Curriculum vitae

Meni Wanunu

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Associate Professor (Experimental Biophysics and Condensed Matter Physics)
Department of Physics, Northeastern University
111 Dana Research Center
110 Forsyth St, Boston, MA 02115

(Co-affiliations: Dept of Chemistry & Chemical Biology, Department of Bioengineering, Northeastern University)

Education and Employment History

Education

Queens College, City University of New York, New York, NY
B.A. Chemistry, (Cum Laude), 1997
Thesis project: ”Determination of the Critical Micelle Concentration of Surfactants in Aqueous Media”.

Weizmann Institute of Science, Rehovot, Israel
M.Sc. Chemistry, (Summa Cum Laude), 2000
Thesis advisors: Abraham Shanzer (organic chemistry), Israel Rubinstein (materials science)
Thesis title: “Coordination-Based Dendrimers Grown on Metal Surfaces”.

Weizmann Institute of Science, Rehovot, Israel
Ph.D. Chemistry/Materials and Interfaces, 2005
Thesis advisor: Israel Rubinstein
Graduate studies partially supported by a Levy Eshkol Doctoral Fellowship
Thesis title: “Coordination Self-Assembled Nanostructures Based on Branched Building Blocks”.

Scientific Employment

2017- Curr.	- Associate Professor, Department of Physics, Department of Bioengineering, Northeastern University - Co-Director, Kostas Advanced Nano-Characterization Facility, Northeastern University, Burlington MA (appointed April 2016) - Graduate Program Director, Physics
2011- 2017	Assistant Professor, Department of Physics and Department of Chemistry/Chemical Biology, Northeastern University Co-Director, Kostas Advanced Nano-Characterization Facility, Northeastern University, Burlington MA (appointed April 2016)
2009-2011	Post-Doctoral Research Associate, Dept. of Physics and Astronomy, University of Pennsylvania, Philadelphia PA Mentor: Dr. Marija Drndic

Developed and fabricated electrical/optical sensors for biomolecules. Fabricated ultrasensitive molecular Coulter Counters, nanogap microRNA electronic sensors, and graphene membranes functionalized with biomolecules for sensor development.

2006-2009 Post-Doctoral Research Associate, Department of Biomedical Engineering, Boston University, Boston MA
Mentor: Dr. Amit Meller

Developed solid-state nanopore tool for single-molecule biophysics of DNA, RNA, and proteins. Utilized this tool for DNA sequence profiling, genomic mapping, and unzipping-based DNA sequencing. Invented novel method for probing DNA/drug interactions and procedure for chemical modification of nanopores.

1997-1998 Research Assistant, Department of Chemistry, Queens College, NY.
Advisor: Prof. Robert Bittman

Synthesized cyclodextrin-based derivatives for shuttling cholesterol between lipoproteins and lipids. Synthesized ceramide analogs. Developed Mitsunobu process for stereospecific diol monoazidation.

Research and Scholarship

Activities and Service

- Oversight committee member, Boston Electron Microscopy Center (BEMC) (2021-curr)
- Co-Director, Kostas Advanced Nano-Characterization Facility (www.neu.edu/kancf), Northeastern University, Burlington Campus, MA (2016-curr)
- Advisory Board, Center for Nanoscale Systems, Harvard University
- Program Director, Department of Physics, Northeastern University (2017-curr)
- Member, Physics Committee on Diversity, Equity, and Inclusion (2020-curr)
- Co-developer, HHMI-funded workshop for faculty on “Promoting Inclusion and Diversity in the Classroom”, 2018/9
- Regular service on NSF, NIH, and European grant review panels
- Editorial board of PLoS One, Journal of Nanobiotechnology
- Manage Physics Machine shop, staffed with one full-time technician (2017-curr)
- Manage Physics JEOL 2010F transmission electron microscope facility (2012-curr)

Peer-Reviewed Publications (Google scholar report here)

Refereed Research Papers (* = prior to Northeastern, # = co-correspondence)

74. Pavlenok M, Yu L, Herrmann D, Wanunu M, Niederweis M, Control of subunit stoichiometry in single-chain MspA nanopores. **Biophysical Journal**, *in press* [originally submitted to BioRxiv, DOI: 10.1101/2021.09.25.461773].

73. Mojtabavi M, Tsai WY, VahidMohammadi A, Zhang T, Gogotsi Y, Balke N, Wanunu M, Ionically Active MXene Nanopore Actuators. **Small**, 2105857 (2022).

72. Farhangdoust F, Cheng F, Liang W, Liu Y, Wanunu M, Rapid Identification of DNA Fragments through Direct Sequencing with Electro-Optical Zero-Mode Waveguides. **Advanced Materials**, 2108479 (2021).

