

# MICHAEL ZINIGRAD

(972) 3 9066281  
rector@ariel.ac.il

## AREAS OF EXPERTISE

- Over 40 years of experience in Materials Science and Materials Engineering, Mathematical modeling and simulation.
- Founded the Research Laboratory for Advanced Materials Investigations.
- Theoretical and experimental investigations on high-temperature processes.
- Development of new materials based on mathematical modeling of physico-chemical and technological processes.
- Plasma electrolytic oxidation (PEO) coatings on aluminum and magnesium alloys created in aqueous solution and molten salt electrolytes.
- Solid oxide fuel cell investigation.
- Metal alloys strengthening by nanoparticles.
- Ink-jet printed thin layers.

**Languages:** Hebrew, English, German, Russian, Ukrainian

## ACADEMIC AND PROFESSIONAL EXPERIENCE

1994 - *present*      **Full professor**, *Ariel University, Ariel, Israel*  
2008 - *present*      **Rector**, *Ariel University, Ariel, Israel*  
1995 - 2008          **Dean of the Natural Science Faculty**, *Ariel University Center, Ariel Israel*  
1999 - *present*      **Head of the Materials Research Center**, *Ariel University, Ariel, Israel*  
1983 - 1992          **Professor**, *Urals Technical University, Ekaterinburg, Russia*  
1988 - 1991          **Head of the Surfacing Department**, *Urals Polytechnic Institute, Sverdlovsk, USSR*  
  
1976 - 1983          **Associated professor**, *Urals Polytechnic Institute, Sverdlovsk, USSR*  
1972 - 1976          **Assistant**, *Urals Polytechnic Institute, Sverdlovsk, USSR*  
1969 - 1972          **Post graduate**, *Urals Polytechnic Institute, Sverdlovsk, USSR*

**Scientific supervision:** 17 Ph.D. Students, 38 Masters Students and 5 Post-Docs

**Publications and Patents:** Over 200 scientific publications (incl. monograph, articles, and patents).

## EDUCATION

1982    **D.Sc. Physical chemistry**  
USSR Academy of Science, Institute of Metallurgy, Sverdlovsk  
Thesis Title: *Kinetics and mechanism of the interaction of sulfide-metal and oxide melts*

1972    **Ph.D. Metallurgy of non-ferrous, noble and rare metals**  
USSR Academy of Science, Institute of Electro-chemistry, Sverdlovsk  
Thesis Title: *Kinetic analysis of sulfide sulfur oxidation by slags*

1968    **M.Sc. Metallurgical engineer, physico-chemical investigations of metallurgical processes**  
Dnepropetrovsk Metallurgical Institute, Ukraine  
Thesis Title: *Synthesis and crystallic structure of some solid solutions*

## **AWARDS AND MEMBERSHIP IN INTERNATIONAL ACADEMIC INSTITUTIONS**

- 2009            **Member of the International Academy of Science and Higher Education, Russia**  
2017            **Doctor Honoris Causa of Russian Academy of Science**  
2017            **Honorary Professor of Ushynsky University, Odessa, Ukraine**

## **VISITING POSITIONS**

- Sum. 1997      **Visiting Professor, Urals State Technical University, Sverdlovsk, Russia**  
Sum. 1998      **Visiting Professor, Central Iron and Steel Institute, Beijing, China**  
Sum. 2001      **Visiting Professor, Institute of Metallurgy, Russian National Academy of Science, Sverdlovsk, Russia**

## **PROFESSIONAL SOCIETIES & GOVERNMENT COMMITTEES**

- Member of the National Committee on Technological Incubators under the Office of the Chief Scientist of Israel's Ministry of Industry, Trade and Labor (2007-2013), Israel
- American Welding Society (AWS), USA
- Materials Information Society (ASM International) , USA
- Coordination Committee for Metallurgical and Welding Technologies, Paton Institute, Kiev Ukraine

## **JOURNAL EDITORIAL BOARD MEMBERSHIPS**

### **GUEST EDITOR**

- *Israel Journal of Chemistry*, 2010, Vol. 47, No 3-4
- **Special issue, Welding, Joining and Casting of Advanced Materials, *Materials***, 2016-2017, Vol. 9-10
- **Special issue, Welding, Joining and Coating of Metallic Materials, *Materials***, 2018-2019
- **Special issue, Thin Coatings and Patterns by Inkjet Printing Technology, *Coatings***, 2018-2019

