Sergey G. Menabde (메나브데세르게이)

Research Assistant Professor

Dept. of Electrical Engineering, Korea Advanced
Institute of Science and Technology (KAIST)

Contact information

Phone
E-mail menabde@kaist.ac.kr
Address 2232 E3-2, KAIST, 291 Daehak-ro, Daejeon 34141, Korea

Research activity

Research projects as Principle Investigator

1. "Image polaritons for ultra-compact optoelectronic devices"
2. "Electrically tunable plasmonic crystal based on 2D materials"

All funded by the National Research Foundation of Korea.

Research interests over the past five years

High-precision near-field sensing, polaritons in van der Waals crystals, light sail design for interstellar space crafts, photodoping of graphene, light trapping in plasmonic waveguides.

Education

- Ph.D. (2012-2017), major in Electrical Engineering.
  Thesis title: "One-dimensional transverse magnetic and unique transverse electric modes in graphene."
- M.Sc. (2007-2009), major in Electrical Engineering.
  Thesis title: "Photonic crystal waveguide optimization for directional emission effect."
- B.Sc. (2001-2005) & M.Sc. (2005-2007), major in Opto-electronics and Laser Engineering. Diploma Cum Laude. Thesis title: "Initial schemes design for a compact zoom lens with large zoom ratio."

Work experience

- 2021.03 – present: Research Assistant Professor, KAIST (Daejeon, Korea)
- 2017.10 – 2021.02 (3 years 4 months): Postdoc researcher, KAIST (Daejeon, Korea)
- 2009.09 – 2012.06 (2 years 10 months): Senior R&D Engineer, Samsung Electronics (Suwon, Korea).

Other Notable Achievements

- **Naturalized Korean citizen** since 2017 (former citizenship: Russia).
- Languages: **Korean** (fluent), **English** (fluent), **Russian** (native).
- Broad international collaboration network: Denmark, Switzerland, UK, USA, and Korea.
- Early career research highlights and awards:
  - First experimental observation of transverse electric mode in graphene (2016).
  - First theoretical prediction of 1D plasmons in graphene junctions (2014).
  - "Excellent Graduate Student Award" of the year 2016.
  - "Journal of Materials Chemistry C Poster Prize" at Metamaterials Congress 2015, U. of Oxford, UK.
  - **Samsung Global Scholarship Program** for talented international students: full tuition fee and living expenses for Master's course in Korea (2007-2009).

Academic & Research Achievements

Academic Papers

†equal contribution ‡co-corresponding author

1. **Sergey Menabde**, Junghoon Jahng, Sergejs Boroviks, Jongtae Ahn, Jacob T. Heiden, Do Kyung Hwang, Eun Sung Lee, N. Asger Mortensen, and Min Seok Jang‡, "Low-loss anisotropic image polaritons in van der Waals crystal α-MoO_3", *Advanced Optical Materials* **10**, 2201492 (2022).

2. **Sergey Menabde** and Min Seok Jang‡, "Graphene unlocks dispersion of topological polaritons" *Nature Nanotechnology* **17**, pp. 903–904 (2022).

3. Junhyung Kim, Geonwoo Lee, **Sergey Menabde**, Yong Jai Cho, Carsten Rockstuhl, and Min Seok Jang‡, "Temperature-Dependent Plasmonic Response of Graphene Nanoresonators", *ACS Photonics* **9**, pp. 2256–2262 (2022).

4. **Sergey Menabde**, Sergejs Boroviks, Jongtae Ahn, Jacob T. Heiden, Kenji Watanabe, Takashi Taniguchi, Tony Low, Do Kyung Hwang, N. Asger Mortensen‡, and Min Seok Jang‡, "Near-field probing of image phonon-polaritons in hexagonal boron nitride on gold crystals," *Science Advances* **8**, eabn0627 (2022).

5. Hongyu Tang, **Sergey Menabde**, Tarique Anwar, Junhyung Kim, Min Seok Jang‡, and Giulia Tagliabue‡, "Photo-modulated optical and electrical properties of graphene," *Nanophotonics* **11**, pp. 917–940 (2022).

6. **Sergey Menabde**, Jacob T. Heiden, Joel D. Cox, N. Asger Mortensen‡, and Min Seok Jang‡, "Image polaritons in van der Waals crystals," *Nanophotonics* **11**, pp. 2433–2452 (2022).

7. Shinho Kim, **Sergey Menabde**, Joel D. Cox, Tony Low, and Min Seok Jang‡, "Ultracompact electro-optic waveguide modulator based on a graphene-covered λ/1000 plasmonic nanogap," *Optics Express* **29**, pp. 13852–13863 (2021).