71. Arcadia CE, Hu K, Epstein S, Wanunu M, Adler A, Rosenstein JK, CMOS electrochemical imaging arrays for the detection and classification of microorganisms, 2021 **IEEE International Symposium on Circuits and Systems** (ISCAS), IEEE, 1-5 (2021).

70. Hejazi D, Tan R, Kari Rezapour N, Mojtabavi M, Wanunu M, Kar S, MoS2 Nanosheets with Narrowest Excitonic Line Widths Grown by Flow-Less Direct Heating of Bulk Powders: Implications for Sensing and Detection. **ACS Applied Nano Materials**, 4, 2583-2593 (2021).

69. Tripathi P, Benabbas A, Mehrafrooz B, Yamazaki H, Aksimentiev A, Champion PM, Wanunu M, Electrical unfolding of cytochrome c during translocation through a nanopore constriction. **Proceedings of the National Academy of Sciences** 118, e2016262118 (2021).

68. Mojtabavi M, VahidMohammadi A, Ganeshan K, Hejazi D, Shahbazmohamadi S, Kar S, Van Duin AC, Wanunu M, Wafer-Scale Lateral Self-Assembly of Mosaic Ti3C2T x MXene Monolayer Films. **ACS Nano**, 15, 625-636 (2021).

67. Tavakoli S, Nabizadehmashhadtoroghi M, Makhamreh A, Gamper H, Rezapour NK, Hou YM, Wanunu M, Rouhanifard SH, Detection of pseudouridine modifications and type I/II hypermodifications in human mRNAs using direct, long-read sequencing. **bioRxiv,** DOI: 10.1101/2021.11.03.467190 (2021). [in revision, **Nature Methods**]

66. VahidMohammadi A, Liang W, Mojtabavi M, Wanunu M, Beidaghi M, 2D Titanium and Vanadium Carbide MXene Heterostructures for Electrochemical Energy Storage. Energy Storage Materials **Energy Storage Materials***, 41, 554-562* (2021).

65. “Stable polymer bilayers for protein channel recordings at high guanidinium chloride concentrations” Yu L, Kang X, Alibakhshi MA, Pavlenok M, Niederweis M, Wanunu M, **Biophysical Journal** 120 (9), 1537-1541 (2021).

64. “Unidirectional Single-File Transport of Full-Length Proteins Through a Nanopore”, Yu L, Kang X, Li F, Mehrafrooz B, Makhamreh A, Fallahi A, Aksimentiev A, Chen M, Wanunu M, **bioRxiv**, DOI: 10.1101/2021.09.28.462155 (2021).

63. “Rosette Nanotube Porins as Ion Selective Transporters and Stochastic Sensors”, Tripathi P, Shuai L, Joshi H, Yamazaki H, Fowle WH, Aksimentiev A[#], Fenniri H[#], and Wanunu M[#], **Journal of the American Chemical Society**, 142, 1680–1685 (2020).

62. “High Permeability Sub-Nanometre Sieve Composite MoS2 Membranes”, Sapkota B, Liang W, VahidMohammadi A, Karnik R, Noy A, and Wanunu M, **Nature Communications**, 11, 1-9 (2020).

61. “One-Pot Species Release and Nanopore Detection in a Voltage-Stable Lipid Bilayer Platform”, Kang X, Alibakhshi MA, Wanunu M, **Nano Letters**, 19, 9145-9153 (2019).

60. “Strong Electroosmotic Coupling Dominates Ion Conductance of 1.5 nm Diameter Carbon Nanotube Porins”, Yao YC, Taqieddin A, Alibakhshi, MA, Wanunu M, Aluru NR, Noy A, **ACS Nano**, 13, 12851-12859 (2019).

59. “Single-Molecule Sensing Using Nanopores in Two-Dimensional Transition Metal Carbide (MXene) Membranes”, Mojtabavi M, VahidMohammadi A, Liang W, Beidaghi M, Wanunu M. **ACS Nano**, 13, 3042-3053 (2019).

58. “Assembling 2D MXenes into Highly Stable Pseudocapacitive Electrodes with High Power and Energy Densities”, VahidMohammadi A, Mojtabavi M, Caffrey NM, Wanunu M, and Beidaghi M. **Advanced Materials**, 31, 1806931 (2019). [*Journal Cover*]

57. “Abnormal Ionic-Current Rectification Caused by Reversed Electroosmotic Flow under Viscosity Gradients across Thin Nanopores”, Qiu Y, Siwy Z, and Wanunu M. **Analytical Chemistry**, 91, 996-1004 (2019).

56. “Porous Zero-Mode Waveguides for Picogram-Level DNA Capture”, Jadhav V, Hoogerheide D, Korlach J, and Wanunu M. **Nano Letters**, 19, 921-929 (2019).