### **EDITORIAL BOARD MEMBER**

- *Journal of Metals (High-Temperature Physical Chemistry and Electrochemistry of Melts)*
- *Journal of Ferrous Metals*
- *Journal of Non-Ferrous Metals*
- *The Paton Welding Journal*
- *Journal of Modern Electrometallurgy*

## RESEARCH GRANTS

2019 -2021	Exact sciences-3D printing. Development of innovative 3D Ink-jet printing technology for efficient and durable solid oxide fuel cell.	<b>Israeli Ministry of Science and Technology</b> <b>595,000 NIS</b>
2016-2019	Project: Solid oxide fuel cells (SOFC) – using scandium.	<b>Norma Investments Ltd., British Virgin Islands;</b> <b>800,000USD</b>
2016-2019	Project: Photovoltaic cells doped with scandium.	<b>Norma Investment Ltd., British Virgin Islands;</b> <b>700,000USD</b>
2016-2017	Zimin Foundation	<b>500,000USD</b>
2015-2017	Development of a technology for the Mechanical properties improvement of copper-based alloys by nano-sized materials.	<b>Israeli Ministry of Economy and Industry, Framework Kamin;</b> <b>794,000 NIS</b>
2012 - 2015	Development of a technology for producing dental implants with surface coatings improved for osseo-integration.	<b>Framework of the Resolution of the Perm Krai Government, Russia: Granting of subsidies for realization of scientific projects by international research groups of scientists on the base of state educational institutions of higher professional education;</b> <b>93,246 USD</b>
2009	Technology development for mechanical properties improvement of cast aluminum alloys by nano and ultrafine materials.	<b>Israeli Ministry of Industry, Framework MAGNETON;</b> <b>773,820 NIS</b>
2007	Developing of the Metal Materials with required structure and properties using nano sized powders.	<b>Israeli Ministry of Industry Framework NOFAR;</b> <b>418,280NIS</b>
2006	Environmentally Friendly Coating Technology As An Alternative To The Electrolytic Hard Chrome Plating.	<b>Israeli Ministry of Industry Framework MAGNETON;</b> <b>1,053,219 NIS</b>
2006	Obtaining Compact Nanomaterials Based on Transition Metal Oxides by Intensive Plastic Deformations, Investigating their Structure and Properties.	<b>Israeli Ministry of Science;</b> <b>129,360 NIS</b>
2004	Synthesis of compact nanocrystal lanthanum manganites by the hard plastic deformations method.	<b>Israeli Ministry of Science;</b> <b>40,000 NIS</b>

	Investigations of the structure and stability of the nanostates in different oxidizing media, analysis of electric, magnetic and diffusion properties.	
2002	Air pressure Welding of Dissimilar Metals.	<b>GM Foundation; 12,000 USD</b>
1999 - 2001	Modeling and simulation in Materials Engineering.	<b>GM Foundation; 35,000 USD</b>
1998 - 2001	New compositions of flux core electrodes.	<b>Israeli Ministry of Industry and Trade; 400,000 USD</b>
1998 - 2000	Development of a new welding material.	<b>GM Foundation; 45,000 USD</b>
1997 - 2000	Development of high-temperature wear – resistant metallic material based on Ni-Al intermetallics.	<b>China-Israel Foundation for Scientific and Strategic R&amp;D; 100,000 USD Israeli Ministry of Science</b>

## LIST OF PUBLICATIONS

### MONOGRAPH

1. V. Boronenkov, M. Zinigrad, L. Leontev, E. Pastukhov, M. Shalimov, S. Shanchurov, *Phase Interaction in the Metal—Oxides Melts—Gas System: The Modeling of Structure, Properties and Processes*. Springer, 407p. 2012.  
[V. Boronenkov, M. Zinigrad, L. Leontev, E. Pastukhov, M. Shalimov, S. Shanchurov, *Simulation of structure properties and interphase interaction processes in the Metal – Oxides Melts – Gas System*. Ural Branch of the Russian Academy of Science Press, 450p. 2010].

