DMYTRO DEMIRSKYI

CURRENT POSITION

Research Scientist

Temasek Laboratories @ Nanyang Technological University, Singapore

CURRENT ADDRESS

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RESEARCH ABILITY

Spark Plasma Sintering, microwave processing of materials, synthesis, characterization & fabrication of ceramic materials, sintering phenomena, nanostructured materials, solid state physics and some closely related fields.

EDUCATION

Ph.D.	Powder Metallurgy and Composites	Dec. 2010	Institute for Problems of Materials, Ukraine
M.Sc.	Powder Metallurgy and Metal Ceramics	July 2006	National Technical University of Ukraine (NTTU) "KPI", Kyiv, Ukraine (with honors).

PREVIOUS EMPLOYMENT

Name of Institution	Location	Position	From – To
Nanyang Technological University	Singapore	Research scientist	2015 - present
National Institute for Materials Science	Tsukuba, Japan	Post Doc Fellow	2013 - 2015
Frantsevich Institute for Problems in Materials Science NAS of Ukraine	Kiev, Ukraine	Senior Researcher	2012 - 2013
Frantsevich Institute for Problems in Materials Science NAS of Ukraine	Kiev, Ukraine	Researcher	2011 - 2012
Pennsylvania State University	University Park, PA, USA	Research Fellow	2009, 2012
Frantsevich Institute for Problems in Materials Science NAS of Ukraine	Kiev, Ukraine	Postgraduate student	2006 - 2011

RESEARCH WORK

Spark-plasma consolidation, Microwave processing, Development of new techniques for thermal expansion measurements, Sintering theory for non-isothermal and field-activated processes, 2006 - to date; IPMS, PSU, NIMS and NTU.

Sintering kinetics and sintering mechanisms for materials with various nature of microwave energy absorption: Ph.D. Thesis; 2010, IPMS, Ukraine.

Fundamentals of microwave heating and sintering of complex oxides: M.Sc. Thesis; 2006, National Technical University of Ukraine, Kyiv, Ukraine.

Past Research and Achievements

Research Scientist
Temasek Laboratories @ Nanyang Technological Univeristy
2015 – present /20 months /

Responsible for comparative research on the densification using Spark Plasma Sintering (SPS) of ceramics, including: B_4C, TiB_2; and their composites. Developing consolidation procedures to obtain large scale ceramics tiles for dynamic and static testing. Possibility for improving of mechanical properties of spark-plasma sintered ceramics by tayloring of the SPS annealing process is being analyzed. Development, synthesis, consolidation and characterization of high-temperature ceramic with complex 'core-shell' or organized eutectic structure of non-oxide ceramic, including B_4C-$Me^{IV}B_2$ ($Me^{V}B_2$), B_4C-SiC, B_4C-SiC-MeB_2 systems. Room and high-temperature (up to 2000 °C) analysis of the mechanical properties of non-oxide ceramic composites including flexural strength and fracture toughness. Analytical study of the grain size effect on the flexural strength of ceramics. In depth fractographical analysis of the ceramics (oxide and non-oxide) after the flexural strength tests at room and elevated temperatures.
Skills acquired: Analysis and optimization of SPS schedules using a bottom – top approach: starting from diameter of 10 mm and targeting samples with diameter of 100 mm.

Japan Society Promotion of Science International
Postoctoral Fellowship
National Institute for Materials Science
2013 – 2015 /24 months/

Responsible for comparative research on the densification using Spark-Plasma Sintering and millimeter wave (28 GHz) sintering of ceramics, including: B_4C, TiB_2, NbC, ZrB_2, TiB_2, ZrC, TiN, TiCN. Developed unique technique for in-situ synthesis and consolidation of boron carbide – metal diboride lightweight ceramic composites with controlled eutectic structure for high-temperature perfomance. Two-stage densification process of nanosized nitride ceramics by microwave and conventional sintering has been developed. Multistage densification process during spark-plasma consolidation of carbides of titanium, zirconium, niobium and tantalum is being monitored. Interdependence of processing conditions (i.e. consolidation technique used, temperature, heating and cooling rate) on Young's modulus and strength of high-melting point compounds is being studied. Possibility for improving of mechanical properties of spark-plasma sintered ceramics by additional annealing is being analyzed.
Skills acquired: Analysis of hot-pressing and spark-plasma sintering techniques as pressure-assisted sintering process.