55. “Photothermally Assisted Thinning of Silicon Nitride Membranes for Ultrathin Asymmetric Nanopores”, Yamazaki H, Hu R, Zhao Q, and Wanunu M. **ACS Nano**, 12, 12472-12481 (2018).

54. “Thermostable Virus Portal Proteins As Reprogrammable Adapters For Solid-State Nanopore Sensors.” Cressiot B, Greive S, Mojtabavi M, Antson AA, and Wanunu M. **Nature Communications**, 9, 4652 (2018).

53. “Femtosecond Photonic Viral Inactivation Probed Using Solid-State Nanopores”, Nazari M, Li X, Alibakhshi MA, Yang H, Souza K, Gillespie C, Gummuluru S, Hong MK, Reinhard BM, Korolev KS, Ziegler LD, Zhao Q, Wanunu M, and Erramilli S, **Nano Futures**, 2, 045005 (2018).

52. “Differential Enzyme Flexibility Probed Using Solid-State Nanopores”, Hu R, Rodrigues JV, Waduge P, Yamazaki H, Cressiot B, Chishti Y, Makowski L, Yu D, Shakhnovich E, Zhao Q, and Wanunu M, **ACS Nano**, 12, 4494-4502 (2018).

51. “Porphyrin-Assisted Docking of a Thermophage Portal Protein Into Lipid Bilayers: Nanopore Engineering and Characterization”, Cressiot B, Greive SJ, Si W, Pascoa T, Mojtabavi M, Chechik M, Jenkins HT Lu X, Zhang K, Aksimentiev A, Antson AA, and Wanunu M, **ACS Nano**, 11, 11931-11945 (2017).

50. “Label-Free Single-Molecule Thermoscopy Using a Laser-Heated Nanopore”, Yamazaki H, Hu R, Henley RY, Halman J, Afonin KA, Yu D, Zhao Q, and Wanunu M, **Nano Letters**, 17, 7067–7074 (2017).

49. “Picomolar Fingerprinting of Nucleic Acid Nanoparticles Using Solid-State Nanopores”, Alibakhshi MA, Halman JR, Wilson J, Aksimentiev A, Afonin KA, and Wanunu M, **ACS Nano**, 11, 9701–9710 (2017).

48. “Length-Independent DNA Packing into Nanopore Zero-Mode Waveguides for Low-Input DNA Sequencing”, Larkin J, Henley RY, Jadhav V, Korlach J, and Wanunu M, **Nature Nanotechnology**, 12, 1169-1175 (2017). Highlighted in Nature Methods.

47. “Enhanced water permeability and tunable ion selectivity in subnanometer carbon nanotube porins”, Tunuguntla RH, Henley RY, Yao YC, Pham TA, Wanunu M, and Noy A, **Science** 357, 792-796 (2017). Highlighted in Phys.org, Sciencedaily, Nanowerk, TUN, and Northeastern News.

46. “Driven translocation of a semi-flexible polymer through a nanopore”, Sarabadani J, Ikonen T, Mokkonen H, Ala-Nissila T, Carson S, and Wanunu M, **Scientific Reports**, 7, 7423 (2017).

45. “Nanopore-Based Measurements of Protein Size, Fluctuations, and Conformational Changes”, Waduge P, Hu R, Bandarkar P, Yamazaki H, Cressiot B, Zhao Q, Whitford PC, and Wanunu M, **ACS Nano**, 11, 5706–5716 (2017).

44. “Peptide-Decorated Tunable-Fluorescence Graphene Quantum Dots”, Sapkota B, Benabbas A, Lin HYG, Liang W, Champion P, and Wanunu M, **ACS Applied Materials and Interfaces**, 9, 9378–9387 (2017).

43. “Graphene Symmetry Amplified by Designed Peptide Self-Assembly”, Mustata M, Kim YH, Zhang J, DeGrado WF, Grigoryan G#, and Wanunu M#, **Biophysical Journal**, 110, 2507–2516 (2016). See New and Notable.

42. “Electrophoretic Deformation of Individual Transfer RNA Molecules Reveals Their Identity”, Henley RY, Ashcroft BA, Farrell I, Cooperman BS, Lindsay S, and Wanunu M, **Nano Letters**, 16, 138–144 (2016).

41. “Distance-dependent energy transfer between CdSe/CdS quantum dots and a two-dimensional semiconductor”, Goodfellow KM, Chakraborty C, Sowers K, Waduge P, Wanunu M, Krauss T, Driscoll K, Vamivakas AN, **Applied Physics Letters**, 108, 021101 (2016).

