Shmuel Hayun May. 2017

CURRICULUM VITAE

• **Personal Details**

Name: Shmuel Hayun
Date and place of birth: 09.03.1975, Israel
Address and telephone number at work: Ben-Gurion University of the Negev, Department of Materials Engineering, +972-8-6428742
Address and telephone number at home: Hatzeva 16 Meitar, 050 - 7237266

• **Education**

1999-2003	B.Sc.	Ben-Gurion University of the Negev, Physics
1999-2003	B.Sc. Magna cum laude	Ben-Gurion University of the Negev, Materials Engineering Prof. Moshe Dariel and Prof. Nachum Frage. The use of SHS for joining ceramics
2003-2005	M.Sc. Magna cum laude	Ben-Gurion University of the Negev, Materials Engineering Prof. Moshe Dariel, Prof. Nachum Frage and Prof. Eugene Zaretsky. Dynamic response of B_4C-SiC ceramic composites.
2005-2009	Ph.D.	Ben-Gurion University of the Negev, Materials Engineering Prof. Nachum Frage, Prof. Moshe Dariel and Prof. Eugene Zaretsky. The inter-relationships between the static and dynamic mechanical properties and the microstructure of reaction bonded boron carbide composites.

• **Employment History**

2016-Present	Associate Professor -Department of Materials Engineering, Ben-Gurion University of the Negev, Israel
2017-2018	Visiting Professor - Peter A. Rock Thermochemistry Laboratory, University of California, Davis, CA, USA
2011-2016	Senior lecturer -Department of Materials Engineering, Ben-Gurion University of the Negev, Israel
2009-2011	Postdoctoral researcher -Peter A. Rock Thermochemistry Laboratory, University of California, Davis, CA, USA
2003-2009	Teaching Assistant - Department of Materials Engineering, Ben-Gurion University of the Negev, Israel

• **Professional Activities**

Positions in academic administration

Departmental	
Dec. 2016- present	Chair of undergraduate teaching committee, Department of Materials Engineering, Ben-Gurion University of the Negev
Sep. 2015 – Apr. 2016	Chair of undergraduate teaching committee, Department of Materials Engineering, Ben-Gurion University of the Negev
2011- present	Member of undergraduate teaching committee. Responsible for the joint program Materials Engineering-Mechanical Engineering at the Department of Materials Engineering, Ben-Gurion University of the Negev
Faculty	
2011- present	Member of the steering committee of the Faculty of Engineering machine-shop, Ben-Gurion University of the Negev.

Professional functions outside universities/institutions (inter-university, national, international)

2018	Guest editor, Materials, MDPI.
2018	Member of the International Advisory Board of the 14th International Ceramics Congress – CIMTEC 2018 Perugia, Italy June 4-14 2018
2015	Member of the Scientific Committee of the 17th Israel Materials Engineering Conference (IMEC-17) which will be held on February 1-2, 2016 at Bar-Ilan University, Israel.
2015	Member of the Technical Program Committee (TPC) of Euro PM2015 Congress & Exhibition, held on October 4-7 October, 2015 Reims, France.
2015	Chair of "Sintering and Related Powder Processing Science and Technologies: SPS I" Materials Science & Technology 2015 (MS&T15) Columbus, OH, USA Oct. 4-8, 2015
2014	Chair of "Physical Metallurgy" session at the 16th Israel Materials Engineering Conference IMEC16, Technion, Haifa, Israel
2014-present	Academic advisor for thermal analysis in Ilse Katz Institute for nano-science, Ben Gurion University of the Negev, Beer-Sheva, Israel.
2014-present	Advisor (joint with Prof. Yuval Golan) of the Ben-Gurion University chapter of the Materials Research Society (MRS)
2014	Organizer and Chair of the thermal analysis symposium in memory of Eng. Gabriel Fischer, held on January 7, 2014 at the Ilse katz institute for nanoscale science and technology (IKI), Ben-Gurion University of the Negev, Israel.
2013-2014	Member in the Organizing Committee and Scientific Committee of the 16th Israel Materials Engineering Conference (IMEC-16), held on February 23-25, 2014 at the Technion, Haifa.
2011- 2013	Research associate without salary, Peter A. Rock Thermochemistry Laboratory, University of California, Davis, CA,USA

Significant professional consulting

2015-present	Israel Aerospace Industries (IAI) Israel, sintering of fused silica

2013-present Thermal batteries department, RAFAEL Advanced Materials & Processes (RAMP) Israel, oxidation of Al-Li compound.

Ad-hoc reviewer for journals

Journal of the European Ceramic Society
Journal of the American Ceramic Society
Ceramics International
Applied Physics A
Surface Review and Letters
Materials Research Letters
Journal of Materials Chemistry C

Membership in professional/scientific societies

2014-present	Materials Research Society (MRS)
2008-present	American Ceramic Society
2005-2007	American Physical Society

• Educational activities

Courses taught

1. Ceramic materials – Undergraduate (given each autumn semester, course number 365.1.4791)- Ben-Gurion University of the Negev.
2. Materials engineering laboratories - Undergraduate (given each fall and spring semesters, courses number 365.1.4013, 4023, 4343, 4153) - Ben-Gurion University of the Negev.
3. Physical properties of nanomaterials for energy applications –Graduate (365.2.9609) - Ben-Gurion University of the Negev.
4. Thermal analysis for materials science- Graduate (365.2.6012) - Ben-Gurion University of the Negev.

Research students

Post-doctoral fellows:

1. **Dr. Shei Meir**- "Effect of an Electric Field on FGM Materials Fabrication " Received Kreitman Post-Doctoral Scholarship. Completed in 2016.

Ph. D.