### BOOK CHAPTERS

1. K. Borodianskiy, M. Zinigrad, Computational Methods for Creation Materials with Required Composition and Structure. In *Materials Science* 445-464 (ed. I. Mastai) Intec publ., (2013).
2. A. Lugovskoy, M. Zinigrad, Plasma Electrolytic Oxidation of Valve Metals. In *Materials Science* 85-102 (ed. I. Mastai) Intec publ. (2013).

### PATENTS

1. A. Balin, L. Barmin, M. Zinigrad, B. Zilbergleit, A. A. Kojevnikov, Yu. Plishevskiy, Flux for hardsurfacing. Patent USSR 1073975, 1983.
2. A. Balin, L. Barmin, M. Zinigrad, B. Zilbergleit, E. Shulimovich, I. Naydenov, Flux for hardsurfacing. Patent USSR 1075544, 1983.
3. V. Ilinsky, M. Zinigrad, A. Fljagin, A. Balin, M. Shalimov, L. Barmin, B. Zilbergleit, Ceramic flux for hardsurfacing Patent USSR 1352820, 1987.
4. V. Ilinsky, A. Okolzdajev, M. Zinigrad, A. Fljagin, A. Fefelov, N. Korolev, V. Merkulov, V. Miroschnichenko, Ceramic flux for hardsurfacing. Patent USSR 1485543, 1989.
5. A. Timoshin, P. Ivanov, M. Zinigrad, M. Shalimov, V. Tokar, Flux for electros slag remelting. Patent USSR 1767884, 1991.

6. A. Krasnopolski, M. Zinigrad, Method and system for cooling by using solar energy. Patent WO 2008135990 A2, 2008.
7. K. Borodianskiy, M. Zinigrad, A. Sobolev, A. Kossenko, A. Krasnopolski. Advanced methods of Plasma Electrolytic Oxidation (PEO) treatment using solid or foam-based electrolytes. US provisional patent application No. 62/629719 2018.
8. K. Borodianskiy, A. Krasnopolski, M. Zinigrad, Copper-based substances with nanomaterials. US provisional patent application No. 62/695055 2018.
9. V. Goldshtein, A. Kossenko, A. Sobolev, M. Zinigrad. Solid oxide fuel cell array generating ammonia as byproduct and utilizing ammonia as secondary fuel. US provisional patent application No. 62/787,387 2019.

#### ARTICLES

1. A. Schepetkin, V. Antonov, M. Zinigrad, A. Men, G. Chufarov, Crystal-chemical changes during titan cobalt dissociation at equilibrium conditions. *Zhurnal Fizicheskoy Khimii* **43**(12) 3084-3085 (1969).
2. A. Schepetkin, R. Zakharov, M. Zinigrad, G. Chufarov, Synthesis of spinel solid solutions in systems Me-Ti-Fe-O (Me = Zn, Co, Ni, Mn). *Crystallografiya* **14**(5) 889-894 (1969).
3. M. Zinigrad, L. Barmin, Velocity of the interaction of cupric sulfide with cupric oxide dissolved in slag. *Izvestiya vuzov. Tsvetnaya metallurgiya* **6** 28-33 (1971).
4. M. Zinigrad, L. Barmin, A. Sotnikov, S. Popel, M. Lvov, Kinetics of the interaction of cupric, nickel and cobalt sulfide with corresponding oxides dissolved in slag. *Izvestiya vuzov. Tsvetnaya metallurgiya* **1** 32-36 (1972).
5. M. Zinigrad, L. Barmin, The rate of cobalt sulfide oxidation by oxide melt involving cobalt oxide (II). *Fiziko-khimicheskie protsessy v tsvetnoy metallurgii* **204** 115-118 (1972).
6. M. Zinigrad, A. Sotnikov, L. Barmin, Investigation of the anodic polarization of liquid sulfides in oxide melts., *Izvestiya Ac. Nauk SSSR. Metalli* **3** 97-102 (1973).
7. A. Sotnikov, M. Zinigrad, L. Barmin, Oxygen role in kinetics of the interaction of Ni-S alloys with liquid oxides. *Izvestiya vuzov. Tsvetnaya metallurgiya* **6** 40-43 (1973).
8. M. Zinigrad, A. Sotnikov, L. Barmin, Investigation of sulfides-slugs interaction by relaxation techniques. *Fiziko-khimicheskiye issledovaniya metallurgicheskikh protsessov* **1** 80-86 (1973).
9. M. Zinigrad, L. Barmin, A. Sotnikov, Kinetics and the mechanism of sulfides oxidation by slag melts. In *Electrokhimiya i rasplavy* 228-235. Nauka, Moscow (1974).
10. Y. Nikitin, M. Zinigrad, A. Sotnikov, L. Barmin, The function of the absorption in processes of oxygen transition from slag to metal. In *Kinetics and thermodynamics of gases-liquid metals interaction* 72. Nauka, Moscow (1974).
11. M. Zinigrad, L. Malisheva, L. Barmin, Peculiarities of anodic polarization of liquid ferrous sulfide within liquid oxides. *Izvestiya vuzov. Tsvetnaya metallurgiya* **5** 91-95 (1975).
12. M. Zinigrad, L. Barmin, A. Sotnikov, Kinetics and mechanism of discharge of oxygen ions in liquid sulfides. *Fiziko-khimicheskiye issledovaniya metallurgicheskikh protsessov* **3** 79-82 (1975).
13. M. Zinigrad, L. Barmin, E. Eremin, B. Kulishenko, V. Kojurkov, Improvement of weld metal forming under welding of transformer steel. *Avtomaticheskaya svarka* **7** 66 (1976).

