# International Conference on Synthesis and Consolidation of Powder Materials (SCPM-2018)

IOP Conference Series: Materials Science and Engineering Volume 558

Chernogolovka, Russia 23 – 26 October 2018

ISBN: 978-1-5108-9092-3

ISSN: 1757-8981

#### Printed from e-media with permission by:

Curran Associates, Inc. 57 Morehouse Lane Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

This work is licensed under a Creative Commons Attribution 3.0 International Licence. Licence details: http://creativecommons.org/licenses/by/3.0/.

No changes have been made to the content of these proceedings. There may be changes to pagination and minor adjustments for aesthetics.

Printed by Curran Associates, Inc. (2019)

For permission requests, please contact the Institute of Physics at the address below.

Institute of Physics Dirac House, Temple Back Bristol BS1 6BE UK

Phone: 44 1 17 929 7481 Fax: 44 1 17 920 0979

techtracking@iop.org

#### Additional copies of this publication are available from:

Curran Associates, Inc. 57 Morehouse Lane Red Hook, NY 12571 USA Phone: 845-758-0400

Fax: 845-758-2633

Email: curran@proceedings.com Web: www.proceedings.com

# **Table of contents**

# Volume 558

#### **Preface**

International Conference on Synthesis and Consolidation of Powder Materials

Peer review statement

## **Papers**

Effect of aluminum additives on the ignition of tungsten–teflon mixtures

M I Alymov, S G Vadchenko and I S Gordopolova....1

Azide SHS of highly dispersed powder of titanium carbonitride with intermediate partial nitriding or partial carburizing titanium powder

A P Amosov and Yu M Markov.....6

X-ray powder diffraction analysis of a tungsten carbide-based ceramic

P V Andreev, K E Smetanina and E A Lantsev....12

Modeling of the distribution of thermal fields during spark plasma sintering of alumina ceramics

N N Berendeev, A A Popov, V V Pyaterikova, M S Boldin, A V Nokhrin, V N Chuvil'deev and E A Lantsev.....17

<u>Investigation of the kinetics of spark plasma sintering of alumina ceramics. Part 1. The initial stage of sintering</u>

M S Boldin, A A Popov, E A Lantsev, A V Nokhrin and V N Chuvil'deev.....22

<u>Investigation of the kinetics of spark plasma sintering of alumina. Part 2. Intermediate</u> and final stages of sintering

M S Boldin, A A Popov, E A Lantsev, A V Nokhrin and V N Chuvil'deev.....27

Synthesis and investigation of highly dispersed active phases of intermetallic and supported SHS-catalysts

V N Borshch, E V Pugacheva, S Ya Zhuk, I M Dement'eva, V N Sanin, D E Andreev and V I Yukhvid.....33

Microstructures and mechanical properties of tungsten-tantalum alloys consolidated by electron beam melting, hot pressing and spark plasma sintering

F Dong, Y Chen, Z Bai, H Wang and L Jiang.....38

<u>Chrono-topographical analysis of the laws of the microheterogeneous combustion mode</u> for the production of powders by the SHS method

A V Dolmatov....44

Tensile strength of materials obtained by electric pulse consolidation of powders

V Y Goltsev, E G Grigor'ev, N A Gribov, A V Osintsev and A S Plotnikov.....50

<u>Determination of tensile strength of brittle materials by bending thin discs on the annular support</u>

V Y Goltsev and N A Gribov.....57

Application of the "Brazilian test" to determine the strength of materials obtained by electric pulse consolidation of powders

V Y Goltsev, E G Grigor'ev, N A Gribov, A V Osintsev and A S Plotnikov.....62

Evaluation of tensile strength of nuclear fuel samples

V Y Goltsev and A V Osintsev.....69

Advanced metho	ds for cor	nsolidation of	of powder	materials by	impulse	electromagnetic
fields			•	-	-	