40. “Osmium-Based Pyrimidine Contrast Tags for Enhanced Nanopore-Based DNA Base Discrimination”, Henley RY, Vazques-Pagan AG, Johnson M, Kanavarioti A, and Wanunu M, **PLoS One**, 0142155 (2015).

39. “Direct Analysis of Gene Synthesis Reactions Using Solid-State Nanopores”, Carson S, Wick ST, Carr PA, Wanunu M#, and Aguilar CA#, **ACS Nano**, 9, 12417–12424 (2015).

38. “Hydroxymethyluracil modifications enhance the flexibility and hydrophilicity of double-stranded DNA”, Carson S, Wilson J, Aksimentiev A, Weigele P#, and Wanunu M#, **Nucleic Acids Research**, gkv1199v1 (2015).

37. “Simultaneous Electro-Optical Tracking for Nanoparticle Recognition and Counting”, Angeli E#, Volpe A, Fanzio P, Repetto L, Firpo G, Guida P, Lo Savio R, Wanunu M#, and Valbusa U, **Nano Letters**, 15, 5696–5701 (2015).

36. “Direct and Scalable Deposition of Atomically Thin Low-Noise MoS2 Membranes on Apertures”, Waduge P, Bilgin I, Larkin J, Henley RY, Goodfellow K, Graham AC, Bell DC, Vamivakas N, Kar S#, and Wanunu M#, **ACS Nano**, 9, 7352–7359 (2015).

35. “Nanopores Suggest a Negligible Influence of CpG Methylation on Nucleosome Packaging and Stability”, Langecker M, Ivankin A, Carson S, Kinney SRM, Simmel F#, Wanunu M#, **Nano Letters**, 15, 783–790 (2015).

34. “Programmed Synthesis of Freestanding Graphene Nano-Membrane Arrays”, Waduge P, Larkin J, Upmanyu M, Kar S#, Wanunu M#, **Small**, 11, 597-603 (2015).

33. "Label-Free Optical Detection of Biomolecular Translocation through Nanopore Arrays" Ivankin A*, Henley RY*, Larkin J, Carson S, Toscano M, and Wanunu M, **ACS Nano**, 10, 10774–10781 (2014).

32. “Smooth DNA transport through a Narrowed Pore Geometry”, Carson S, Wilson J, Aksimentiev A, Wanunu M, **Biophysical Journal**, 107, 2381–2393 (2014). See New and Notable.

31. “Nanopore-based Conformational Analysis of a Viral RNA Drug Target”, Shasha C, Henley RY, Stoloff DH, Rynearson KD, Hermann T, Wanunu M, **ACS Nano**, 8, 6425–6430 (2014).

30. "Reversible Positioning of Single Molecules inside Zero-Mode Waveguides", Larkin J, Foquet M, Turner SW, Korlach J, Wanunu M, **Nano Letters**, 14, 6023–6029 (2014).

29. “Graphene Nanopore Support System for Simultaneous High Resolution AFM Imaging and Conductance Measurements”, Connelly L, Meckes B, Larkin J, Gillman AL, Wanunu M, Lal R, **ACS Applied Materials and Interfaces**, 6, 5290–5296 (2014).

28. “High-Bandwidth Protein Analysis Using Solid-State Nanopores”, Larkin J, Henley R, Muthukumar M, Rosenstein JK, Wanunu M, **Biophysical Journal**, 106(3), 696-704 (2014).

27. ”Slow DNA Transport through Nanopores in Hafnium Oxide Membranes”, Larkin J*, Henley R*, Bell DC, Cohen-Karni T, Rosenstein JK, Wanunu M, **ACS Nano**, 7, 10121-10128 (2013).

26. “Fast, Label-Free Force Spectroscopy of Histone–DNA Interactions in Individual Nucleosomes Using Nanopores”, Ivankin A, Carson S, Kinney SRM, Wanunu M, **Journal of the American Chemical Society**, 135, 15350–15352 (2013).

25. “Electrically Controlled Nanoparticle Synthesis inside Nanopores”, Venta K, Wanunu M, Drndic M, **Nano Letters**, 13, 423-429 (2013).

24. “Nanocomposite gold-silk nanofibers”, Cohen-Karni T, Jeong KJ, Tsui J, Reznor G, Mustata M, Wanunu M, Graham A, Marks C, Bell DC, Langer R, Kohane DS, **Nano Letters**, 12, 5403–5406 (2012).

*23. ”Integrated Nanopore Sensing Platform with Sub-Microsecond Temporal Resolution”, Rosenstein J, Wanunu M, Merchant C, Drndic M, and Shepard K, **Nature Methods**, 9, 487-492 (2012).