8. **Sergey Menabde**, In-Ho Lee, Sanghyub Lee, Heonhak Ha, Jacob T. Heiden, Daehan Yoo, Teun-Teun Kim, Tony Low, Young Hee Lee‡, Sang-Hyun Oh‡, and Min Seok Jang‡, "Real-space imaging of acoustic plasmons in large-area graphene grown by chemical vapor deposition," *Nature Communications* **12**, 938 (2021).

9. Sung Yoon Min, Ju Young Kim, Sunkyu Yu, **Sergey Menabde**‡, and Min Seok Jang‡, "Exceptional points in plasmonic waveguides do not require gain or loss," *Physical Review Applied* **14**, 054041 (2020)

10. Seyoon Kim†, **Sergey Menabde**†, Victor W. Brar‡, and Min Seok Jang‡, "Functional Mid-Infrared Polaritonics in van der Waals Crystals," *Advanced Optical Materials* **8**, 1901194 (2020).

11. Juho Park, Sanmun Kim, Joongwon Lee, **Sergey Menabde**‡, and Min Seok Jang‡, "Ultimate light trapping in free-form plasmonic waveguide," *Physical Review Applied* **12**, 024030 (2019).

12. Joel Siegel, Anthony Wang, **Sergey Menabde**, Mikhail A. Kats, Min Seok Jang, and Victor W. Brar‡, "Self-Stabilizing Laser Sails Based on Optical Metasurfaces," *ACS Photonics* **6**, pp. 2032-2040 (2019).

13. Sanghoon Kim†, **Sergey Menabde**†, and Min Seok Jang‡, "Efficient Photodoping of Graphene in Perovskite–Graphene Heterostructure," *Advanced Electronic Materials* **5**, 1800940 (2019).

14. Min Seok Jang‡, Seyoon Kim, Victor W. Brar, **Sergey Menabde**, and Harry A. Atwater, "Modulated Resonant Transmission of Graphene Plasmons Across a λ/50 Plasmonic Waveguide Gap," *Physical Review Applied* **10**, 054053 (2018).

15. **Sergey Menabde**, Hyunwoo Cho, and Namkyoo Park‡, "Interface defect-assisted phonon scattering of hot carriers in graphene," *Physical Review B* **96**, 075426 (2017).

16. Viacheslav Shaidiuk, and **Sergey Menabde**‡, "Modal evolution in asymmetric three- and four-layer plasmonic waveguides," *Optics Express* **24**, pp. 16595-16608 (2016).

17. Viacheslav Shaidiuk†, **Sergey Menabde**†, and Namkyoo Park‡, "Effect of structural asymmetry on three layer plasmonic waveguide properties," *JOSA B* **33**, pp. 963-970 (2016).

18. **Sergey Menabde**, Daniel R. Mason, Evgeny Kornev, Changhee Lee, and Namkyoo Park‡, "Direct Optical Probing of Transverse Electric Mode in Graphene," *Scientific Reports* **6**, 21523 (2016).

19. Daniel R. Mason†, **Sergey Menabde**†, Sunkyu Yu, and Namkyoo Park‡, "Plasmonic Excitations of 1D Metal-Dielectric Interfaces in 2D Systems: 1D Surface Plasmon Polaritons," *Scientific Reports* **4**, 4536 (2014).

20. Daniel R. Mason†, **Sergey Menabde**†, and Namkyoo Park‡, "Unusual Otto excitation dynamics and enhanced coupling of light to TE plasmons in graphene," *Optics Express* **22**, pp. 847-858 (2014).

21. M. Sathish Kumar, **Sergey Menabde**, Sunkyu Yu, and Namkyoo Park‡, "Directional emission from photonic crystal waveguide terminations using particle swarm optimization," *JOSA B* **27**, pp. 343-349 (2010).

Patents

1. KR102203338 / Date: 2021.01.11 / Title: "GRAPHITE-BASED PHOTODETECTOR AND MANUFACTURING METHOD THEREOF" / Inventors: **Menabde, Sergey**; Jang, Min Seok / Assignee: KAIST.

2. KR102162023 / Date: 2020.09.25 / Title: "NANO-FILTER FOR TUNABLE TRANSMISSION OF INFRARED RADIATION AND MANUFACTURING METHOD THEREOF" / Inventors: **Menabde, Sergey**; Jang, Min Seok / Assignee: KAIST.