Senior Researcher
Frantsevich Institute for Problems in Materials Science NAS of Ukraine
2012 - 2013

Responsible for comparative research on the densification during microwave and spark-plasma sintering of ceramics, including: 3 mol% Y_2O_3 – ZrO_2, Al_2O_3, WC. Two-stage densification process of nanosized YSZ by microwave and spark-plasma sintering have been observed. The initial stage sintering is controlled by the grain-boundary diffusion mechanism. The second stage involves the competition between grain-growth and densification. Grain-growth studies were also performed, the modification of the heating schedule was proposed. The two-stage sintering approach was tested and verified during microwave sintering of zirconia, alumina and binderless WC nanopowders. Developed an effective method for recalculation of the shrinkage data during Spark Plasma Sintering process. Results show the significant mismatch in the shrinkage data if results of the graphite-die are not accounted for. Evaluated the dielectric and gaseous (Paschen's Law) breakdown during microwave and spark-plasma sintering of nanocrystalline powders.
Skills acquired: Supervisory skills. A working knowledge of creep and pressure sintering processes.

Researcher
Frantsevich Institute for Problems in Materials Science NAS of Ukraine
2011 - 2012

Developed and conducted experiments on field assisted sintering experiments (microwave and spark plasma sintering) of metal powders. The application of a classical sphere-to-sphere approach showed the possibility of identifying the main diffusion mechanisms operating during the initial stage of microwave sintering of iron, copper and silver powders. A methodology is proposed to investigate in detail shrinkage kinetics under isothermal spark plasma sintering (SPS) conditions applied to ceramic nano powders such as Y_2O_3 stabilized ZrO_2. To do so, mild SPS conditions were used (low temperatures and pressure, long dwell times). Thus obtained results are in agreement with densification by a grain-boundary diffusion mechanism as for conventional sintering and the contribution from the specific pressure-assisted mechanisms as for hot pressing is insignificant. This result suggests that exploration of mild SPS might prove rewarding in separation and control of the sintering mechanisms leading to production of specific ceramic with new or improved functionality.
Participant of the STCU # 4259 Project, responsible for microwave sintering studies of nanostructured composites of the Ti-Si-N-B system. Densification kinetics study during microwave sintering of titanium nitride-based nanocomposite has been conducted. A TiN-SiC, TiN-Si_3N_4, TiN-AlN compositions were used. The effect of the SiC content on heating uniformity and final density and grain-size achieved has been investigated. Optimized microwave sintering resulted in fine microstructure (<300 nm) and hence high values of micro hardness (>20 GPa). Studied the effect of nitrogen pressure during microwave sintering experiments of TiN on grain-boundary composition.
Skills acquired: Supervisory skills. A working knowledge of creep and pressure sintering processes.

PhD student
Frantsevich Institute for Problems in Materials Science NAS of Ukraine
2006 - 2011

Developed and conducted experiments on initial stage of microwave sintering. Those have been conducted for materials with different nature of microwave energy absorption. Therefore the kinetics of the initial and intermediate stages of microwave sintering of metals and ceramics has been studied. Developed a method for evaluation of the apparent diffusivity during initial stage of microwave sintering processes based on the statistical analysis of neck growth data. Discovered an anomalous neck growth rate during microwave sintering of copper, nickel, iron and fused tungsten carbide powders. The latter is caused by the formation of the melted regions during the neck growth/formation processes between spherical shaped particles and have been confirmed by the apparent diffusion coefficients and the activation energies observed. Participant of the NATO SfP # 982831, duties required experimental research on synthesis and sintering of nanocrystalline $BaTiO_3$ ceramics. Experience in tape-casting of fine $BaTiO_3$ based MLCC.
Skills acquired: Ceramic and metal powder processing and sintering. Fine powders ceramics processing via tape-casting. Extensive use of powder characterization equipment: SEM, XRD, particle size distribution measurement and analysis. A working knowledge of FORTRAN, PASCAL programming, basic knowledge on COMSOL programming and operation, RCS dilatometer.