*22. ”Nanopore Analysis of Individual RNA/Antibiotic Complexes”, Wanunu M#, Bhattacharya S, Xie Y, Tor Y, Aksimentiev A#, Drndic M#, **ACS Nano**, 5, 9345-9353 (2011). [highlighted in C&E News and ACS’s In Nano]

21. “Discrimination of methylcytosine from hydroxymethylcytosine in individual DNA Molecules”, Wanunu M, Cohen-Karni D*, Johnson RR*, Fields L, Benner J, Peterman N, Zheng Y, Klein ML, and Drndic M, **Journal of the American Chemical Society**, 133, 486–492 (2011).

20. “Rapid Electronic Detection of Probe-Specific MicroRNAs Using Thin Nanopore Sensors”, Wanunu M, Dadosh T*, Ray V, Jin J, McReynolds L, Drndic M; **Nature Nanotechnology**, 5, 807–814 (2010) (COVER FEATURE).

*19. “DNA Translocation through Graphene Nanopores”, Merchant C, Healy K, Wanunu M, Ray V, Peterman N, Bartel J, Fischbein MD, Venta K, Luo Z, Johnson C, Drndic M; **Nano Letters**, 10 2915–2921 (2010).

18. “Nanopore-based sequence-specific detection of duplex DNA for genomic profiling”, Singer A, Wanunu M*, Morrison W, Kuhn H, Frank-Kamenetskii M, Meller A, **Nano Letters**, 10, 738-742 (2010).

*17. “Electrostatic Focusing of Unlabeled DNA into Nanoscale Pores using a Salt Gradient”, Wanunu M, Morrison W, Rabin Y, Grosberg AY, Meller A, **Nature Nanotechnology**, 5, 160-165 (2010).

*16. “DNA Profiling Using Solid-State Nanopores: Detection of DNA-Binding Molecules”, Wanunu M, Sutin J, Meller A, **Nano Letters**, 9, 3498-3502 (2009).

*15. “Electro-mechanical unzipping of individual DNA molecules using synthetic sub-2 nm pores”, McNally B, Wanunu M, Meller A, **Nano Letters**, 8, 3418-3422 (2008).

*14. “DNA Translocation Governed by Interactions with Solid State Nanopores”, Wanunu M., Sutin J, McNally B, Chow A, Meller A, **Biophysical Journal**, 95, 4716-4725 (2008).

*13. “Orientation Dependent Interactions of DNA with an alpha-Hemolysin Channel”, Wanunu M, Chakrabarti B, Mathe J, Nelson DR, Meller A, **Physical Review E**, 77, 031904 (2008).

*12. “Chemically-Modified Solid-State Nanopores”, Wanunu M, Meller A, **Nano Letters**, 7, 1580-1585 (2007). [highlighted in Nature]

11. “Rapid Fabrication of Uniform Nanopores and Nanopore Arrays”, Kim MJ, Wanunu M*, Bell DC, Meller A, **Advanced Materials**, 18, 23, 3149-3153 (2006).

*10. “Divergent Growth of Coordination Dendrimers on Surfaces”, Wanunu M, Vaskevich A, Shanzer, A, Rubinstein I, **Journal of the American Chemical Society**, 128, 8341-8349 (2006).

*9. “Assembly of coordination nanostructures via ligand derivatization of oxide surfaces”, Wanunu M, Livne S, Vaskevich A, Rubinstein I, **Langmuir**, 22, 2130-2135 (2006).

*8. “Reversible Binding of Gold Nanoparticles to Polymeric Solid Supports”, Abed O, Wanunu M, Vaskevich A, Arad-Yellin R, Shanzer A, Rubinstein I, **Chemistry of Materials**, 18, 1247-1260 (2006).

*7. “Branched Coordination Multilayers on Gold Surfaces”, Wanunu M, Vaskevich A, Cohen S, Cohen H, Arad-Yellin R, Shanzer A, Rubinstein I, **Journal of the American Chemical Society**, 127, 17877-17887 (2005).

*6. “Coordination-Based Gold Nanoparticle Layers”, Wanunu M., Popovitz-Biro R., Cohen H, Vaskevich A, Rubinstein I, **Journal of the American Chemical Society**, 127, 9207-9215 (2005).

*5. “Improved Blocking Properties of Short-Chain Alkanethiol Monolayers Self- Assembled on Gold”, Wanunu M, Vaskevich A, Rubinstein I, **Israel Journal of Chemistry**, 45, 337-344 (2005).

*4. “Widely-Applicable Gold Substrate for the Study of Ultrathin Overlayers”, Wanunu M, Vaskevich A, Rubinstein I, **Journal of the American Chemical Society**, 126, 5569-5576 (2004).

*3. “A Rapid Approach to Reproducible, Atomically Flat Gold Films on Mica”, Nogues C, Wanunu M, **Surface Science**, 573, L383-L389 (2004).

