussman. "GaSb/InAsSb heterostructure MWIR detector for high temperature operation". Proc. SPIE Defense and Security, Infrared Technology and Applications XXXIV, Vol. 6940, pp. 69400D, Orlando FL Mar. **2008**.

5. L.M. Merensky, I. Shafir, Y. Sharabani, D. Eger, M, Oron, A.F. Kardo-Sysoev, A. Sher, and A.S Kesar. "Fast switching of drift step recovery diodes based on all epi-Si growth". 2009 IEEE International Conference on Microwaves,

Communications, Antennas and Electronics Systems, COMCAS 2009, pp. 1-4, Tel-Aviv, **2009**.

6. A. S. Kesar and Y. Sharabani, "A compact 10 kV 2 ns rise-time pulsed power circuit based on of-the-shelf-components", The 20th Israeli conference on plasma science and its applications, IPSTA 2018, Tel-Aviv, Israel, **2018**.

7. Y. Sharabani, I. Shafir, S. Zoran, A. S. Keasr, and D. Eger. "Solid-state opening switches for pulsed power based on reverse recovery in diodes", The 20th Israeli conference on plasma science and its applications, IPSTA 2018, Tel-Aviv, Israel, **2018.**