ISI Publication list

1. O. Vasylkiv, D. Demirskyi, H. Borodianska, Y. Sakka, P. Badica, High temperature flexural strength in monolithic boron carbide ceramic obtained from two different raw powders by Spark Plasma Sintering, ***Journal of the Ceramic Society of Japan***, (in press)
2. D. Demirskyi, I. Solodkyi, Y. Sakka, O. Vasylkiv, High-temperature strength of boron suboxide ceramic consolidated by spark plasma sintering, ***Journal of American Ceramic Society***, (in press).
3. D. Demirskyi, Y. Sakka, O. Vasylkiv, High-strength B4C-TaB2 eutectic composites obtained via in situ by spark plasma sintering, ***Journal of American Ceramic Society***, (in press).

4. O. Vasylkiv, D. Demirskyi, P. Badica, T. Nishimura, A.I.Y. Tok, Y. Sakka, H. Borodianska, Room and high temperature flexural failure of spark plasma sintered boron carbide, ***Ceramics International***, (in press, accepted 10.1016/j.ceramint.2016.01.088)
5. I. Solodkyi, D. Demirskyi, Y. Sakka, O. Vasylkiv, Hardness and toughness control of brittle boron suboxide ceramics by consolidation of star-shaped particles by spark plasma sintering, ***Ceramics International***, Vol.42, pp. 3525-3530 (2016).
6. D. Demirskyi, T. Nishimura, Y. Sakka, O. Vasylkiv, High-strength TiB2–TaC ceramic composites prepared using reactive spark plasma consolidation, ***Ceramics International***, Vol. 42, pp. 1298-1306 (2016).
7. D. Demirskyi, Y. Sakka, O. Vasylkiv, Consolidation of B4C–VB2 eutectic ceramics by spark plasma sintering, ***Journal of the Ceramic Society of Japan***, Vol. 123, pp. 1051-1054, (2015).
8. I. Solodkyi, D. Demirskyi, Y. Sakka, O. Vasylkiv, Synthesis of Multi-Layered Star-Shaped B6O Particles Using the Seed-mediated Growth Method, ***Journal of American Ceramic Society***, Vol. 98 [12] pp. 3635-3638 (2015).
9. D. Demirskyi, Y. Sakka, O. Vasylkiv, Consolidation of B4C-TaB2 eutectic composites by spark plasma sintering, ***Journal of Asian Ceramic Societies***, Vol. 3 [4] Dec. 369-372 (2015).
10. D. Demirskyi, Y. Sakka, O. Vasylkiv, High-temperature reactive spark plasma consolidation of TiB_2-NbC ceramic composites, ***Ceramics International***, Vol.41, pp. 10828-10834, (2015).
11. D. Demirskyi, Y. Sakka Fabrication, microstructure and properties of in situ synthesized B4C–NbB2 eutectic composites by spark plasma sintering, ***Journal of the Ceramic Society of Japan***, Vol. 123, pp. 33-37, (2015).
12. D. Demirskyi, Y. Sakka, High-temperature reaction consolidation of TaC–TiB2 ceramic composites by spark-plasma sintering, ***Journal of the European Ceramic Society***, Vol. 35, pp. 405-410, (2015).
13. D. Demirskyi, Y. Sakka, In Situ Fabrication of B4C–NbB2 Eutectic Composites by Spark–Plasma Sintering, ***Journal of American Ceramic Society***, Vol. 97, [8] pp. 2376-2378, (2014).
14. D. Demirskyi, D. Agrawal, A. Ragulya, Tough ceramics by microwave sintering of nanocrystalline titanium diboride ceramics, ***Ceramics International*** Vol. 40, pp. 1303-1310, (2014).
15. P. Badica, H. Borodianska, S. Xie, T. Zhao, D. Demirskyi, P. Li, A.I.Y. Tok, Y. Sakka, O. Vasylkiv, Toughness control of boron carbide obtained by spark plasma sintering in nitrogen atmosphere, ***Ceramics International***, Vol. 40, pp. 3053-3061, (2014).
16. D. Demirskyi, D. Agrawal, A. Ragulya, Comparisons of grain size-density trajectory during microwave and conventional sintering of titanium nitride, ***Journal of Alloys and Compounds***, Vol. 581, No 25, pp. 498-501, (2013).
17. D. Demirskyi, J. Cheng, D. Agrawal, A. Ragulya, Densification and grain growth during microwave sintering of titanium diboride, ***Scripta Materialia***, Vol. 69, No 8, pp. 610-613, (2014).
18. D. Demirskyi, A. Ragulya, Low-temperature microwave sintering of TiN-SiC nanocomposites, ***Journal of Material Science***, Vol. 47, No 8, pp. 3741-3745, (2012).
19. O. Vasylkiv, D. Demirskyi, Y. Sakka, A. Ragulya, H. Borodianska, Densification Kinetics of Nanocrystalline Zirconia Powder Using Microwave and Spark Plasma Sintering - A Comparative Study, ***Journal of Nanoscience and Nanotechnology***, Vol. 12, No 6, pp. 4577-4582, (2012).
20. H. Borodianska, D. Demirskyi, Y. Sakka, P. Badica, O. Vasylkiv, Grain boundary diffusion driven spark plasma sintering of nanocrystalline zirconia, ***Ceramics International***, Vol. 38, No 5, pp. 4385-4389, July, (2012).
21. D. Demirskyi, H. Borodianska, D. Agrawal, A. Ragulya, Y. Sakka, O. Vasylkiv, Peculiarities of the neck growth process during initial stage of spark-plasma, microwave and conventional sintering of WC spheres, ***Journal of Alloys and Compounds***, Vol. 523, pp. 1-10,