14. L. Barmin, M. Zinigrad, A. Phljagin, K. Zhdanovich, A. Zaitsev, Kinetics of aluminum transition through metal-slag boundary *Izvestiya vuzov. Chernaya metallurgiya* **7** 59-62 (1976).
15. M. Zinigrad, L. Malisheva, L. Barmin, Oxygen transition through ferrum sulfide/ionic melts interface. In *Physical chemistry of ionic melts* **2** 36. Institut Obsh'ey i neorganicheskoy khimii, AN UkSSR, Kiev (1976).
16. L. Malisheva, M. Zinigrad, L. Barmin, Investigation of oxygen transition through the boundary of ferrous sulfide and oxide melt. *Izvestiya vuzov. Tsvetnaya metallurgiya* **1** 148-150 (1977).
17. A. Phljagin, L. Barmin, V. Kojurkov, M. Zinigrad, K. Zhdanovich, A. Zaytsev, Equilibrium distribution of aluminum between iron alloys and slag. *Fiziko-khimicheskiye issledovaniya metallurgicheskikh protsessov* **5** 76-79 (1977).
18. M. Zinigrad, A. Phljagin, Electrochemical behavior of aluminum at iron-carbon melt/oxide electrolyte interface. In *Present problems of physical chemistry of solutions* **2** 47-51. VINITI, Leningrad (1978).
19. L. Panphilova, M. Zinigrad, L. Barmin, The influence of oxygen surface concentration in Me-S alloys on kinetics of oxygen transition through the boundary of sulfide and oxide melt. *Zhurnal Fizicheskoy Khimii* **52**(10) 2491-2494 (1978).
20. L. Barmin, M. Zinigrad, A. Panov, K. Zhdanovich, A. Zaytsev, Influence of temperature and concentration of aluminum on melts viscosity in system Fe-C-Al. *Fiziko-khimicheskiye issledovaniya metallurgicheskikh protsessov* **6** 54-58 (1978).
21. E. Eremin, B. Kulishenko, M. Zinigrad, On tungsten electrode stableness while welding in mixture of argon and carbon oxide. *Svarochnoye proizvodstvo* **1** 17-18 (1979).
22. V. Boronenkov, S. Shantshurov, M. Zinigrad, Kinetics of the interaction of multicomponent metal with slag under diffusion conditions. *Izvestiya Ac. Nauk SSSR. Metalli* **6** 21-27 (1979).
23. Y. Nikitin, E. Belyaeva, M. Zinigrad, Kinetics of slag spreading over metal in the conditions of component transition across the interface. *Fiziko-khimicheskiye issledovaniya metallurgicheskikh protsessov* **7** 116-122 (1979).
24. L. Panphilova, M. Zinigrad, L. Barmin, Laws of the oxidation of ferrous, cupric, nickel and cobalt sulfides by slags. *Izvestiya Ac. Nauk SSSR. Metalli* **4** 19-24 (1979).
25. A. Phljagin, M. Zinigrad, L. Barmin, Kinetics of ionic exchange between Fe-C-Al melt and an oxide electrolyte. *Elektrokhimiya* **15**(12) 1858-1861 (1979).
26. L. Barmin, Yu. Aganaev, B. Kulishenko, M. Zinigrad, B. Pastuchov, V. Chlinov, The influence of the surface properties of the liquid phase on the formation of crystallization cracks during the surfacing of iron-boron alloys. *Adgeziya rasplavov i payka materialov* **5** 83-85 (1980).
27. M. Zinigrad, V. Kojurkov, A. Phljagin, The effect of aluminum and carbon on the equilibrium concentration of oxygen in the iron - carbon melt. *Fiziko-khimicheskiye issledovaniya metallurgicheskikh protsessov* **8** 82-103 (1980).
28. M. Zinigrad, A. Sotnikov, A. Phljagin, L. Barmin, On the regime of electrochemical oxidation of aluminum at the metal - slag interface. *Fiziko-khimicheskiye issledovaniya metallurgicheskikh protsessov* **8** 99-104 (1980).
29. M. Zinigrad, S. Panov, L. Barmin, Sulfur transfer through metal melt - slag melt interface. *Chermetinformatsiya* **931** (1980).

