

«Saint Petersburg OPEN 2019»



BOOK of ABSTRACTS

**6th International School and Conference
on Optoelectronics, Photonics,
Engineering and Nanostructures**

April 22-25, 2019 • Saint Petersburg, Russia

“Saint Petersburg OPEN 2019”

6th International School and Conference on
Optoelectronics, Photonics, Engineering and
Nanostructures

St. Petersburg, Russia, April 22 – 25, 2019

BOOK of ABSTRACTS



Academic University Publishing
St. Petersburg, 2019

Copyright © by 2019 St. Petersburg Academic University and individual contributors. All rights reserved. No parts of this electronic publication may be multiple copied, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the written permission of the publisher. Single photocopies of single articles may be made for private study or research.

6th International School and Conference “Saint Petersburg OPEN 2019” on Optoelectronics, Photonics, Engineering and Nanostructures carries on the tradition of annual conferences and schools organized at St Petersburg Academic University for students, PhD students and young scientists.

More detailed information on the School and Conference is presented on <http://spbopen.spbau.com/>

The Book of Abstracts includes abstracts of contributed works accepted for presentation at the Conference.

The volume was composed by St. Petersburg Academic University from electronic files submitted by the authors. Only minor technical corrections were made by the composers.

Chief Editor: A. E. Zhukov

Published by
St. Petersburg Academic University, Khlopina 8(3),
194021 St Petersburg, Russia
Printed in Russian Federation

Organizer



St Petersburg Academic University

Acknowledgements



SPIE. **STUDENT**
CHAPTER
SAINT-PETERSBURG
ACADEMIC UNIVERSITY
RUSSIAN ACADEMY
OF SCIENCES

IOP Institute of Physics

Head of Program Committee

Alexey E. Zhukov

corr. member of the RAS, Head of Nanophotonics Lab and Vice-rector

St Petersburg Academic University, Russia

Program Committee

Andrey A. Lipovskii (Peter the Great St.Petersburg Polytechnic University, Russia)

George E. Cirlin (St Petersburg Academic University, Russia)

Valentina V. Zhurikhina (Peter the Great St.Petersburg Polytechnic University, Russia)

Head of Organizing Committee

Alexey E. Zhukov (St Petersburg Academic University, Russia)

Organizing Committee

Mikhail V. Maximov (Ioffe Institute, St Petersburg Academic University, Russia)

Andrey A. Lipovskii (Peter the Great St.Petersburg Polytechnic University, Russia)

Vladimir V. Korenev (St Petersburg Academic University, Russia)

Eduard I. Moiseev (St Petersburg Academic University, Russia)

Julia S. Balezina (St Petersburg Academic University, Russia)

Crystal growth and structural properties of nanostructures

Raman analysis of graphene on SiC <i>A. Babichev, K. Shubina, V. Sharov, I. Mukhin.....</i>	28
Role of the wetting layer in the crystallization stage during droplet epitaxy of InAs/GaAs nanostructures <i>S. Balakirev, M. Eremenko, N. Chernenko, O. Ageev, M. Solodovnik.....</i>	30
New polymorphic varieties of fluorographene forming during fluorine functionalization of 4-8 graphene layers <i>M. Belenkov, V. Chernov, E. Belenkov.....</i>	32
The model for in-plane and out-of-plane growth regimes of III-V nanowires <i>Y. Berdnikov, N. Sibirev.....</i>	34
Transmission electron microscopy of crystallization centers in antimony thin films with the use of the bend-contour atlas <i>A. Bokuniaeva, V. Kolosov, A. Yushkov.....</i>	36
MISFIT STRESS RELAXATION BY DISLOCATION LOOPS IN CORE-SHELL NANOWIRES <i>A. Chernakov, M. Gutkin, A. Romanov, A. Kolesnikova.....</i>	38
Effect of morphology features of a patterned surface on the nucleation processes of In/GaAs nanostructures during droplet epitaxy <i>N. Chernenko, S. Balakirev, M. Eremenko, M. Solodovnik, O. Ageev.....</i>	42
In situ study of structural transformation of the (TeO)_x(Mo,V,Nb)O₁₄ nanocatalyst with a tunnel structure <i>E. Derevyannikova, T. Kardash, A. Marchuk, A. Simanenko, A. Ishchenko, D. Svintsitskiy, E. Lazareva.....</i>	44
On the dendrite growth simulation during multitrack selective laser melting process <i>A. Dubrov, F. Mirzade, V. Dubrov.....</i>	46
XPS analysis of metallic wetting layer in In/GaAs system obtained at different growth temperatures <i>M. Eremenko, S. Balakirev, N. Chernenko, O. Ageev, M. Solodovnik.....</i>	48
Investigation of indium antimonide nanoparticles, obtained by the method of liquid chemical etching <i>M. Gavrikov, A. Mikhailov, V. Kabanov.....</i>	50