(2012).

22. D. Demirskyi , D. Agrawal, A. Ragulya, A scaling law study of the initial stage of microwave sintering of iron spheres, ***Scripta Materialia***, Vol. 66, No 6, pp. 323-326, (2012).
23. D. Demirskyi, H. Borodianska, S. Grasso, Y. Sakka, O. Vasylkiv, Microstructure evolution during field-assisted sintering of zirconia spheres, ***Scripta Materialia***, Vol. 65, No 8, pp. 683-326, (2011).
24. D. Demirskyi, A Ragulya, D. Agrawal, Initial Stage Sintering of Binderless Tungsten Carbide Powder Under Microwave Radiation, ***Ceramics International***, Vol. 37, No 2, pp. 505-512, (2011).
25. D. Demirskyi, D. Agrawal, A. Ragulya, Neck growth kinetics during microwave sintering of nickel powder, ***Journal of Alloys and Compounds***, Vol. 509, No 5, pp. 1790-1795, (2011).
26. D. Demirskyi, D. Agrawal, A. Ragulya, Densification kinetics of powdered copper under single-mode and multimode microwave sintering, ***Materials Letters***, Vol. 64, No 13, pp. 1433-1436, (2010).
27. D. Demirskyi, D. Agrawal, A. Ragulya, Neck growth kinetics during microwave sintering of copper, ***Scripta Materialia***, Vol. 62, No 8, pp. 552-555, (2010).
28. D. Demirskyi, D. Agrawal, A. Ragulya, Neck formation between copper spherical particles under single-mode and multimode microwave sintering, ***Materials Science and Engineering: A***, Vol. 527, No 7-8, pp. 2142-2145, (2010).
29. D. Demirskyi, A. Ragulya, Initial kinetics of microwave sintering of copper, ***Powder Metallurgy and Metal Ceramics***, Vol. 49, No 3-4 , pp. 147-152, (2010).