2. **Itzik Edry** – "The effect of external electric field on the structure of solidified aluminum " -Started at Feb. 2013, BGU (Joint supervision with Prof. N. Frage). Graduation 2017.
3. **Mahdi Halabi** – "The effect of an applied electric field on lattice ordering in non-stoichiometric magnesium aluminate spinel."- Started at. 2014, in 2014 was accepted to the direct MSc-PhD track. The student received two Ph. D. Scholarships one for Ph. D. scholarship for student's members of the Arab society from the planning and budgeting committee. The second from ministry of sciences and technology scholarships in Memory of Zvi Yanai Israeli Arabs, Druze and Circassians for Phd Students. During his PhD he received two best poster awards: one by the Israel Society for Microscopy and the second in the Microscopy Conference 2015 (MC 2015), BGU (Joint supervision with Prof. A. Kohan, Tel Aviv university). Anticipate graduation 2019

4. **Yuval Mordekovitz,** "Energetics of simple corrosive gases (H_2O, H_2, O_2) with $UO_2\backslash CeO_2$, $UO_2\backslash ThO_2$ and $ThO_2\backslash CeO_2$." Start Oct. 2015, The student received Negev scholarship. Anticipate graduation 2020
5. **Mathieu Dutto,** "Reaction bonded boron carbide using microwave sintering" Joint supervision with Prof. Dominique Goeuriot from MINES SAINT-ETIENNE France). Graduated at 2018
6. **Einat Strumza,** *Experimental Thermochemistry of Multi Principal Element Alloys*. **"**Anticipate graduation 2023
7. **Lee Shelly**, "water - actinides interaction" Anticipate graduation 2022

M. Sc.

8. **Mahdi Halabi**, "The effect of an applied electric field on lattice ordering in non-stoichiometric magnesium aluminate spinel", internal student toward M.Sc. For his MSc research, the student received Micron Award for excellence encouragement and The IVS excellence award (received at the 2014 IVS annual meeting). Completed in 2014.
9. **Sivan Sagi,** "Surface and water adsorption enthalpies of Nanoscale Nd doped CeO_2", internal student toward M.Sc., completed in 2015.
10. **Yuval Mordekovitz**, "Thermal and phase stability of Li-doped nano-sized MgO*n*Al_2O_3 spinel", internal student toward M.Sc., completed in 2015.
11. **Yael Shoval**, "Water adsorption enthalpy of non-stoichiometric nano-sized magnesium aluminate spinel", internal student toward M.Sc., completed in 2015.
12. **Tomer Mordechai**, "Effects of treatment duration and cooling rate on pure aluminum solidification upon pulse magneto-oscillation treatment", internal student toward M.Sc., completed in 2015.
13. **Gleb Spiridonov**-"Sintering of SiO_2"-external student toward M.Sc. started at 2015. Anticipate completion 2017
14. **Lee Shelly**, "water - actinides interaction using XPS" - internal student toward M.Sc., started at 2015. Anticipate completion 2017
15. **Evgeni Yonash**," Thermal properties of Reaction Bonding Boron Carbide, RBBC", internal student toward M.Sc., started at 2015. Anticipate completion 2017
16. **Nofar Baruch,** "Mechanical and optical characterization of spinel tiles connected with optical glue" external student toward M.Sc. started at 2015. Anticipate completion 2017.
17. **Einat Strumza, "**Thermal properties of 3D printed Al and Ti parts ,", internal student toward M.Sc., started at 2016. Anticipate completion 2018
18. **Or Rhamim** "Fabrication and characterization of Al-TiB2 composite by SPS **"**external student toward M.Sc. started at 2015. Anticipate completion 2019.
19. **Tomer Sol "**Characterization of additively manufactured material using time of flight and attenuation measurements" External student toward M.Sc. started at 2015. Anticipate completion 2019.

B.Sc.

2012-2013	Yael Shoval, Yuval Mordekovitz, Lital Neumann
2103-2014	Tanya Shmulavits, Gabriel dikovsky, Hadas Lusky and Ram Zidon (Joint supervision with Mr. Ido Zukerman (NRCN))
2014-2015	Mor Alfasi, Nofar Adadi, Netanel Barhanin and Eran Atar (Joint supervision with Mr. I. Zukerman (NRCN)

2015 -2016 Rachel Winestook, Evgani Reznik, Karin Kern (Joint supervision with Mr. M. Ben Baroush (NRCN))

Awards, Citations, Honors, Fellowships

Honors, Citation Awards

2005 - Israel Materials & Processes Society - First prize award on undergraduate research: "Self-propagating high-temperature synthesis for joining ceramics".
2009 - Wolf foundation - award for excellence in Ph. D. research.

Fellowships

2009 - Ben-Gurion University of the Negev, 15,000 $, Post-doctoral fellowship.
2009 – ISEF Foundation, 10,000 $, Post-doctoral fellowship.
2010 - Ben-Gurion University of the Negev, 10,000 $, Post-doctoral fellowship.
2010 - ISEF Foundation, 8,500 $ - Post-doctoral fellowship.

Scientific Publications

Chapters in collective volumes - Conference proceedings, Festschrifte, etc.

1. **S. Hayun[S],** N. Frage[PI], H. Dilman[C],V. Tourbabin[S] and M. P. Dariel[PI]. 2005,"Dense B_4C-SiC-TIB_2 composites" Edited by V. V. Skorkhod - Proceedings of the International Conference HighMatTech, Kiev, Ukraine, 235. Publisher, Ukraine Academy of Science 235.
2. **S. Hayun[S],** N. Frage[PI], M. P. Dariel[PI], E. Zaretsky[PI], Y. Ashuah[C], 2006, "Dynamic response of B_4C-SiC ceramic composites", Edited by Eugene Medvedovski - Ceramic Armor and Armor Systems IIPublisher: American Ceramic Society, 147-156. (6 citations)
3. **S. Hayun[S],** N. Frage[PI], H. Dilman[C], V. Tourbabin[S] and M. P. Dariel[PI], 2006, "Synthesis of dense B_4C-SiC-TlB_2 composites". Edited by Eugene Medvedovski - Ceramic Armor and Armor Systems IIPublisher: American Ceramic Society, 37-44. (6 citations)
4. A. Weizmann[S], **S. Hayun[S]**, M. P. Dariel[PI] and N. Frage[PI], 2007, "Optimization of the Particle Size Distribution for improving the Mechanical Properties of Reaction-Bonded Boron Carbide (RBBC) Composites", Edited by M.Zinigrad, E.A. Pastukhov - Proceedings of the Sixth Israel-Russian Bi-National Workshop Publisher Israeli Academy of Science and Humanities, 23-33.
5. **S. Hayun[S],** N. Frage[PI], M. P. Dariel[PI] and E. Zaretsky[PI], 2007, "Dynamic Mechanical Behavior of Boron Carbide Based Composites", Edited by M. L. Elert, M. D. Furnish,R. Chau, N. Holmes and J. Nguyen - Shock Compression of Condensed Matter Publisher: American Institute of Physics - 747-750. (2 citations)
6. **S. Hayun[S],** N. Frage[PI], M. P. Dariel[PI], 2008, "The Effect of Carbon Source on the Microstructure and Mechanical Properties of Reaction Bonded Boron Carbide" Edited by Rajendra K. Bordia and Eugene A. Olevsky. Advances in Sintering