CWDM demultiplexer using the anti-reflection, contra-directional couplers based on silicon nitride rib waveguide <i>E. Zubkova, A. Golikov, P. An, V. Kovalyuk, A. Korneev, G. Goltsman</i>	467
---	------------

Spintronics, Electro- and Magneto-optics

Advanced aperture cantilevers made by focused ion beam for both magnetic domain structure and morphology investigation in high resolution magneto optical microscopy <i>S. Krasnoborodko, Y. Vysokikh, D. Churikov, M. Bulatov, V. Shevyakov, A. Fedotov, A. Kolomyitsev, A. Shaposhnikov</i>	469
---	------------

Magneto-optical properties of terbium-doped metaphosphate and borate glasses <i>E. Kuljpina, A. Babkina, Y. Fedorov</i>	471
---	------------

Magneto-optical properties of easy-plane epitaxial films of ferrites-garnets for eddy current non-destructive testing <i>N. Lugovskoy, V. Berzhansky, E. Semuk, S. Lyashko, A. Shaposhnikov</i>	473
---	------------

Spin waves edge modes in chains of ferromagnetic pillars <i>S. Osokin, A. Sharaevskaya, A. Safin, D. Kalyabin, S. Nikitov</i>	475
---	------------

Electric, Magnetic and Microwave Devices

Effect of oxygen on the properties of Ga₂O₃:Si thin films <i>A. Almaev, E. Chernikov, B. Kushnarev, N. Yakovlev</i>	477
---	------------

Size effect in the electronic transport properties of Bi₂Se₃ <i>V. Chistyakov, A. Domozhirova, J. Huang, V. Marchenkov</i>	479
--	------------

Formation of out-of-plane film micro arch by methods of technological control of internal stress <i>Y. Enns, E. Pyatishev, R. Kleimanov</i>	481
---	------------

Investigation of the piezoresistive properties and temperature coefficient of resistance of epitaxial GaN layers for sensor applications <i>Y. Enns, A. Kazakin</i>	483
---	------------

Investigation of the surface modification effect of aligned carbon nanotubes on their memristor properties <i>M. Ilina, A. Guryanov, O. Osotova, E. Solomin</i>	485
---	------------

Ti/4H-SiC Schottky diode with breakdown voltage up to 3 kV <i>D. Knyagin, S. Rybalka, A. Drakin, A. Demidov</i>	487
---	------------