*2. “Regioselective and Stereospecific Azidation of 1,2- and 1,3-Diols by Azidotrimethylsilane via a Mitsunobu Reaction”, He L, Wanunu M, Byun HS, Bittman R, **Journal of Organic Chemistry**, 64, 6049-6055 (1999).

*1. “A Comparison of the Capacity of beta-Cyclodextrin Derivatives and Cyclophanes to Shuttle Cholesterol between Cells and Lipoproteins”, Christian E, Byun HS, Zhong N, Wanunu M, Marti T, Furer A., Diederich F, Bittman R, Rothblat GH, **Journal of Lipid Research**, 40, 1475-1482 (1999).

Book

Wanunu M and Tor Y, eds. “Methods for studying Nucleic Acid/Drug Interactions“, Taylor and Francis (Dec 2011).

Reviews, Book Chapters, and Highlights (* = prior to Northeastern)

17. Wanunu M, Back and forth with nanopore peptide sequencing. **Nature Biotechnology** 2022, 1-2.

16. Alfaro JA, Bohländer P, Dai M, Filius M, Howard CJ, van Kooten XF, Ohayon S, Pomorski A, Schmid S, Aksimentiev A, Anslyn EV, Bedran G, Cao C, Chinappi M, Coyaud E, Dekker C, Dittmar G, Drachman N, Eelkema R, Goodlett D, Hentz S, Kalathiya U, Kelleher NL, Kelly RT, Kelman Z, Kim SH, Kuster B, Rodriguez-Larrea D, Lindsay S, Maglia G, Marcotte EM, Marino JP, Masselon C, Mayer M, Samaras P, Sarthak K, Sepiashvili L, Stein D, Wanunu M,

Wilhelm M, Yin P, Meller A, Joo C, The emerging landscape of single-molecule protein sequencing technologies. **Nature methods** 2021, 18 (6), 604-617.

15. Xue L, Yamazaki H, Ren R, Wanunu M#, Ivanov A#, Edel J#, "Solid State Nanopore Sensors", **Nature Reviews Materials**, https://doi.org/10.1038/s41578-020-0229-6 (2020).

14. Noy A, Wanunu M, "Desalination: A new type of artificial water channels", **Nature Nanotechnology***, invited highlight* 15, 9–10 (2020).

13. Garoli D, Yamazaki H, Maccaferri N, Wanunu M, "Plasmonic nanopores for single-molecule detection and manipulation: towards sequencing applications", invited mini-review, **Nano Letters**, 19, 7553-7562 (2019).

12. Henley RY, Carson S, Wanunu M, "Studies of RNA Sequence and Structure Using Nanopores", **Progress in Molecular Biology and Translational Science**, 139, 73-99 (2016).

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7. Ivankin A, Wanunu M, "Research Highlights: Localized profiling of multiple neurotransmitter concentrations", **Nanomedicine**, 10, 1479-1481 (2012).

6. Gu LQ, Wanunu M, Wang MX, McReynolds L, Wang Y, "Detection of miRNAs with a nanopore single-molecule counter", **Expert Review of Molecular Diagnostics**, 12(6), 573-584 (2012).

*5. Wanunu M, Squires A, Meller A, (2010) "Capture and Translocation of Nucleic Acids into Sub-5nm Solid-State Nanopores", in **Nanopores: Sensing Fundamental Biological Interactions at the Single Molecule Level** (ed. R. Bashir), Springer, NY 227-254 (2011).

*4. Wanunu M, Soni GV, Meller A, (2009) "Analyzing Individual Biomolecules using Nanopores", in **Handbook of Nanophysics: Nanomedicine and Nanorobotics**, Taylor & Francis, Section 12-1, (2010).

*3. Branton, D et al. "The Potential and Challenges of Nanopore Sequencing", **Nature Biotechnology**, 26, 10, 1146-1153 (2008).

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PCTs and Patents Filed (* = prior to Northeastern)

17. “Method and apparatus for sensing a molecule”, M Wanunu, M Alibakhshi, X Kang, Z Zhang, US Patent App. 17/083,264.

*16. “Chemical functionalization of solid-state nanopores and nanopore arrays and applications thereof”, A Meller, M Wanunu, US Patent #11,002,724 (Issued 2021).

15. “Low noise ultrathin freestanding membranes composed of atomically-thin 2D materials”, P Waduge, S Kar, M Wanunu, J Larkin, I Bilgin, US Patent #11,041,247 (issued 2021).

14. “Nanoscale etching of light absorbing materials using light and an electron donor solvent”, M Wanunu, H Yamazaki, US Patent #11,073,764 (issued 2021).