E G Grigoryev.....75

<u>Synthesis of Ti<sub>3</sub>SiC<sub>2</sub> MAX phase ceramic materials using macrosized non-powder forms</u> of titanium metal

P V Istomin, A V Nadutkin, E I Istomina and V E Grass.....79

Refractory and heat-insulating materials based on aluminosilicate SHS compositions

R D Kapustin....84

Synthesis of Ti<sub>2</sub>AlN MAX-phase by sintering in vacuum

A A Kondakov, I A Studenikin, A V Linde, N A Kondakova and V V Grachev.....89

Theoretical and experimental study of cellular structures in restricted filtration combustion of porous media

P M Krishenik, S V Kostin, N I Ozerkovskaya and K G Shkadinsky.....93

Effect of nanosized titanium and silicon carbides on synthesis and consolidation of titanium silicon carbide during spark plasma sintering

V B Kulmet'eva, M N Kachenyuk, S A Oglezneva and A A Smetkin....97

Processing of Al–Zn–Mg–Cu/SiC composite prepared by mechanical alloying

E I Kurbatkina, A A Shavney, O I Grishina and A V Gololoboy.....102

Synthesis of nanopowders of Fe-C system via Flow-Levitation method and study of their properties

M L Kuskov, A N Zhigach, I O Leipunsky, E S Afanasenkova, O A Safronova, N G Berezkina, V V Artemov, O M Zhigalina and D N Khmelenin.....105

Combined equipment for synthesis of ultrafine metals and metal compounds powders via Flow-Levitation and crucible methods.

M L Kuskov, A N Zhigach, I O Leipunsky, A N Gorbachev, E S Afanasenkova and O A Safronova.....111

Synthesis of nanopowders of titanium compounds via Flow-Levitation method and study their properties

M L Kuskov, A N Zhigach, I O Leipunsky, E S Afanasenkova, O A Safronova, N G Berezkina and G A Vorobjeva.....117

Study of structure of copper-based composite materials during the spark plasma sintering

K V Kuskov, I N Volkov, N F Skodich, A A Nepapushev, D I Arkhipov and D O Moskovskikh.....123

Prospective SHS composites for high-temperature applications

E A Levashov, V V Kurbatkina, S Vorotilo, Yu S Pogozhev and E I Patsera.....127

<u>Processing of mineral raw materials and production wastes by combustion under atmospheric conditions</u>

V E Loryan, A R Kachin and N Yu Khomenko.....132

Manufacture of products from boron-containing materials by the method of combined static-pulse compaction

V A Mironov, V A Glushchenkov, Yu S Usherenko, I S Belyaeva, P I Stankevich and I I Irtisheva.....137

The influence of electromagnetic component of the process on the structure of dissimilar alloys in high-voltage capacitor welding

S V Nescoromniy, E L Strizhakov, A A Chularis and G I Inasaridze.....140

Spark plasma sintering for high-rate diffusion welding of a UFG titanium alloy PT3V

A V Nokhrin, M S Boldin, E A Lantsev, M M Vostokov, M Yu Gryaznov, V I Kopylov and V N Chuvil'deev.....145

Synthesis and investigation of highly transparent ceramics

V V Osipov, V A Shitov, V V Platonov, R N Maksimov and K E Lukyashin.....152

<u>Features of interaction of powder high-velocity particles with the surface layer of the target</u>

E V Petrov.....157

Features of shock pressing and electro-impulse heating during consolidation of a powder material

R L Plomodyalo, E G Grigor'ev, L I Svistun and D V Dmitrenko....161

Features of the synthesis and consolidation of Me<sup>IV</sup>B<sub>2</sub>– (Me<sup>IV</sup>, Mo)Si<sub>2</sub> ceramic powder for high-temperature applications

Yu S Pogozhev, M V Lemesheva, A Yu Potanin, V I Vershinnikov and E A Levashov.....165

Mechanical activation of metallic powders in planetary ball mills: multi-scale modeling and experimental observation