Quantum-mechanical models for calculating the electrical characteristics of semiconductor 2-d structures for technological optimization of nanoelectronics devices based on them <i>A. Koziy, N. Vetrova, K. Pchelintsev, V. Shashurin, S. Meshkov</i>	489
The effect of nano-inclusions on the magnetic properties of thin YBCO films <i>A. Kudriashov, L. Klyachkin, A. Malyarenko, V. Romanov, S. Rykov, N. Bagraev, A. Nashchekin</i>	491
Developing of normally-off p-GaN gate HEMT <i>O. Kukhtyaeva, V. Egorkin, V. Zemlyakov, A. Zaitsev, V. Kapaev, A. Tsatsulnikov, A. Nikolaev, A. Sakharov</i>	494
Aviation kerosene sensors based on nanocrystalline SnO₂ thin films with various catalysts <i>B. Kushnarev, N. Maksimova, K. Ludmila, E. Chernikov, E. Sevastyanov, T. Davidova</i>	496
Wireless software-hardware complex for testing semiconductor structures <i>S. Loganchuk, T. Lotfi, S. Chebotarev, L. Goncharova, A. Varnavskaya, A. Mohamed, S. Lotfi</i>	498
Microwave low mass-dimensional frequency standard on Hg-199 ions <i>N. Lukashev, V. Davydov, V. Rud</i>	500
Control electrically conductive of thin films by using subminiature eddy current transducers <i>V. Malikov, A. Ishkov, A. Katasonov, A. Grigorev, A. Sagalakov</i>	503
Contact resistance and lifecycle of an ohmic MEMS switch with single and multiple contact bumps <i>N. Marukhin, I. Uvarov</i>	505
Features of transmission bearing and heterodyne receivers for signals in fiber-optic communication line in active phased array antenna <i>A. Moroz, V. Rud</i>	507
The effect of ion implantation and annealing on forming process in Al₂O₃/HfO₂/Al₂O₃ memristor structure <i>O. Permyakova, A. Rogozhin, A. Miakonkikh, K. Rudenko</i>	509
Determination of dV/dt values for domestic SiC Schottky diodes <i>S. Sedykh, S. Rybalka, A. Drakin, A. Demidov, E. Kulchenkov</i>	511
Magnetic-field-driven electron transport in SOI back-gate device <i>L. Shanidze, A. Tarasov, A. Lukyanenko, M. Rautskii, I. Yakovlev, F. Baron, N. Volkov</i>	513
Modeling of transparent electromagnetic interference shielding materials based on a silver nanowires network <i>P. Shiriaev</i>	515

Determination of dV/dt values for domestic SiC Schottky diodes

S V Sedykh, S B Rybalka, A Yu Drakin, A A Demidov, E A Kulchenkov
Bryansk State Technical University, Bryansk, 50 let Oktyabrya 7, Russia

Abstract. In this study the dV/dt values for 4H-SiC commercial diodes have been determined experimentally. The experimental measuring tester for determination of dV/dt values of diodes at amplitude of impulse of reverse voltage V_A ($V_A=100\div950$ V) applied across the Schottky diode was constructed. It was determined that the dV/dt value linearly increase with increase of impulse of reverse voltage V_A (in interval of $V_A=100\div900$ V) applied across the 5DS402A9 diode for the first time. It is determined experimentally that at the maximal impulse of reverse voltage (900 V) applied across the domestic SiC commercial 5DS402A9 diode the dV/dt value (148 V/ns) is comparable with others commercial diodes and therefore domestic SiC commercial Schottky diode can stably function in electric power circuit.

1. Introduction

Nowadays Schottky diodes on the base of silicon carbide (SiC) widely using in high-temperature power electronics [1]. Some type of SiC Schottky diodes have been designed earlier [2,3] and now the commercial for power electronics is produced by domestic company the ZAO «GRUPPA KREMNY EL» (Bryansk, Russia). The one of the important characteristics for silicon carbide Schottky diodes is value of dV/dt when the impulse of reverse voltage (V_A) applied across to diode. Devices with lower dV/dt capability are more susceptible to failure from large in-rush currents [4-6]. The number of some investigations with discussion about dV/dt effect is very limited and presented in general investigations of diodes by Infineon Technologies [4] and Wolfspeed (Cree) [5,6]. Study of the Infineon SiC diodes it is shown that for diodes with breakdown voltage of 600 V the value of dV/dt equals ~ 90 V/ns and for diodes with breakdown voltage of 1200 V ~ 120 V/ns, respectively [4]. In C3D03060A type Wolfspeed diode value of $dV/dt=295$ V/ns (amplitude of $V_A=800$ V) and for C4D10120A diode $dV/dt=495$ V/ns ($V_A=1000$ V) [5,6]. dV/dt value limit for domestic SiC diodes is unknown to present and therefore main goal of this work is to obtain experimentally the dV/dt values.