Science and Technology, Publisher: American Ceramic Society - 29-41. (10 citations)

7. **S. Hayun[S],** M. P. Dariel[PI] and N. Frage[PI], 2008, "Microstructure and properties of boron carbide processed by FAST (Field Assisted Sintering Technology)" *Edited by J. Grin* - Advanced Processing for Novel Functional Materials, APNFM 2008 Publisher: IFAM 6pp.
8. **S. Hayun[S]**, A.Weizmann[S], H. Dilman[C], M. P. Dariel[PI] and N. Frage[PI],2009, "Rim region growth and its composition in reaction bonded boron carbide composites with core-rim structure"Journal of Physics: Conference Series 176, (7pp) doi:10.1088/1742-6596/176/1/012009. (5 citations)
9. V. Paris[S], **S. Hayun[S]**, M. P. Dariel[PI], N. Frage[PI], and E. Zaretsky[PI],2009,"On the Compressive and Tensile Strength of Magnesium Aluminate Spinel" Edited by M. Elert, M. D. Furnish, W. W. Anderson, W. G. Proud, W. T. Butler- Shock Compression of Condensed MatterPublisher: American Institute of Physics - 1003-1006. (4 citations).
10. M. Radune[S], M. Zinigrad[PI], N. Frumin[C], **S. Hayun**[C] and N. Frage[PI],2014, "Thermal stability of supersaturated (Ti, Al)N solid solution" Edited by M. Zinigrad, Proceedings of The Eighth International Conference on Material Technologies and Modeling (MMT-2014), 102-111
11. N. Frage[PI], E. Oz[S], E. Ionash[S], H. Dilman[C] and S. Hayun[PI], 2016, „Low temperature fabrication of reaction bonded boron carbide composites infiltrated with Al-Si alloys"Advances in Ceramic Armor, Bioceramics, and Porous Materials: Ceramic Engineering and Science Proceedings Volume 37(4) 49
12. Mathieu Dutto[s], Dominique Goeuriot[PI], Sébastien Saunier[C], Sergio Sao-Joa[C], Matthieu Lenci[C], Sylvain Marine[PI], Shmuel Hayun[PI], Nachum Frage[C], "Infiltration of molten silicon in a porous body of B_4C under microwave heating" HTCMC-9 & GFMAT 2016.
13. M. Radune[S], M. Zinigrad[PI], D. Fuks[C], **S. Hayun**[C] and N. Frage[PI] , 2016, "Thermal Decomposition of Supersaturated Ti1-xAlxN Solid Solution Synthesized by High-Energy Milling" Diffusion Foundations, 9, 82-89.

Refereed articles and refereed letters in scientific journals

1. L. Shelly, D. Schweke, S. Zalkind, N. Shamir, S. Barzilai, T. Gouder, and S. Hayun "Effect of U Content on the Activation of H_2O on $Ce_{1-x}U_xO_{2+\delta}$ Surfaces" Chemistry of Materials 2018 30 (23), 8650-8660
2. D. Schweke, Y. Mordehovitz, M. Halabi, L. Shelly, **S. Hayun** "Defect chemistry of oxides for energy applications", Adv. Mater. 2018, 30, 1706300
3. T. Sol, **S. Hayun**, D. Noiman, E. Tiferet, O. Yeheskel, O. Tevet, "Nondestructive ultrasonic evaluation of additively manufactured AlSi10Mg samples Additive Manufacturing 2018, 22, 700-707

4. **S. Hayun**, E. Ionash, S. Kalabukhov, N. Frage, E. Zaretsky, "Strength of ceramic–metal joints measured in planar impact experiments", Journal of Materials Science 2018, 53 (11), 8211-8220
5. **S. Hayun**, "Reaction-bonded boron carbide for lightweight armor: The interrelationship between processing, microstructure, and mechanical properties" American Ceramic Society Bulletin 96 (6), (2017) 20-26
6. M. Sokol, S. Meir, E. Strumza, S. Kalabukhov, **S. Hayun**, N. Frage, "On the effects of LiF on the synthesis and reactive sintering of gahnite ($ZnAl_2O_4$)" Ceramics International 43 (17), (2017), 14891-14896
7. M. Sokol, M. Halabi, Y. Mordekovitz, S. Kalabukhov, **S. Hayun**, N. Frage, An inverse Hall-Petch relation in nanocrystalline MgAl2O4 spinel consolidated by high pressure spark plasma sintering (HPSPS), Scripta Materialia 139, (2017), 159-161
8. M. Halabi, V. Ezersky, A. Kohn and **S. Hayun**, "Charge Distribution in Nanoscale Grains of Magnesium Aluminate Spinel". Journal of the American Ceramic Society. 100 (2),(2017) 800-811
9. Zukerman, M. Halabi, **S. Hayun**, R.L. Boxman , A. Raveh, "Segregation as a driving force in the formation of nanocomposite ZrO2-Al_2O_3 coatings", Surface and Coatings Technology,(2017) 314, 28–34
10. A. Munitz, S. Salhov, **S. Hayun** and N. Frage, "Heat Treatment Impacts the Microstructure and Mechanical Properties of AlCoCrFeNi High Entropy Alloy". Journal of Alloys and Compounds, 683, (2016) 221-230
11. I. Edry, N. Frage and **S. Hayun**, "The effect of pulse magneto-oscillation treatment on the structure of aluminum solidified under controlled convection." Materials letters, 182, (2016), 118-120
12. Y. Mordekovitz, L. Shelly, M. Halabi, S. Kalabukhov and **S. Hayun**, "The Effect of Lithium Doping on the Sintering and Grain Growth of SPS-Processed, Non-Stoichiometric Magnesium Aluminate Spinel" Materials, 9(6), (2016), 481
13. Y. Mordekovitz and **S. Hayun** "On the Effect of Lithium on the Energetics and Thermal Stability of Nano Sized Nonstoichiometric Magnesium Aluminate Spinel", Journal of American Ceramic Society, 99[8],(2016), 2786–2794
14. I. Edry, T. Mordechai, N. Frage and **S. Hayun**, "Effects of treatment duration and cooling rate on pure aluminum solidification upon pulse magneto-oscillation treatment", Metallurgical and Materials Transactions A, 47 (3), (2016), 1261-1267.
15. M. Ben-Haroush, G. Dikovskyss, S. Kalabuhuv, M. Aizenshtein and **S. Hayun**, "Spark Plasma Sintering of MgO strengthen aluminum" Journal of Materials Engineering and Performance, 25 (2), (2016) 648-655
16. S. Sagi and **S. Hayun**, "High temperature heat capacity of SPS-processed $Y_3Al_5O_{12}$ (YAG) and Nd:YAG, Journal of Chemical Thermodynamics, 93, (2016), 123–126
17. **S. Hayun**, S. Meir, S. Kalabukhov, N. Frage and E. Zaretsky, "Phase Constitution and Dynamic Properties of Spark Plasma-Sintered Alumina-Titanium Composites", Journal of American Ceramic Society, 99 [2], (2016), 573–580
18. S. Barzilai and **S. Hayun**, "Mechanical alloying and thermal analysis of Ta-Ti alloys" Journal of Materials Science, 50(20), (2015), 6833-6838