13. “Bead-barcoded digital quantifiers of molecular species.” Wanunu M, Alibakhshi MA, 16/376,094 issued October 2020.

12. “Nucleic acid nanoparticles for analyte detection”. A Aksimentiev, KA Afonin, M Wanunu, US Patent #10,900,067 (Issued 2021).

11. “Electrically actuatable zero-mode waveguides for high-throughput pg-level sequencing.” Alibakhshi MA, Farhangdoust F, and Wanunu M. Filed October 2019, application processed.

10. “MXene Nanopore Sequencer of Biopolymers.” Wanunu M, Mojtabavi M, VahidMohammahi A, and Beidaghi M. Filed February 7, 2019, publication number WO 2020/160559.

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7. “Low noise ultrathin freestanding membranes composed of atomically-thin 2D materials”, P Waduge, S Kar, M Wanunu, J Larkin, I Bilgin, US Patent #11,041,247 (issued 2021).

6. “Label-free fluorescence-based biopolymer sequencing using nanopore arrays.” Ivankin A, Larkin J, Henley RY, and Wanunu M. Patent # 10,047,392, **issued** Aug 2018.

5. “Production of Transfer-Free Freestanding Graphene Membranes.” Waduge P, Larkin J, Upmanyu M, Kar S, and Wanunu M. PCT Application No. PCT/US2015/062686 (filed 11/25/2014).

4. “Nanopores in Zero-Mode Waveguides.” Wanunu M, Foquet M, Turner S, and Korlach J. Patent # 9,267,917, **issued** Feb 2016.

*3. “Graphene-Based Nanopore and Nanostructure Devices and Methods for Macromolecular Analysis.” Drndic M, Healy K, Wanunu M, Merchant CA, Puster M, Venta KE. Patent # 10,761,043, **issued** September 2020.

*2. “High Resolution Analysis Devices and Related Methods.” Drndic M, Wanunu M, Dadosh T. PCT/US2011/025434, filed February 18, 2011, US patent # 9,121,823, **issued** 09/01/2015.

*1. “Chemical functionalization of solid-state nanopores and nanopore arrays and applications thereof.” Meller A and Wanunu M. European Patent # 2158476, US patent 9,121,843 **issued** 09/01/2015.

Pending Research Grants

1. Project/Proposal Title: MRI: Acquisition of a Scanning Near-field Optical Microscope for Broadband, Nanoscale and Transient Microscopy and Spectroscopy (PI: Liu, Northeastern)

Proposal/Award Number (if available):
Source of Support: NSF
Primary Place of Performance: Northeastern University, Boston MA Project/Proposal Support Start Date (if available): 09/2022
Project/Proposal Support End Date (if available): 08/2024
Total Award Amount (including Indirect Costs): $999,999

2. Project/Proposal Title: Protein Identification and Sequencing Using a Barrel-Adapted Engineered MspA Nanopore Platform (PI: Wanunu)
   Proposal/Award Number (if available): 1R01HG012553
   Source of Support: NIH
   Primary Place of Performance: Northeastern University
   Project/Proposal Support Start Date (if available): 08/2022
   Project/Proposal Support End Date (if available): 07/2025
   Total Award Amount (including Indirect Costs): $2,292,785
3. Project/Proposal Title: Multiplexed electronic counting of scarce protein targets using nucleic acid nanoparticles (PI: Afonin, UNC Charlotte)
   Proposal/Award Number (if available): 1R21EB032640 Source of Support: NIH
   Primary Place of Performance: UNC Charlotte/Northeastern/UIUC Project/Proposal Support Start Date (if available): 04/2022
   Project/Proposal Support End Date (if available): 03/2024
   Total Award Amount (including Indirect Costs): $137,499
4. Project/Proposal Title: ViralNPQ: An integrated platform for discretely measuring viral particle count and functional titer with single molecule resolution (PI: Rouhanifard, Northeastern)
   Proposal/Award Number (if available):
   Source of Support: NSF
   Primary Place of Performance: Northeastern University
   Project/Proposal Support Start Date (if available): 02/2022
   Project/Proposal Support End Date (if available): 01/2024
   Total Award Amount (including Indirect Costs): $249,743

Active Externally-Funded Research Grants ($8M secured to date)

1. Project/Proposal Title: Long-Lived Platform Development for Exonuclease-Based Sequencing (PI: Ervin, Electronic Biosciences)
   Proposal/Award Number (if available): R41HG012163-01
   Source of Support: NIH/NHGRI
   Primary Place of Performance: Electronic Biosciences
   Project/Proposal Support Start Date (if available): 09/2021
   Project/Proposal Support End Date (if available): 08/2022
   Total Award Amount (including Indirect Costs): $100,000
2. Project/Proposal Title: Ion Fountain Nanopore Readers for High-Resolution DNA and RNA Sequencing (PI: Wanunu)
   Proposal/Award Number (if available): R21HG011689
   Source of Support: NIH/NHGRI
   Primary Place of Performance: Northeastern University
   Project/Proposal Support Start Date (if available): 07/2021