3. US9706902B2 / EP2596740B1 / JP6126812B2 / CN103135211B / KR20130059150A / RU2621492C2 / Title: "Objective lens for endoscopic device, actuator for focusing, and endoscopic system" / US Patent date: Jul. 18, 2017 / Inventors: **Sergey Menabde** [primary], Jongchul Choi, Haein Chung / Assignee: Samsung Electronics.

Research Projects

1. "Image polaritons for ultra-compact optoelectronic devices" / Funding agency: National Research Foundation of Korea (NRF) / Role: **Principle Investigator**

2. "Electrically tunable plasmonic crystal based on 2D materials" / Funding agency: National Research Foundation of Korea (NRF) / Role: **Principle Investigator**

International Conferences

1. **[Invited talk] Sergey G. Menabde**, and Min Seok Jang, "Real-space mapping of ultra-confined 'image' phonon-polaritons", APNFO-14, Busan, Korea, June 2023.

2. **Sergey G. Menabde**, "Gold crystals for improved near-field probing of highly confined 'image' polaritons in mid-IR", Neaspec Summer School, San Sebastian, Spain, June 2023.

3. **Sergey Menabde**, Junghoon Jahng, Sergejs Boroviks, Jongtae Ahn, Jacob T. Heiden, Do Kyung Hwang, Eun Sung Lee, N. Asger Mortensen, and Min Seok Jang, "Ultra-Low-Loss Anisotropic Image Polaritons in α-MoO_3", 2022 MRS Fall, Boston, USA, November 2022.

4. [*Invited talk*] **Sergey Menabde**, "Image Polaritons in van der Waals Crystals", 2022 MRS Fall, Boston, USA, November 2022.

5. **Sergey Menabde**, Jacob T. Heiden, Jongtae Ahn, Sergejs Boroviks, Kenji Watanabe, Takashi Taniguchi, N. Asger Mortensen, Do Kyung Hwang, Min Seok Jang, "Near-field Probing of Image Polaritons in van der Waals Crystals", 2021 MRS Fall, Boston, USA, December 2021.

6. **Sergey Menabde**, Jacob T. Heiden, Jongtae Ahn, Sergejs Boroviks, Kenji Watanabe, Takashi Taniguchi, N. Asger Mortensen, Do Kyung Hwang, Min Seok Jang, "Near-Field Probing of Image Phonon-Polaritons in van der Waals Crystal on crystalline gold", Nanophotonics of 2D materials (N2D 2021), Spain, November 2021.

7. **Sergey Menabde**, Jacob T. Heiden, Jongtae Ahn, Sergejs Boroviks, Kenji Watanabe, Takashi Taniguchi, N. Asger Mortensen, Do Kyung Hwang, Min Seok Jang, "Near-field probing of image polaritons in van der Waals crystals", Recent Progress in Graphene and 2D Materials Research (RPGR 2021), Seoul, Korea, October 2021.

8. **Sergey Menabde**, In-Ho Lee, Teun-Teun Kim, Sanghyub Lee, Sang-Hyun Oh, and Min Seok Jang, "Near-field study of infrared acoustic plasmon-polaritons in heterostructure with CVD graphene," METANANO 2020, Tbilisi, Georgia, September 2020.

9. **Sergey Menabde**, In-Ho Lee, Teun-Teun Kim, Sanghyub Lee, Sang-Hyun Oh, and Min Seok Jang "Near-field study of infrared acoustic plasmon-polaritons in heterostructure with CVD graphene at room temperature," Nanophotonics of 2D Materials (N2D) 2020, San Sebastian, Spain, July 2020.

10. Joel Siegel, Anthony Y. Wang, **Sergey Menabde**, Mikhail A. Kats, Min Seok Jang, and Victor Watson Brar, "Optical Dielectric Metasurfaces for use as Self-Stabilizing Laser Sails," OSA Advanced Photonics Congress (AP), Burlingame, California, United States, August 2019.

11. Sangjun Han, Seyoon Kim, **Sergey Menabde**, Shinho Kim, Tony Low, Victor Brar, and Harry Atwater, "Recent Advances in Mid-Infrared Graphene Plasmonics: Metasurface for Complex Amplitude Modulation and Compact Waveguide Switch," META 2019 The 10th International Conference on Metamaterials, Photonic Crystals and Plasmonics, Lisbon, Portugal, July 2019.

12. Juho Park, Sanmun Kim, Sangjun Han, Heonhak Ha, **Sergey Menabde**, Min Seok Jang, "Ultimate light trapping in free-form plasmonic waveguide," The 9th International Conference on Surface Polariton Photonics (SPP9), Copenhagen, Denmark, May 2019.