19. V. Erukhimovitch, Y. Mordekovitz, and **S. Hayun**, “Spectroscopic study of ordering in non- stoichiometric magnesium aluminate spinel”, American Mineralogist, 100, (2015) 1744–1751
20. S. Meir, S. Kalabukhov, N. Frage and **S. Hayun**” Mechanical Properties of Al_2O_3\Ti Composites Fabricated by Spark Plasma”, Ceramics International, 41(3B) (2015) 4637-4643
21. S. Meir, S. Kalabukhov and **S. Hayun**, 2014, ”Low temperature spark plasma sintering of Al2O3-TiC composites”, Ceramics International, 40(8) (2014) 12187-12192
22. N. Frage, **S. Hayun**, H. Dilman and M. P. Dariel, "Low temperature processing of reaction-bonded boron carbide composites", Advanced Engineering Materials 16(6) (2014) 797-805
23. I. Edry, V. Erukhimovitch, A. Shoihet, Y. Mordekovitz, N. Frage and **S. Hayun.** “Effect of impurity levels on the structure of solidified aluminum under pulse magneto-oscillation (PMO)” Journal of Materials Science - 48(24) (2013) 8438 – 8442
24. **S. Hayun**, V. Paris, R. Mitrani, M. P. Dariel, S. Kalabukhov, E. Zaretsky and N. Frage. “Microstructure and Mechanical Properties of Silicon Carbide Processed by Spark Plasma Sintering (SPS)” , *Ceramics International* 38(8) (2012) 6335-6340
25. **S. Hayun**, T. Tran, J. Lian, A. F. Fuentes, A. Navrotsky. "Energetics of stepwise disordering transformation in pyrochlores”, $Re_2Ti_2O_7$ (Re = Y, Gd and Dy)" *Acta Materialia*, 60(10), (2012), 4303-4310
26. **S. Hayun** and A. Navrotsky. "Formation Enthalpies and Heat Capacities of Rear Earth Titanates: RE_2TiO_5 (RE = La, Nd and Gd)", *Journal of Solid State Chemistry*,187, (2012), 70-74.
27. T. B. Tran, **S. Hayun**, A. Navrotsky, and R. H. R. Castro “Transparent Nanocrystalline Pure and Ca-Doped MgO by Spark Plasma Sintering of Anhydrous Nanoparticles” J. Am. Ceram. Soc., 95 [4] 1185–1188 (2012).
28. V. Alexandrov , T. Y. Shvareva , **S. Hayun** , M. D. Asta, and A. Navrotsky. "Actinide Dioxides in Water: Interactions at the Interface" *J. Phys. Chem. Lett.*, (24), (2011), 3130-3134 DOI: 10.1021/jz201458x.
29. **S. Hayun**, T. Tran, S. V. Ushakov, A. M. Thron, K. van Benthem, A. Navrotsky, and R. H. R. Castro, "Experimental Methodologies for Assessing the Surface Energy of Highly Hygroscopic Materials: The Case of Nanocrystalline Magnesia”, *J. Phys. Chem. C*, 115 (48),(2011) 23929-23935
30. **S. Hayun**, S. V. Ushakov, A. Navrotsky. "Direct Measurement of Surface Energy of CeO2 by Differential Scanning Calorimetry", *Journal of the American Ceramic Society*, 94, (2011) 3679-3682
31. **S. Hayun**, T. Y. Shvareva, A. Navrotsky, "Nanoceria Energetics of Surfaces, Interfaces and Water Adsorption", *Journal of the American Ceramic Society*, 94, (2011), 3992-3999.
32. **S. Hayun**, M.P. Dariel, N. Frage and E. Zaretsky. "The High Strain Rate Dynamic Response of Boron Carbide Based Composites", *Acta Materialia*, 58(5), (2010), 1721-173.

33. **S. Hayun** A.Weizmann, M. P. Dariel and N. Frage, “Microstructural Evolution During the Infiltration of Boron Carbide with Molten Silicon", *Journal of the European Ceramic Society*, 30(4), (2010), 1007-1014.
34. **S. Hayun**, H. Dilman, M. P. Dariel and N. Frage, “The effect of aluminum on the microstructure and phase composition of boron carbide infiltrated with silicon”, *Materials Chemistry and Physics,* 118(2-3), (2009), 490-495.
35. **S. Hayun**, S. Kalabukhov, V. Ezersky, M.P. Dariel, N. Frage, “Microstructural Characterization of Spark Plasma Sintered Boron Carbide Ceramics”, *Ceramics International*, 36(2), (2010), 451-457.
36. **S. Hayun**, V. Paris, M.P. Dariel, N. Frage and E. Zaretzky "Static and dynamic mechanical properties of boron carbide processed by spark plasma sintering”, *Journal of the European Ceramic Society*, 29, (2009), 3395-3400.
37. **S. Hayun**, M. P. Dariel, and N. Frage "Effect of the Carbon Source on the Microstructure and Mechanical Properties of Reaction Bonded Boron Carbide" Ceramic Transactions 209 (Advances in Sintering Science and Technology), Publisher: American Ceramic Society, (2010) 29-41.
38. **S. Hayun**, A.Weizmann, M. P. Dariel and N. Frage, "The Effect of Particle Size Distribution on the Microstructure and the Mechanical Properties of Boron Carbide-Based Reaction-Bonded Composites”. *International Journal of Applied Ceramic Technology*, 6[4], (2009), 492500.
39. **S. Hayun**, D. Rittel, N. Frage and M. P. Dariel, "Static and dynamic mechanical properties of infiltrated B_4C-Si composites", *Materials Science and Engineering A*, 487, (2008), 405409.
40. N. Frage, **S. Hayun**, S. Kalabukhov, M.P. Dariel "The effect of Fe addition on densification of B_4C powder by spark plasma sintering (SPS)" *Powder Metallurgy and Metal Ceramics*, 46(11-12), (2007), 1068-1302.
41. M. Aizenshtein, I. Mizrahi, N. Froumin, **S. Hayun**, M.P. Dariel and N. Frage "Interface Interaction in the B_4C/(Fe-B-C) system*"*, *Materials Science and Engineering A*, 495, (2008), 7074.
42. Orly Hachimi, **S. Hayun**, A. Venkert and M.P. Dariel "Microstructural study of CeNd alloys". *Journal of Alloys and Compounds* 427(1-2), (2007) 104-109.
43. **S. Hayun**, N. Frage H. Dilman, V. Tourbabin, M. P. Dariel "Synthesis of dense B_4C-SiC-TlB_2 composites". Ceramic Transactions, 178 Ceramic Transactions 178 (Ceramic Armor and Armor Systems II), Publisher: American Ceramic Society, (2006) 37-44.
44. **S. Hayun**, N. Frage, M. P. Dariel, E. Zaretsky, Y. Ashuah, "Dynamic response of B_4C-SiC ceramic composites", Ceramic Transactions 178 (Ceramic Armor and Armor Systems II), Publisher: American Ceramic Society, (2006), 147-156.
45. **S. Hayun**, N. Frage and M.P. Dariel "The morphology of ceramic phases in B_xC-SiC-Si infiltrated composites" *Journal of Solid State Chemistry*, 179(9), (2006), 2875-2879.