Project/Proposal Support End Date (if available): 06/2023
Total Award Amount (including Indirect Costs): $627,457

3. Project/Proposal Title: Single-cell direct RNA sequencing using electrical zero-mode waveguides and engineered reverse transcriptases (PI: Wanunu)
   Proposal/Award Number (if available): R01HG0011087
   Source of Support: NIH/NHGRI
   Primary Place of Performance: Northeastern University
   Project/Proposal Support Start Date (if available): 05/2020
   Project/Proposal Support End Date (if available): 02/2024
   Total Award Amount (including Indirect Costs): $3,016,527
4. Project/Proposal Title: Research proposal on Nanopores in 2D Materials (PI: Wanunu)
   Proposal/Award Number (if available):
   Source of Support: Oxford Nanopore Technologies
   Primary Place of Performance: Northeastern University Project/Proposal Support Start Date (if available): 03/2017 Project/Proposal Support End Date (if available): 05/2022
   Total Award Amount (including Indirect Costs): $843,855
5. Project/Proposal Title: Direct Picogram DNA and RNA Sequencing using Nanopore Zero-Mode Waveguides (PI: Wanunu)
   Proposal/Award Number (if available): R01HG009186
   Source of Support: NIH
   Primary Place of Performance: Northeastern University
   Project/Proposal Support Start Date (if available): 09/2016
   Project/Proposal Support End Date (if available): 07/2022
   Total Award Amount (including Indirect Costs): $2,304,889
6. Project/Proposal Title: INSPECT: IN Situ Phenotype Evaluation using CMOS Technology (Phase 1) (PI: Epstein, Northeastern)
   Proposal/Award Number (if available):
   Source of Support: DARPA
   Primary Place of Performance: Northeastern University, Raytheon BBN
   Project/Proposal Support Start Date (if available): 03/2019
   Project/Proposal Support End Date (if available): 08/2021
   Total Award Amount (including Indirect Costs): $1,100,000
7. Project/Proposal Title:Spark Fund: ViralNPQ: An integrated platform for discretely measuring viral particle count and functional titer with single-molecule resolution (PI: Rouhanifard, Northeastern)
   Proposal/Award Number (if available):
   Source of Support: Northeastern University
   Primary Place of Performance: Northeastern University
   Project/Proposal Support Start Date (if available): 04/2021
   Project/Proposal Support End Date (if available): 03/2022
   Total Award Amount (including Indirect Costs): $50,000

Past Externally-Funded Research Grants

1. Co-PI, NIH/NHGRI R01 (PI: S. Lindsay, ASU): Recognition Tunneling for Single Molecule RNA Sequencing (09/01/2016 – 08/31/2020).

2. Co-PI, NSF/DMR: Understanding transport in biomimetic carbon nanotube porin membranes for water treatment and osmotic energy harvesting (8/15/2017 – 07/31/2020).
3. Co-PI, DARPA: IN Situ Phenotype Evaluation using CMOS Technology (Friend or Foe/INSPECT). Phase 1 project (02/04/2019 – 11/30/2020).
4. PI (US counterpart), Bilateral NSF/BIO-BBSRC: Engineering Tunable Portal Hybrid Nanopores for High-Resolution Sequence Mapping (08/15/2016 – 08/14/2020).
5. Co-PI, NSF EFRI-2DARE: Two-dimensional nanopores with electro-optical control for next generation biotechnological applications (08/01/2015 – 07/31/2019).
6. PI: Hybrid Organic-Inorganic Channels based on Carbon Nanotubes and Inorganic Pores, Lawrence Livermore National Laboratories, 11/2015 – 10/2016.
7. PI: Reading DNA sequence with a solid-state tunnel junction (multi-PI project), Roche Corporation, 09/2015 – 08/2017.
8. PI: “Picogram-Level DNA Sequencing using Nanopores and Zero- Mode Waveguides,” R21 HG006873, 09/2012 – 08-2016.
9. Co-PI: “Ultra-Rapid DNA Sizing Using Solid-State Nanopores,” MIT Lincoln Laboratory, 06/2013 – 09/2013.
10. Co-PI: ARDEC phase I award, PI: David Luzzi, Nanomaterials for Force Protection and Increased Performance of Soldiers and Vehicles. 2012/2013.
11. Co-PI: “DNA Sequencing using a Phi29 Polymerase Motor,” NIH award # R01 HG006321, 10/2011 – 09/2014.