30. M. Zinigrad, S. Panov, L. Barmin, Limiting stage of Fe-C melt desulphurization by slags. *Chermetinformatsiya* **938** (1980).
31. M. Zinigrad, G. Toporistshev, V. Najdenov, Limiting stage of sulfur oxidation from sulfide melts by oxygen from slags. *Izvestiya vuzov. Tsvetnaya metallurgiya* **1** 29-33 (1981).
32. M. Zinigrad, S. Panov, L. Barmin, K. Zhdanovich, Kinetic features of the desulfurization of iron-carbon melt by slag. *Izvestiya vuzov. Tchernaya metallurgiya* **2** 4-6 (1981).
33. M. Zinigrad, G. Toporistshev, Velocity of quick stage of sulfur oxidation from sulfide melts by oxygen from slag. *Izvestiya vuzov. Tsvetnaya metallurgiya* **2** 32-36 (1981).
34. L. Panphilova, M. Zinigrad, L. Barmin, Quick stage kinetics of oxygen ion discharge on the boundary of sulfide melts and liquid oxides. *Electrokhimiya* **17**(9) 1346-1349 (1981).
35. M. Zinigrad, The peculiarities of oxidation of sulfur from sulfide-metal melts by liquid slags' oxygen. *Fiziko-khimicheskiye issledovaniya metallurgicheskikh protsessov* **9** 87-104 (1981).
36. M. Zinigrad, S. Panov, L. Barmin, M. Shalimov, Investigation of the distribution of sulfur between Fe-C-S melt and CaO-Al<sub>2</sub>O<sub>3</sub>-MgO slag. *Fiziko-khimicheskiye issledovaniya metallurgicheskikh protsessov* **9** 60-64 (1981).
37. M. Zinigrad, S. Panov, L. Barmin, Kinetic parameters of sulfur transition quick stage through the boundary of Fe-C and oxide melts. *Electrokhimiya* **18**(4) 523-526 (1982).
38. M. Zinigrad, L. Barmin, L. Panphilova, Kinetic analysis of the reactions of interaction of oxides and sulfides of copper, iron, nickel and cobalt. *Fiziko-khimicheskiye issledovaniya metallurgicheskikh protsessov* **10** 83-87 (1982).
39. M. Shalimov, M. Zinigrad, S. Panov, L. Barmin, K. Zhdanovich, A. Zaytsev, Kinetic analysis of joint transfer of S, Fe, C, Al metal - synthetic slag interface. *Fiziko-khimicheskiye issledovaniya metallurgicheskikh protsessov* **10** 107-114 (1982).
40. M. Zinigrad, A. Phephelov, L. Barmin, M. Shalimov, The oxidation rate of boron that is dissolved in metal by oxide melt. *Chermetinformatsiya* **1533** (1982).
41. M. Zinigrad, A. Phephelov, L. Barmin, M. Shalimov, The peculiarities of kinetic stage of boron transfer through metal - oxide interface. *Chermetinformatsiya* **1569** (1982).
42. M. Zinigrad, L. Panphilova, L. Barmin, Surface concentration of oxygen in sulfide-metal melts and the rate of oxygen transition through sulfide - oxide melt interface. In *Surface properties of melts* 286. Naukova dumka, Kiev (1982).
43. M. Zinigrad, N. Korolev, I. Noskov, L. Tolstych, Physico-chemical peculiarities of alloying of weld metal. In *Welding materials* 37. Naukova dumka, Kiev (1982).
44. V. Boronenkov, M. Zinigrad, M. Shalimov, L. Barmin, K. Zhdanovich, Mathematical modeling of metal and slag processes interaction in a ladle. *Izvestiya vuzov. Tchernaya metallurgiya*, **1** 36-41 (1983).
45. Y. Nikitin, S. Tretyakov, M. Zinigrad, N. Vlasov, Kinetics of formation of the sulfide-metal melt/oxide melt. *Fiziko-khimicheskiye issledovaniya metallurgicheskikh protsessov* **11** 128-132 (1983).
46. M. Shalimov, A. Phephelov, M. Zinigrad, L. Barmin, Calculation of the metal composition after hardsurfacing under ceramic flux. *Avtomaticheskaya svarka* **1** 33-37 (1984).
47. M. Shalimov, M. Zinigrad, S. Panov, A. Phephelov, A. Phljagin, Calculation of equilibrium distribution of elements between metal and slag melts. In *Structure and properties of slag melts*, 62-66. Kurgan machinostroitelnyy institut (1984).