Lectures and Presentations at Meetings and Invited Seminars

Presentation of papers at conferences/meetings (oral or poster)

1. ***Invited lecture*** **S. Hayun**, T. Y. Shvareva, A. Navrotsky, "Surface and water adsorption energetics for cerium and thorium dioxides" 7th Conference MMT(Material Technologies and Modeling) Ariel, Israel , August 20-23, 2012.
2. ***Invited lecture*** **S. Hayun** - "Experimental assessment of the Surface and Water Adsorption Energetics for nanocrystalline magnesia". Twelfth Israeli - Russian Bi-National Workshop 2013, Jerusalm, Israel July 8-15, 2013.
3. ***Invited lecture*** **S. Hayun** - "The Effect of Oxide Non-stoichiometry on the Consolidation Behavior of Nanopowders by Spark Plasma Sintering" Materials Science & Technology 2013 Montreal, QC, Canada Oct. 27-31, 2013.
4. ***Invited lecture*** **S. Hayun** - "The Effect of Magnesium Aluminate Spinel Composition on Consolidation by Spark Plasma Sintering (SPS)", Israel Materials Engineering Conference IMEC 16, Technion, Haifa Israel 23-25 Feb. 2014.
5. ***Invited lecture*** **S. Hayun** – "Effect of Electric Field on the Disorder-Order Transformation in $MgOnAl_2O_3$ System", 2014 MRS Spring Meeting & Exhibit San Francisco, California, USA, April 21-25, 2014
6. ***Invited lecture*** **S. Hayun** - "Field assisted sintering of nano ceramic oxides", The 32nd Israel Vacuum Society conference - IVS 2014, Sep. 2014 , Herzliya, israel
7. ***Invited lecture*** **S. Hayun – "**Influence of external electric field and magnesium aluminate spinel stoichiometry on cation distribution and surface properties" 8th International Conference on High Temperature Capillarity (HTC-2015) May 17-21, 2015 Bad-Herrenalb, Germany.
8. ***Invited lecture*** **S. Hayun – "**The Effect of Lithium and Applied Pressure on the Sinterabilty of Magnesium Aluminate Spinel" Materials Science & Technology 2015 (MS&T15) Columbus, OH, USA Oct. 4-8, 2015.
9. ***Invited lecture*** **S. Hayun – "**New developments in reaction bonded boron carbide " 2016 E-MRS Fall Meeting, Warsaw University of Technology Plac Politechniki 1 - Warsaw, Poland. Oct. 19-22, 2016.

10. **S. Hayun**, N. Frage H. Dilman, V. Tourbabin, M. P. Dariel "Low temperature synthesis of dense B_4C-SiC-TiB_2 composites-The American Ceramic Society, Annual Meeting 2005, Baltimore, Maryland, USA, April, 2005(oral)
11. **S. Hayun**, N. Frage H. Dilman, V. Tourbabin, M. P. Dariel "Dense B_4C-SiC-TIB_2 composites International Conference HighMatTech, Kiev, Ukraine 2005.(oral)
12. **S. Hayun**, N. Frage, M. P. Dariel "The morphology of ceramic phases in BxC-SiC-Si infiltrated composites 15th International Symposium on Boron, Borides, and Related Compounds, Hamburg, Germany, Aug. 2005.(oral)
13. **S. Hayun**, N. Frage, M. P. Dariel and E. Zaretsky "Dynamic Response of B_4C-SiC Ceramic Composites Israel Materials Engineering Conference - IMEC XII, Beer-Sheva, Israel, March 2006. (poster)
14. **S. Hayun**, N. Frage, M. P. Dariel "Synthesis of Dense B_4C-SiC-TIB_2 Composites, Israel Materials Engineering Conference - IMEC XII, Beer-Sheva, Israel, March 2006. (Poster)
15. **S. Hayun**, N. Frage, M. P. Dariel "The Morphology of Ceramic Phases in B_xC-SiC-Si Infiltrated Composites., Israel Materials Engineering Conference - IMEC XII, Beer-Sheva, Israel, March 2006. (oral)