O Politano, A Fourmont, S Le Gallet, F Baras, A A Nepapushev, A S Sedegov, S G Vadchenko and A S Rogachev.....172

Simulation of spatial ordering of powder mixture particles when packed in square matrices using an example of monodisperse balls

M A Ponomarev and V E Loryan....177

Synthesis of materials with multiscale porosity from fine powders of boron, titanium, aluminum and coarse granules of VT6 alloy

M A Ponomarev and V E Loryan.....183

### High-temperature reactive melt spreading: Experimental modeling of SHS reactions

A S Rogachev, S G Vadchenko, E V Illarionova, Yu B Scheck, S Rouvimov and A S Mukasyan.....189

Applicability of molecular dynamics method to the prediction of the melting point of refractory metals and compounds

S A Rogachev.....193

Experimental studies of the fundamental mechanism for phase formation in reactive solutions toward creation of the functional materials

S I Roslyakov, D O Moskovskikh, A A Nepapushev, K V Kuskov, G V Trusov, A S Sedegov, A S Mukasyan and K V Manukyan.....198

#### Electroconductivity of Al<sub>2</sub>O<sub>3</sub>/graphene nanocomposite processed by SPS technique

A Sanchez-Bolinchez, E Klyatskina, F Segovia-Lopez, A G Zholnin and V V Stolyarov.....204

Mill scale recycling by SHS metallurgy for production of cast ferrosilicon and ferrosilicoaluminium

V N Sanin, D M Ikornikov, D E Andreev, N V Sachkova and V I Yukhvid.....208

<u>Self-propagating high-temperature synthesis of Fe<sub>2</sub>TiSn based Heusler alloys with following spark plasma sintering</u>

A S Sedegov, Zh S Yermekova, A I Taranova, A P Novitskii, A I Voronin, A A Nepapushev and D O Moskovskikh.....213

Synthesis and study of high-entropy ceramics based on the carbides of refractory metals

A Sedegov, S Vorotilo, V Tsybulin, K Kuskov and D Moscovskikh.....220

Thermally coupled processes in a composite granular mixture (Ni + Al)-(Ti + C)

B S Seplyarskii, R A Kochetkov, T G Lisina and N I Abzalov.....227

The conditions for the implementation of the convective mode of combustion for granular mixtures of Ti + xC

B S Seplyarskii, R A Kochetkov, T G Lisina and M I Alymov.....232

Mathematical modeling of phase separation in three-phase melt formed behind the combustion wave

K G Shkadinsky, N I Ozerkovskaya and P M Krishenik.....238

Nanostructured Cu-Cr-W pseudoalloys by combined use of high-energy ball milling and spark plasma sintering

N F Shkodich, K V Kuskov, I D Kovalev and Yu B Scheck.....244

Titanium carbide based metal-ceramic material with porous layered structure

V S Shustov.....249

Morphology and phase composition of hybrid powders based on aluminum, synthesized for a gas-dynamic spraying of coatings by milling

A V Sobol'kov and A V Aborkin....253

Arctic protective materials based on complex oxides of titanium

I A Sologubova, M K Kotvanova and S S Pavlova.....257

The use of impulse electric and magnetic fields in obtaining permanent joints

E L Strizhakov, S V Nescoromniy, S O Ageev and V G Vinogradov.....260

<u>Influence of the binder composition on the properties of the silicon carbide green</u> compacts and sintered parts prepared from the powders produced by SHS

K S Torosyan and V G Pak.....264

## SHS membranes based on materials of mica-like structure

V I Uvarov, M I Alymov, A R Kachin, V E Loryan, V S Shustov, A S Fedotov and M V Tsodikov.....268

SHS in the Ta–Zr–Si–B system and properties of the produced ceramics

S Vorotilo and E A Levashov.....272

Application of nickel nanopowders of different morphology for the synthesis of highly porous materials by powder metallurgy

V A Zelensky, A B Ankudinov, M I Alymov, N M Rubtsov and I V Tregubova.....276