48. M. Zinigrad, A. Timoshin, V. Lepinsky, Cathodic deposition of Fe, Ni, Co from the melt based on MgF. In *Structure and properties of slag melts* **2** 73. Kurgan machinostroitelnyy institut (1984).
49. A. Phephelov, M. Zinigrad, B. Arnautov, Flux for alloying of metal by boron in hardsurfacing. *Svarochnoye proizvodstvo* **4** 21-22 (1985).
50. A. Phephelov, M. Zinigrad, B. Arnautov, Influence of boron flux concentration on the coefficient of boron transition into hardsurfacing metal. *Svarochnoye proizvodstvo* **10** 36-37 (1985).
51. M. Zinigrad, A. Balin, A. Phephelov, L. Barmin, M. Shalimov, Kinetics of boron reduction from oxide melt by carbon that is dissolved in Fe. *Chermetinformatsiya* **3017** (1985).
52. M. Zinigrad, A. Okolzdajev, A. Phljagin, Anodic oxidation of tungsten on metal/oxide electrolyte interface. In *Physical chemistry of high temperature and electrochemistry* **1** 167. Uralskiy Nauchnyy Tsentr, AN SSSR, Sverdlovsk (1985).
53. M. Shalimov, A. Phljagin, M. Zinigrad, Improving the technology of the ladle treatment of steel using mathematical modeling. In *Theory and Practice of the Ladle Treatment of Steel* 128-130. Moscow (1985).
54. A. Phljagin, A. Phephelov, M. Zinigrad, M. Shalimov, Kinetics of Al and B crossing through the boundary liquid metal-oxide melt. *Izvestiya Ac. Nauk SSSR. Metally* **1** 50-55 (1986).
55. M. Zinigrad, A. Phephelov, L. Barmin, M. Shalimov, Kinetics of interaction of a boron-containing metal melt with an oxide electrolyte. *Electrokhimiya* **22**(1) 74-78 (1986).
56. A. Balin, M. Zinigrad, L. Barmin, B. Silberglait, Alloying of weld metal by reduction of elements from flux oxides. *Teoriya i praktika svarki* 24-27 (1986).
57. M. Shalimov, A. Phljagin, M. Zinigrad, M. Ilinsky, Dephosphorization of metal during submerged arc welding. *Teoriya i praktika svarki* 19-23 (1986).
58. Zinigrad, A. Okolzdajev, A. Phljagin, V. Merkulov, Influence of phase composition and temperature on the equilibrium distribution of tungsten between metal and slag melts. *Rasplavy* **1**(5) 7-11 (1987).
59. A. Timoshin, M. Zinigrad, Development and application of low fluoride neutral flux for electroslog remelting alloys. *Problemy spetsialnoy electrometallurgiyi* **4** 21-25, (1987).
60. M. Zinigrad, A. Phephelov, M. Shalimov, A. Balin, Modeling of building-up processes. *Teoriya i praktika svarki* **5** 20 (1987).
61. N. Razikov, M. Zinigrad, V. Shumjakov, Interaction of oxides of alkali metals with iron in flux-cored wire arc welding. *Avtomaticeskaya svarka* **3** 34-36 (1988).
62. M. Zinigrad, A. Balin, L. Barmin, B. Zilbergleit, Hardsurfacing of 170 8CP steel with chromium and boron recovery from slag. *Avtomaticeskaya svarka* **5** 52-55 (1988).
63. M. Zinigrad, A. Okolzdajev, A. Phljagin. Limiting stage of tungsten anodic oxidation on boundary of metal and oxide melts. *Rasplavy* **2** (3) 46-51 (1988).
64. M. Zinigrad, A. Okolzdajev, A. Phljagin, K. Zhdanovich, Quick stage of tungsten oxidation on boundary of metal and oxide melts. *Rasplavy* **2**(4) 19-25 (1988).
65. M. Zinigrad, Modeling of metal and slag melt interaction. In *Bases of physico-chemical and technological data* 182. Dnepropetrovsk (1988).
66. M. Zinigrad, Development and production of ceramic flux. In *Advances and prospects of welding production* 132. Moscow (1988).
67. A. Phljagin, A. Okolzdajev, M. Zinigrad, Application of oxide tungsten compounds for alloying of metal in submerged arc built welding. *Svarochnoye proizvodstvo* **10** 41-43 (1988).