16. N. Frage, **S. Hayun**, S. Kalabukhov, M.P. Dariel " The effect of Fe addition on densification of B_4C powder by spark plasma sintering (SPS)" International Conference HighMatTech, Kiev, Ukraine Oct. 2007. (oral)
17. **S. Hayun**, N. Frage, M. P. Dariel and E. Zaretsky "Dynamic Mechanical Behaviour of Boron Carbide Based Composite." 15th APS Topical Conference on Shock Compression of Condensed Matter, APS SCCM Hawaii, USA, 2007(oral)
18. **S. Hayun**, M. P. Dariel and N. Frageand E. Zaretsky" Mechanical Properties of B_4C Based Si Infiltrated Composites at Various Strain Rate - Israel Materials Engineering Conference- IMEC XIII, Technion, Haifa Israel Dec. 2007. (oral)
19. **S. Hayun**, M. P. Dariel and N. Frage," The Effect of Carbon Source on the Microstructure and Mechanical Properties of Si Infiltrated Boron Carbide Composite- Israel Materials Engineering Conference IMEC XIII, Technion, Haifa Israel Dec. 2007. (poster)
20. **S. Hayun**, M. P. Dariel and N. Frage,"Microstructure and properties of boron carbide processed by FAST (Field Assisted Sintering Technology)"Advanced Processing of Novel Functional Materials - APNFM 2008 Dresden, Germany, (oral)
21. A. Weizman, **S. Hayun**, H. Dilman, M. P. Dariel, N. Frage "Microstructural evolution of reaction bonded boron carbide compositesE-MRS Fall Meeting 2008 Warsaw University of Technology Poland (oral)
22. **S. Hayun**, A.Weizmann, H. Dilman, M. P. Dariel and N. Frage"Rim region growth and its composition in reaction bonded boron carbide composites with core-rim structure", 16th International Symposium on Boron, Borides and Related Materials Matsue, Shimane, Japan 2008 (oral).
23. **S. Hayun**, M. P. Dariel, and N. Frage "Effect of the Carbon Source on the Microstructure and Mechanical Properties of Reaction Bonded Boron Carbide" - Sintering 2008 - La Jolla (San Diego), Ca. USA (oral).
24. **S. Hayun**, V. Paris, M. P. Dariel, E. Zaretsky and N. Frage, "On The Compressive and Tensile Strength of Magnesium Aluminate Spinel", Spinel -16th APS Topical Conference on Shock Compression of Condensed Matter, APS SCCM - Nashville, Tennessee, USA, 2009 (oral).
25. S. Barzilai, H. Nagar, M. Aizenshtein, **S. Hayun**, N. Froumin"Wetting and interface interaction between thermodynamically stable oxides and Al containing melts" 6th International Conference High Temperature Capillarity, Athens, Greece. 2009 (poster).
26. T. Y. Shvareva, T. J. Park, **S. Hayun** S. V. Ushakov,A. Navrotsky "Surface and water adsorption energetics of actinide and cerium oxides with fluorite structure 241st ACS National Meeting & Exposition - Anaheim, CA, United States, Abstracts of papers of the american chemical society Volume: 241 Meeting Abstract: 96-NUCL (oral).
27. T. Y. Shvareva, **S. Hayun**, S. Ushakov and A. Navrotsky "Exploring actinide and cerium dioxide surface energetics: Experimental insight" All-Hands and Science Advisory Board Meeting of the Materials Science of Actinides, EFRC. Notre Dame, IN, United States September 24, 2011 (poster).
28. R. H. R. Castro, K. Benthem, T. Tran, A. Navrotksy and **S. Hayun**" Experimental methodologies for assessing the surface energy of highly hygroscopic materials: The case of nanocrystalline magnesia" Materials Science & Technology 2011 Conference & Exhibition, Columbus, Ohio , October 16-20, 2011 (oral).
29. **S. Hayun**, V. Paris, R. Mitrani, E. Zaretsky, M. Dariel and N. Frage" Microstructure and mechanical properties, dynamic and static, of siliconcarbide processed by Spark Plasma Sintering (SPS)," Israel Materials Engineering Conference - IMEC 15 - Dead Sea, Israel, 2012 (poster).

30. **S. Hayun**, T. Tran, J. Lian, A. Navrotsky "Energetics of stepwise disordering transformation in pyrochlores, $RE_2Ti_2O_7$ (RE = Y, Gd and Dy)" Israel Materials Engineering Conference - IMEC 15 - Dead Sea, Israel, 2012 (oral).
31. **S. Hayun**, T. Y. Shvareva, A. Navrotsky"Experimental assessment of surface and water adsorption energetics for cerium and thorium dioxides" 7th International Conference High Temperature Capillarity - Eilat, Israel, 2012 (oral).
32. V. Erukhimovitch and **S. Hayun** "IR spectroscopic characterization of non-stoichiometric nano $MgAl_2O_4$ spinels"XV Anniversary Balkan Mineral Processing Congress (BMPC 2013), Bulgaria, June, 12-16 , 2013 (poster).
33. M. Ben-Haroush, M. Aizenshtein and **S. Hayun** "Spark Plasma Sintering of Aluminum Powders: Microstructure and Mechanical Properties" LightMAT 2013 - Magnesium, Aluminium, Titanium 3 - 5 September 2013 in Bremen, Germany (poster).
34. T. Mordechai, N. Aharon, A. Shoihet, I. Edry, V. Erukhimovitch and **S. Hayun**, "The Effects of Nucleation Sites and Cooling Rate on the Structure of Aluminum Solidified Under Pulse Magneto Oscillation (PMO)", Israel Materials Engineering Conference IMEC 16, Technion, Haifa Israel 23-25 Feb. 2014. (poster).
35. M. Halabi, **S. Hayun** "Inversion Parameter of Non-stoichiometric Magnesium Aluminate Spinel", Israel Materials Engineering Conference IMEC 16, Technion, Haifa Israel 23-25 Feb. 2014. (poster).
36. Y. Mordekovitz, **S. Hayun** "Sintering of Li-doped Magnesium Aluminate Spinel", Israel Materials Engineering Conference IMEC 16, Technion, Haifa Israel 23-25 Feb. 2014 (poster).
37. Y. Shoval, **S. Hayun** "The Effect of Magnesia Aluminate Spinel Composition on the Water Adsorption Enthalpy", Israel Materials Engineering Conference IMEC 16, Technion, Haifa Israel 23-25 Feb. 2014 (poster).
38. S. Meir, M. Bereznitsky, V. Kasiyan, **S. Hayun** and N. Frage, "Pressure Assisted Flash Sintering", Israel Materials Engineering Conference IMEC 16, Technion, Haifa Israel 23-25 Feb. 2014 (poster).
39. S. Meir, S. Kalabuhuv, **S. Hayun**, "Low Temperature Spark Plasma Sintering (SPS) OF Al_2O_3/TiC Based Composite", Israel Materials Engineering Conference IMEC 16, Technion, Haifa Israel 23-25 Feb. 2014 (poster).
40. E. Oz, H. Dilman, **S. Hayun**, M. Dariel and N. Frage, "Low Temperature Fabrication of the Reaction Bonded B_4C/Al-Si Composites", Israel Materials Engineering Conference IMEC 16, Technion, Haifa Israel 23-25 Feb. 2014 (poster).
41. Gabay, W. Kaplan, N. Frage and **S. Hayun**, "Electromagnetic Field Assisted Sintering of SiC", Israel Materials Engineering Conference IMEC 16, Technion, Haifa Israel 23-25 Feb. 2014 (poster).
42. M. Ben-Haroush, S. Haroush, M. Cohen, J. Sprintzin, M. Aizenshtein and **S. Hayun**, "Microstructure and Mechanical Properties of Spark Plasma Sintered Aluminum Powders", Israel Materials Engineering Conference IMEC 16, Technion, Haifa Israel 23-25 Feb. 2014 (poster).
43. I. Edry, V. Erukhimovitch, N. Frage and **S. Hayun**, "Effect of Impurity Levels on the Structure of Solidified Aluminum Under Pulse Magneto-oscillation (PMO)" Israel Materials Engineering Conference IMEC 16, Technion, Haifa Israel 23-25 Feb. 2014 (oral).
44. M. Halabi, **S. Hayun** "Inversion Parameter of Non-stoichiometric Magnesium Aluminate Spinel", NanoIsrael 2014 , The 4th International Nanotechnology Conference & Exhibition, March 24-25, 2014, David InterContinental Hotel, Tel Aviv, Israel (poster).