13. **Sergey Menabde**, Shinho Kim, Heonhak Ha, Min Seok Jang, "Ultra-compact optical switch based on Fano resonance in graphene-functionalized plasmonic nano-cavity," SPIE Nanoscience+Engineering 2018, San Diego, California, United States, August 2018.

14. **Sergey Menabde**, Ju Yeong Kim, Sung Yoon Min, Min Seok Jang, "Role of interface defect in hot carriers extraction at graphene-metal contact," SPIE Nanoscience + Engineering 2018, San Diego, California, United States, August 2018.

15. Sang Hoon Kim, **Sergey Menabde**, and Min Seok Jang, "Photo-doping of Graphene Enhanced by Stable Perovskite and Hole Transfer Layer," The 19th International Symposium on the Physics of Semiconductors and Applications (ISPSA 2018), Jeju, Korea, July 2018.

16. Xianji Piao, Sunkyu Yu, **Sergey Menabde**, and Namkyoo Park, "Anisotropic Metamaterials for Controlling Transverse Spin of Light," The 8th International Conference on Surface Plasmon Photonics (SPP8), Taipei, Taiwan, May 2017.

17. **Sergey Menabde**, Daniel R. Mason, Evgeny Kornev, Changhee Lee and Namkyoo Park, "Detection of exotic transverse electric mode in graphene," Near Field Optics 14 (NFO'14), Hamamatsu, Japan, September 2016.

18. **Sergey Menabde**, Viacheslav Shaidiuk, and Namkyoo Park, "Asymmetric plasmonic waveguides as platform for coupling between surface plasmons and propagating waves," Near Field Optics 14 (NFO'14), Hamamatsu, Japan, September 2016.

19. **Sergey Menabde**, and Namkyoo Park, "Detection of Transverse Plasmons in Multilayer Graphene," Metamaterial'2015 Congress, University of Oxford, UK, September 2015 (***award winner***: Journal of Materials Chemistry C Poster Prize).

20. **Sergey Menabde**, Daniel Mason, and Namkyoo Park, "Enhanced coupling of light to TE plasmons in multilayer graphene," Near Field Optics 13 (NFO'13), Salt Lake City, USA, September 2014.

21. Daniel Mason, **Sergey Menabde**, Sunkyu Yu, Seungkyun Park, and Namkyoo Park, "1D plasmons at metal-dielectric interfaces in 2D systems," Near Field Optics 13, Salt Lake City, USA, September 2014.

22. [*Invited talk*] Daniel Mason, **Sergey Menabde**, Sunkyu Yu, and Namkyoo Park, "1-Dimensional Surface Plasmon Polaritons in 2-Dimensional Systems," 3rd Korea-Japan Metamaterials Forum 2013, Seoul, 2013.

23. **Sergey Menabde**, Daniel R. Mason, and Namkyoo Park, "Non-Abrupt-Edge Effects on Graphene Edge Plasmon Dispersion," Conference on Surface Plasmon-Polaritons (SPP6), Ottawa, Canada, May 2013.

24. **Sergey Menabde**, "Small-size Zoom Lens Design," Optics-Photonics Design & Fabrication ODF'06, Nara, Japan, December 2006.

25. **Sergey Menabde**, "Automated zoom lens design," Frontiers in Optics 2006, Rochester, USA, 2006.

26. **Sergey Menabde**, and Vitaly Klimov, "Automated zoom lens design and second-order derivative optimization methods," Optics & Photonics 2006, San-Diego, USA, August 2006.

Domestic Conferences

1. [Invited talk] "Real-space mapping of ultra-confined 'image' phonon-polaritons in van der Waals crystals," Advance in ultrafast optics science and related technology (ALTA-2020), Jeju, Korea, May 2023.
2. [Invited talk] "Near-field probing of ultra-confined 'image' phonon-polaritons in van der Waals crystals," Korean Surface Science and Analysis (KoSSA-2023), Daejeon, Korea, November 2022.
3. [Invited talk] "Real-space mapping of infrared acoustic plasmons in CVD graphene," Advance in ultrafast optics science and related technology (ALTA-2020), Jeju, Korea, August 2020.
4. [Invited talk] "Graphene photodoping platform for active and gate-less photonic devices," The 26th Conference on Optoelectronics and Optical Communications (COOC 2019), Busan, Korea, June 2019.
5. [Plenary talk] "Low Dimensional Nano-Photonic Systems," OSK Annual Summer Meeting 2014, Cheju, Korea, August 2014.