68. M. Jadkevich, S. Zimin, B. Statnikov, M. Zinigrad, Influence of technological parameters of electron beam spraying on content of heat resistant coating. *Fiziko-khimicheskaya mekhanika materialov* **4** 56-61 (1989).
69. M. Jadkevich, S. Zimin, D. Ishchenko, M. Zinigrad, I. Koritko, B. Statnikov, Study of the dependence of the efficiency of electron beam heating on the angle of incidence of the beam on the surface of the body. *Fizika i khimiya obrabotki materialov* **6** 46-48 (1989).
70. M. Zinigrad, A. Phljagin, Modeling of metal alloying in submerged arc built welding. *Informatsionnie materialy* **1**(35) 53-57 (1989).
71. M. Zinigrad, A. Phljagin, A. Okolzdajev, M. Shalimov, Improvement of technology of the processing of waste involving tungsten in the arc steel-making furnace. In *Bases of physico-chemical and technological data* 190. Kurgan machinostroitelnyy institut (1990).
72. M. Zinigrad, Modeling of composition and properties of materials. In *Bases of physico-chemical and technological data* 112. Kurgan machinostroitelnyy institut (1990).
73. M. Zinigrad, A. Phljagin, A. Okolzdajev, M. Shalimov, Improvement of technology of remelting of waste involving tungsten by application of modeling. *Izvestiya vuzov. Chernaya metallurgiya* **12** 59-62 (1991).
74. M. Zinigrad, A. Zinigrad, *The mathematical model of welding process optimization*. *Chimia, Israel* **45** 93-98 (1999).
75. M. Zinigrad, V. Mazurovsky, Development of new welding materials on the base of mathematical modeling of metallurgical processes. Part 1: Phase Interaction Analysis and Development of the Basic Model. In *The optimization of composition, structure and properties of metals, oxides, composites, nano and amorphous materials* 277-291. Bi-National Russia-Israel Workshop, Ekaterinburg (2002).
76. M. Zinigrad, V. Mazurovsky, Development of new welding materials on the base of mathematical modeling of metallurgical processes. Part 2: Development of Solution Algorithm and Software. In *The optimization of composition, structure and properties of metals, oxides, composites, nano and amorphous materials* 292-303. Bi-National Russia-Israel Workshop, Ekaterinburg (2002).
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