45. Y. Mordekovitz, **S. Hayun** "The effect of Lithium on the sinterabilty of nano magnesium aluminate spinel ", NanoIsrael 2014 , The 4th International Nanotechnology Conference & Exhibition, March 24-25, 2014, David InterContinental Hotel, Tel Aviv, Israel (poster).
46. Y. Shoval, **S. Hayun** "Water adsorption enthalpy of non-stoichiometric magnesia aluminate spinel", NanoIsrael 2014 , The 4th International Nanotechnology Conference & Exhibition, March 24-25, 2014, David InterContinental Hotel, Tel Aviv, Israel. (poster)
47. M. Halabi and **S. Hayun** "Cation distribution and inversion parameter of non-stoichiometric magnesium aluminate spinel" ISM 2014 - The 48th annual meeting of the Israel society for microscopy, Weizmann institute of science. Rehovot, Israel, May 13-14th, 2014. (poster)
48. V. Erukhimovitch and **S. Hayun**. "Spectroscopic Study in the $MgOnAl_2O_3$ System", The 14th International Multidisciplinary Scientific GeoConference & EXPO S G E M, June 17-26, 2014, Albena, Bulgaria. (poster)
49. **S. Hayun**, H. Dilman, E. Oz, M. Dariel, N. Frage "Boron Carbide-aluminum Composites Fabricated by Pressureless Infiltration at Low Temperature " International Conference on Mining, Material and Metallurgical Engineering MMME'14 August 11-12 2014 Prague, Czreh Republic (poster)
50. *M. Halabi and **S. Hayun**, "Cations distributions and inversion parameter in the $MgOnAl_2O_3$ spinel system" The 32nd Israel Vacuum Society conference - IVS 2014, Sep. 2014 , Herzliya, israel – Best poster award (poster)
51. S. Sagi, and **S. Hayun**, "Surface and water adsorption enthalpies of nanoscale Nd doped CeO2" The 32nd Israel Vacuum Society conference - IVS 2014, Sep. 2014 , Herzliya, israel (poster)
52. M. Halabi, V. Ezersky, A. Kohn and **S. Hayun**, "Distributions of cations and inversion parameter in nonstoichiometric magnesium aluminate spinel characterized by electron energy-loss spectroscopy l"18 The International Microscopy Congress (IMC 2014), Prague, Czech Republic, 7-12 Sep. 2014. (oral)
53. **S. Hayun**, H. Dilman, E. Oz , M.P. Dariel and N. Frage, "Boron Carbide-aluminum Composites Fabricated by Pressureless Infiltration at Low Temperature", Proceedings of the International Conference on Mining, Material and Metallurgical Engineering Prague, Czech Republic, August 11-12, 2014. (poster)
54. M. Radune, M. Zinigrad, N. Frumin**, S. Hayun** and N. Frage, "Thermal stability of supersaturated (Ti, Al)N solid solution" The Eighth International Conference on Material Technologies and Modeling (MMT-2014), July 28-August 1 , 2014. (oral)
55. Y. Mordekovitz and **S. Hayun**, "The effect of lithium on the synthesis and sinterabilty of nano magnesium aluminate spinel" The 32nd Israel Vacuum Society conference - IVS 2014, Sep. 2014 , Herzliya, israel (poster)
56. *M. Halabi , A. Kohn and **S. Hayun** "Measuring the Space Charge Potential in Granular Magnesium Aluminate Spinel using OffAxis Electron Holography" The 49th Annual Scientific Meeting of ISM (ISM 2015) Bar-Ilan University, Ramat Gan. 17-18 May 2015. Best poster Prize in Materials Sciences (poster)
57. Y. Shoval and **S. Hayun** ,"Water adsorption enthalpy of non-stoichiometric magnesium aluminate spinel" 8th International Conference on High Temperature Capillarity (HTC-2015) May 17-21, 2015 Bad-Herrenalb, Germany. (poster)
58. S. Sagi and **S. Hayun**,"Surface and water adsorption enthalpies of Nanoscale Nd doped CeO_2" 8th International Conference on High Temperature Capillarity (HTC-2015) May 17-21, 2015 Bad-Herrenalb, Germany (poster)