2. Materials and methods

The experimental measuring tester is shown in Fig. 1a. The parameters for tester allows carrying out measurement of dV/dt value in interval from 50 V/ns up to 200 V/ns at amplitude of impulse of reverse voltage applied across to diode $V_A=300\div950$ V. Analyses of oscillogram has been carried out with used Hantek DSO5102P oscillograph (bandwidth 100 MHz, refresh rate 1×10^9 s⁻¹). As an object for testing was used the 5DS402A9 (1 A, 1200 V) type domestic 4H-SiC Schottky diodes (ZAO «GRUPPA KREMNY EL», Bryansk, Russia).

3. Results and discussion

In Fig. 1b are shown testing results for 5DS402A9 domestic silicon carbide Schottky diode (Kremny) and C4D10120 diode (Wolfspeed) where value of dV/dt for 5DS402A9 diode equals 148 V/ns at

applied amplitude of impulse of reverse voltage across to diode 900 V. For C4D10120 diode value of dV/dt at the same conditions equals 204 V/ns. It is determined that dV/dt value almost linearly increase with increase of impulse of reverse voltage V_A applied across the 5DS402A9 diode in voltage interval from 100 V up to 900 V. It is determined that dV/dt value almost linearly increase with increase of impulse of reverse voltage V_A applied across the 5DS402A9 diode in voltage interval from 100 V up to 900 V. In addition, it is established that value of dV/dt can be increase by using of diode's module. For diode's module (consist of four diodes of the 5DS402A9 type) the dV/dt value increase up to 184 V/ns ($V_A=900$ V) that is more than on $\sim 28\%$ than for one 5DS402A9 diode. Moreover, the carried out dV/dt analysis also shown that Kremny diodes demonstrate the stable work after 10,000 cycles of impulse without failure.

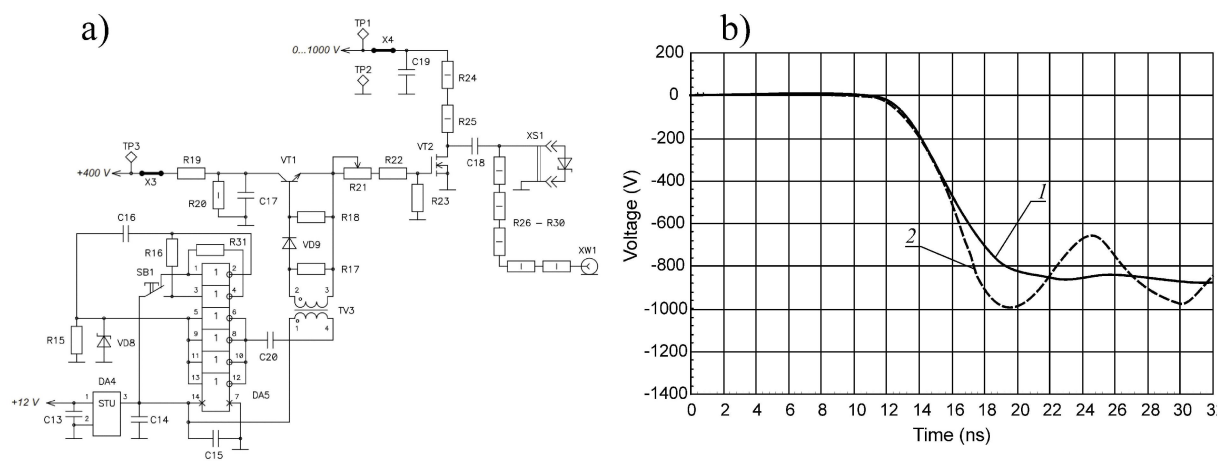


Figure 1. a) Tester circuit used to measure dV/dt value across a Schottky diode; b) Reverse voltage waveform for diodes (1 – 5DS402A9 (Kremny), 2 – C4D10120 (Wolfspeed)) with impulse amplitude $V_A=900$ V.