Selected Presentations on International Conferences

1. Ragulya A., Demirskyi D. Fundamentals and Challenges of Microwave Sintering Process. / ICMAT 2011, Singapore, 2011.
2. Ragulya A., Demirskyi D. Neck Formation and Growth on Initial Stage Microwave Sintering. / Sintering 2011, Rep. of Korea, 2011.
3. Demirskyi D., Ragulya A., Sintering kinetics of nanocrystalline ceramics using microwave assisted sintering. / 7-th Students' Meating, Novi Sad, Serbia, 2011.
4. Demriskyi D., Borodianska H. Competition between Driving Forces for Sintering during Early Stages of Field-Assisted Sintering. MS&T 2012, October 7-11, 2012 – Pittsburgh, Pennsylvania, USA.
5. D. Demirskyi, H. Borodianska, T. Zhao, A. Ragulya, Y. Sakka, O. Vasylkiv. Multifunctional ceramics using reaction FAST consolidation of high entropy alloys. 7th International Conference on the Science and Technology for Advance Ceramics (STAC-7). 21-st June 2013, Yokohama, Japan.
6. D. Demirskyi, O. Vasylkiv, D. Agrawal, A. Ragulya, Y. Sakka, H. Borodianska. Fabrication of dense boride-nitride ceramic nanocomposites by spark-plasma and microwave sintering. EMRS 2013 Fall Meeting. 16-th September 2013, Warsaw, Poland.
7. D. Demirskyi, A. Ragulya, D. Agrawal, Y. Sakka. Tough ceramics by microwave sintering of nanocrystalline titanium diboride ceramics.
8. 38th International Conference and Exposition on Advanced Ceramics and Composites, 28-th January 2014, Daytona Beach, Florida, USA.
9. Demriskyi D., Sakka Y., Vasylkiv O. Effect of Spark-plasma Sintering Parameters on Densification, Microstructure Evolution and Properties of Ta(Nb)-Ti-B-C Ceramic Composites. MS&T 2014, October 13, 2014 – Pittsburgh, Pennsylvania, USA.
10. Demriskyi D., Borodianska H., Sakka Y., Vasylkiv O., Agrawal D. Competition between Sintering Mechanism during Microwave and Spark-plasma Sintering of Ceramic on Initial, Intermediate and Final Stages of Sintering. MS&T 2014, October 13, 2014 – Pittsburgh,

Pennsylvania, USA.

11. Demriskyi D., Sakka Y., Vasylkiv O. Effect of spark-plasma sintering parameters on densification, microstructure evolution and properties of Ti-Ta-B-C ceramic composites. ICC 5, August 17-21, 2014. – Beijing, China.
12. Demriskyi D., Borodianska H., Sakka Y., Vasylkiv O., Agrawal D. Competition between sintering mechanism during microwave and spark-plasma sintering of ceramic on initial, intermediate and final stages of sintering. ICC 5, August 17-21, 2014. – Beijing, China.
13. Demirskyi D., Sakka Y., Vasylkiv O. Effect of Spark-Plasma Sintering Parameters on Densification, Microstructure Evolution and Properties of Nb-Ti-B-C Ceramic Composites. The Eighth International Conference on the Science and Technology for Advanced Ceramics (STAC8), Yokohama.
14. D. Demirskyi, Y. Sakka, O. Vasylkiv, Fabrication, Microstructure and Properties of in situ Synthesized B4C-NbB2 Eutectic Composites by Spark Plasma Sintering, 3rd International Conference on Powder Metallurgy in AsiaAPMA2015, Kyoto, Japan.
15. I. Solodkyi , D. Demirskyi, H. Borodianska , Y. Sakka, O. Vasylkiv, Spark Plasma Sintering of B6O Star-shaped Nanoplates and Influence of Star-shaped Structure of B6O on Fracture Mechanics, 3rd International Conference on Powder Metallurgy in AsiaAPMA2015, Kyoto. Japan.
16. Dmytro Demirskyi, O. Vasylkiv, Fabrication, microstructure and properties of in situ synthesized B4C-NbB2 eutectic composites by spark plasma sintering, ECerS 2015 - 14th International Conference Eropean Ceramic Society, Toledo, Spain.
17. Dmytro Demirskyi, O. Vasylkiv, High-temperature reaction consolidation of TaC-TiB2 ceramics by spark-plasma sintering (***Keynote lecture***), ECerS 2015 - 14th International Conference Eropean Ceramic Society, Toledo, Spain.

15th February 2016