59. E. Oz, H. Dilman, **S. Hayun**, N. Frage, "Low temperature fabrication of the reaction bonded B_4C/Al –Si composites" 8th International Conference on High Temperature Capillarity (HTC-2015) May 17-21, 2015 Bad-Herrenalb, Germany
60. Y. Mordekoviz and **S. Hayun**, "Effect of lithium on the synthesis process and phase stability of non-stoichiometry nano magnesium aluminate spinel" 8th International Conference on High Temperature Capillarity (HTC-2015) May 17-21, 2015 Bad-Herrenalb, Germany (poster)
61. T. Mordechai , I. Edry and **S. Hayun**, "The effects of cooling rate and duration of Pulse Magneto Oscillation (PMO) treatment on the solidified structure of aluminum" 8th International Conference on High Temperature Capillarity (HTC-2015) May 17-21, 2015 Bad-Herrenalb, Germany (poster)
62. M. Halabi , A. Kohn and **S. Hayun**, "Measuring the Space Charge Potential in Granular Magnesium Aluminate Spinel using Off-Axis Electron Holography" Microscopy conference 2015 (MC 2015), Georg-August-University Göttingen, Germany. 6-11 September 2015. MC Best Poster Award in Materials Sciences: Ceramics, Composites, Geomaterials, Archaeology (MS7). (poster)
63. S. Meir and **S. Hayun**, "Electric Field Effects on Spinel Structure" 11th International Conference of Pacific Rim Ceramic Societies(PacRim-11) Jeju Island, Korea from Aug. 30th- Sept. 4th, 2015. (oral).
64. S. Meir and **S. Hayun**, "Influence Of Electric Fields At High Temperatures On Ceramic Microstructure" Israel Materials Engineering Conference IMEC 17, Bar-Ilan University, Ramat-Gan on February 1-2, 2016. (poster).
65. Y. Mordekovitz, **S. Hayun** "Effect Of Lithium On Thermal Stability Of Nano-Sized Non-Stoichiometeric Magnesium Aluminate Spinel", Israel Materials Engineering Conference IMEC 17, Bar-Ilan University, Ramat-Gan on February 1-2, 2016. (poster).
66. L. Shelly, Y. Mordekovitz, **S. Hayun** "Grain Growth Kinetics In Li-$MgO{\cdot}1.21Al_2O_3$ Spinel, Israel Materials Engineering Conference IMEC 17, Bar-Ilan University, Ramat-Gan on February 1-2, 2016. (poster).
67. M. Halabi, A. Kohn, **S. Hayun** "Measuring The Space Charge Potential In Granular Magnesium Aluminate Spinel Using Off-Axis Electron Holography, Israel Materials Engineering Conference IMEC 17, Bar-Ilan University, Ramat-Gan on February 1-2, 2016. (oral).
68. I. Edry, T. Mordechai, N. Frage, **S. Hayun** "Effect Of Pulse Magneto-Oscillation (Pmo) Treatment Parameters On The Structure Of Solidified Aluminum", Israel Materials Engineering Conference IMEC 17, Bar-Ilan University, Ramat-Gan on February 1-2, 2016. (oral).
69. Y. Mordekovitz, **S. Hayun** "Water-surface energetics in $Ce1\text{-}xM_xO_2\text{-}y$(M-Ca, Ti, Nd) system" 2016 E-MRS Fall Meeting, Warsaw University of Technology Plac Politechniki 1 - Warsaw, Poland. Oct. 19-22, 2016. (poster).
70. L. Shelly, Y.Mordekovitz, **S.Hayun** "X-Ray Photoelectron Spectroscopy of Neodymium doped Cerium oxide" 2016 E-MRS Fall Meeting, Warsaw University of Technology Plac Politechniki 1 - Warsaw, Poland. Oct. 19-22, 2016. (poster).
71. M. Halabi, A. Kohn, **S. Hayun** "Distribution of Electrostatic Charge in Nanoscale Magnesium Aluminate Spinel" 2016 E-MRS Fall Meeting, Warsaw University of Technology Plac Politechniki 1 - Warsaw, Poland. Oct. 19-22, 2016. (poster).

Seminar presentations at universities and institutions

1. 2008, Peter A Rock Thermochemistry Laboratory and NEAT ORU - University of California, Davis , USA, *"The inter-relationship between the mechanical properties*

(static and dynamic) and the microstructure of reaction bonded boron carbide composites".

2. 2012, Department of Materials Science, Ben Gurion University of the Negev, Israel, *"Experimental Methodologies for Assessing the Water Adsorption Effect on the Surface Energy in Nanoceramics".*
3. 2013, Department of Materials Science & Engineering - Technion, Israel, *"Thermo and defect chemistry of nano oxide powders and their SPS consolidation".*
4. 2014, Department of Mechanical Engineering, Colorado State University, USA, *"Effect of Electric Field on the Disorder-Order Transformation in $MgOnAl_2O_3$ System".*
5. 2014, Peter A Rock Thermochemistry Laboratory and NEAT ORU - University of California, Davis ,USA, *"Effect of Electric Field on the Disorder-Order Transformation in $MgOnAl_2O_3$ System".*

• **Patents**

2015, Frage Nahum, Dariel Moshe, Hayun Shmuel, Weizman Amir, Process for manufacturing a composite based on boron carbide, IL 188517, Israel.

Research Grants

1. 2011-2013 - **BSF- S. Hayun (PI)** and A. Navrotsky (PI), "How to retain nanostructure during ceramic sintering: New approach to advanced understanding." Annual amount: 37,500 $, Total amount 75,000 $.
2. 2011-2015 – PAZI foundation - **S. Hayun (PI),** N. Frage (PI**)** and Nissim Navi (PI) "Grain refinement by current pulsing", Annual amount: 33,750 $, Total amount 135,000 $
3. 2012-2018 - Israel Ministry of Defense (MAFAT) - **S. Hayun (PI)** and N. Frage (PI), Metal matrix composite, Annual amount: 120,000$, Total amount 840,000 $
4. 2012-2016 - Marie Curie Career Integration Grants (CIG)- **S. Hayun (PI), "**Effect of an External Electric Field on Grain Boundary Evolution in the Course of Nano-Ceramic Sintering", Annual amount: 31,000$, Total amount 124,000 $
5. 2012-2016 - PAZI foundation - **S. Hayun (PI)** and M. Aizenshtein (PI) " Properties of reinforced Al and metals manufactured by powder metallurgy technique, Annual amount: 33,750 $, Total amount 135,000 $
6. 2014-2016 – Israel Ministry of Economy- **S. Hayun (PI)** and N. Frage (PI) "Development of advanced ceramic material and technological industrialization of reaction bonding with improved performance for advanced applications", Annual amount: 128,000$, Total amount 320,000 $
7. 2014-2017 - International copartion NRCN – JRC, **S. Hayun (PI)** and S. Zalkind (PI) " The interaction of simple gases (H_2O, H_2, O_2) with actinedis (UO_2, CeO_2 and ThO_2) Annual amount: 35,000 $, Total amount 140,000 $
8. 2015-2020 - PAZI foundation - **S. Hayun (PI),** N. Frage (PI**)** and M. Aizenshtein (PI) "Experimental Study and Modeling of Advanced Casting Technologies, Annual amount: 204,000 $, Total amount 1,020,408 $
9. 2015-2018- Israel Ministry of Sciences and Technology (MOST), "Additive manufacturing of metallic parts with improved physical and mechanical properties for applications under severe conditions" **S. Hayun (PI)** and N. Frage (PI**),** Annual amount: 250,000 $, Total amount 750,000 $.