4. Conclusions.

Finally, on the basis of the experimental measuring it is shown that at the maximal impulse of reverse voltage applied across the diode $V_A=900$ V the dV/dt values for domestic 5DS402A9 Kremny («Gruppa Kremny El », Bryansk, Russia) commercial diode (148 V/ns) are comparable with others commercial diodes. Therefore, it is determined that domestic SiC commercial diode possess the dV/dt values that more then typical for these type devices (80-120 V/ns) and therefore can stably work without failures(after 10,000 cycles of impulse). It is shown that value of dV/dt can be increase by using of diode's module (consist of four diodes of the 5DS402A9 type) where the $dV/dt=184$ V/ns.

Acknowledgements

This work was supported by the Russian Ministry of Education and Science (task No. 8.1729.2017/4.6).

References

- [1] Kimoto T, Cooper J A 2014 *Fundamentals of Silicon Carbide Technology. Growth, Characterization, Devices, and Applications* (New York: Wiley–IEEE Press.)
- [2] Sedykh S, Rybalka S, Drakin A, Demidov A et al. 2018 *J. Phys.: Conf. Ser.* **1124** 071012
- [3] Panchenko P, Rybalka S, Malakhanov A, Demidov A et al. 2017 *J. Phys.: Conf. Ser.* **917** 082010
- [4] Holz M, Hultsch G, Scherg T, Rupp R 2009 *Phys. Status Solidi (a)* **206**(10) 2295
- [5] Cree SiC Power White Paper: The Characterization of dV/dt Capabilities of Cree SiC Schottky diodes using an Avalanche Transistor Pulser. Sep. 2015.
- [6] Kartashov E, Lebedev A 2016 *Power Electronics* **2** 18

INDEX

- Akulov Vasily, 172
 Almaev Aleksei, 477
 Andra NareshKumarReddy, 306
 Arkhipov Rostislav, 226
 Artemyev Alexander, 308
 Ashurov Matin, 310
 Assim Ara, 175
 Babichev Andrey, 28
 Baimagambetova Roza, 312
 Baksheeva Kseniya, 177
 Balakirev Sergey, 30
 Balmaev Ivan, 314
 Baranov Artem, 228
 Bastrakova Marina, 316
 Basyrova Liza, 318
 Begletsova Nadejda, 532
 Belenkov Maxim, 32
 Belonovskii Aleksei, 320
 Berdnikov Yury, 34
 Bezverkhniy Nikolay, 180
 Bikberdina Narkiza, 182
 Bobrova Daria, 184
 Bogdanov Oleg, 321
 Boikov Ivan, 230
 Bokuniaeva Aleksandra, 36
 Borodin Bogdan, 534
 Borodkin Alexey, 232
 Budkin Ivan, 323
 Butt Ali, 325
 Cheblovkov Aleksandr, 186
 Chekhonin Igor, 327
 Chernakov Anton, 38
 Chernenko Natalia, 42
 Chernov Maksim, 329
 Chistyakov Vasiliiy, 479
 Choban Tatyana, 234
 Dashkov Alexander, 236
 Davydchenko Michael, 536
 Davydov Roman, 189
 Degterev Alexander, 238
 Denisova Galya, 331
 Derevyannikova Elizaveta, 44
 Diginasheva Olesia, 538
 Dragunova Anna, 333
 Dubrov Alexander, 46
 Dvoretkaia Lily, 335
 Dyagileva Darya, 337
 Egorov Ivan, 540
 Enns Yakov, 483
 Enns Yakov, 481
 Eremenko Mikhail, 48
 Ermakov Alexander, 240
 Ezhova Olga, 542
 Fadeenko Varvara, 544
 Fetisova Marina, 339
 Fimin Andrey, 546
 Fomchenkov Sergey, 341
 Fomin Aleksandr, 548
 Frolov Ilya, 242
 Galiakhmetova Diana, 244
 Gavrikov Maksim, 50
 Gavrish Vladimir, 52
 Geldash Andrei, 55
 Gerasimenko Vladislav, 343
 Gorbunova Joanna, 345
 Grashchenko Alexander, 550
 Grebenikova Nadezhda, 348
 Grebenyuk Georgy, 553
 Greshyakov Vladimir, 57
 Gridchin Vladislav, 59
 Gubaydullin Azat, 350
 Gudkina Zhanna, 191
 Gurin Sergey, 61
 Gushchin Sergey, 351
 Hashemi Mahdieh, 353
 Iachuk Vladimir, 355
 Ignateva Lada, 357
 Ignateva Lada, 246
 Ilin Oleg, 555
 Iliina Marina, 485
 Ilkiv Igor, 359
 Ivanov Andrey, 361
 Kalyuzhnyy Nikolay, 248
 Kaydashev Vladimir, 363
 Khabarov Kirill, 557
 Khalaf Hyam, 193
 Kharchenko Anton, 250
 Khavlyuk Pavel, 63
 Khorin Pavel, 365
 Klimov Aleksandr, 65
 Knyaginina Dmitry, 487
 Kokshina Anna, 559
 Kolodny Stanislav, 367
 Kolokolnikov Ilya, 369
 Komarov Ivan, 195
 Komrakova Sophia, 371
 Korenev, 256
 Korenev Vladimir, 252
 Korepanov Oleg, 67
 Kormilina Tatiana, 69
 Korolev Dmitry, 374
 Koryakin Aleksandr, 73
 Koshelev Oleg, 75
 Koshuro Vladimir, 561
 Kotlyar Konstantin, 77
 Kots Ivan, 79
 Kovalchuk Anna, 563
 Koziy Andrey, 489
 Krasnoborodko Sergey, 469
 Kudriashov Andrei, 491
 Kudriashov Dmitrii, 256
 Kuimov Evgeny, 81
 Kukhtyaeva Olga, 494
 Kulagina Anastasia, 83
 Kuljina Ekaterina, 471
 Kushnarev Bogdan, 496
 Kuzikova Anna, 198
 Kuzin Alexey, 376
 Kuzmenko Vitaly, 85
 Kvitsinskiy Anatoly, 378
 Lazarenko Aleksandra, 258
 Lazarenko Petr, 87
 Lednev Maxim, 380
 Leonidov Andrey, 89
 Leshchenko Egor, 91
 Levina Svetlana, 260
 Liashenko Tatiana, 93
 Lisovskii Stepan, 262
 Liu Xinrui, 382
 Loganchuk Sergey, 498
 Logunov Semen, 264
 Lugovskoy Nazar, 473
 Lukashev Nikita, 500
 Lukyanenko Anna, 95
 Makhov Nikolay, 267
 Malikov Vladimir, 503
 Malinkina Olga, 97
 Manova Nadejda, 384
 Markin Alexey, 565
 Marukhin Nikita, 505
 Masharin Mikhail, 269
 Mashinsky Konstantin, 386
 Masyukov Maxim, 388
 Maximova Alina, 271
 Medvedeva Ekaterina, 390
 Merkulova Irina, 99
 Mikhailova Tatyana, 392
 Mikhailova Tatiana, 101
 Mikhailovskii Mikhail, 394
 Mikhaylin Ilya, 103
 Mikheev Konstantin, 105
 Minnullin Ramil, 396
 Mintairov Mikhail, 273
 Mironov Sergey, 398
 Mirovpol'tsev Maksim, 400
 Moiseev Eduard, 275
 Mokhov Alexey, 402
 Moroz Angelina, 507
 Morozov Ivan, 277
 Morozov Konstantin, 410
 Morozova Kate, 567
 Morozova Julia, 107
 Moshkova Maria, 411
 Muretova Maria, 279
 Myazin Nikita, 413
 Nevenchanny Yury, 281
 Nezhentsev Aleksei, 569
 Nikolaev Kirill, 283
 Nikolskaya Alena, 109
 Nizameev Irek, 111
 Osokin Sergey, 475
 Osychenko Alina, 200
 Panchenko Ivan, 571
 Pavlov Nikolay, 285
 Permyakova Olga, 509
 Petriev Iliya, 113
 Petrova Olga, 415
 Polikarpov Yury, 202
 Polupanov Nikita, 573
 Polyakova Margarita, 417
 Polykova Victoria, 115
 Prasolov Nikita, 575
 Proskuryakov Vitaly, 287
 Rakhmanova Gulnaz, 419
 Raudik Sergei, 289
 Redkov Alexey, 117
 Reshetov Ilya, 421
 Reznik Rodion, 119
 Reznik Vladislav, 204
 Rezvan Alexey, 120
 Rezvan Alexey, 424
 Rochas Stanislav, 291
 Rogozny Mikhail, 426
 Romanov Nikolay, 206
 Rozhkov Mikhail, 122
 Rudyk Nikolay, 124
 Ruzankina Julia, 428
 Ryashentsev Dmitry, 126
 Salii Roman, 293
 Salimgareev Dmitrii, 431
 Saushin Aleksandr, 295
 Savchuk Aleksandr, 128
 Savelyev Dmitry, 433
 Scherbak Sergey, 435
 Sedykh Sergey, 511
 Sergushichev Kirill, 577
 Serin Artem, 297
 Shanidze Lev, 513
 Shariyat Faridoddin, 208
 Sharov Vladislav, 131
 Shiriaev Pavel, 515
 Shishkin Ivan, 299
 Shishov Konstantin, 579
 Shkoldin Vitaliy, 437
 Shlepakov Pavel, 517
 Shostka Natalia, 439
 Shubina Kseniia, 133
 Shugurov Konstantin, 135
 Shumilin Aleksandr, 137
 Sidorov Fedor, 585
 Sigaev Alexander, 139
 Sinicyna Ekaterina, 441
 Sivkov Danil, 141
 Smirnov Maksim, 443
 Smolyarova Tatyana, 143
 Snigirev Leonid, 146
 Sobolev Maxim, 148
 Soboleva Victoria, 150
 Sokolenko Bogdan, 445
 Sokolovskii Andrei, 152
 Sokura Liliia, 447
 Son Aleksandra, 154
 Starnikova Aleksandra, 158
 Stepanova Oxana, 210
 Stolpner Anna, 212
 Stupin Daniil, 214
 Tapinova Olga, 216
 Taranets Konstantin, 587
 Tikhomirov Vladimir, 519
 Timkaeva Diana, 589
 Titova Nadezhda, 521
 Tomilin Sergey, 449
 Tomilina Olga, 160
 Toropova Aleksandra, 218
 Trofimov Pavel, 451
 Tupik Aleksandra, 220
 Uvarov Alexander, 523
 Vakulov Zakhar, 162
 Vasiliev Oleg, 453
 Vasilyeva Olga, 591
 Ved Mikhail, 164
 Vershinin Andrew, 166
 Volcheck Vladislav, 525
 Volkova Natalya, 455
 Volokitina Anna, 457
 Voronkov Vladislav, 168
 Votyakov Sergei, 593
 Voyko Aleksey, 527
 Vysokikh Yury, 595
 Yanibekov Iskander, 459
 Yarunova Elizaveta, 301
 Zelentsov Kirill, 303
 Zharikov Igor, 304
 Zhukov Mikhail, 529
 Zhukova Maria, 461
 Zhuravlev Andrey, 463
 Zhuravlev Anton, 465
 Zinphyo Kyaw, 170
 Zograf George, 222
 Zorin Vitaly, 224
 Zubkova Evgenia, 467