Anirudha Sumant

Materials Scientist
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Education

Ph.D. Electronic Science, University of Pune, India 1998
M.Sc. Electronic Science, University of Pune, India 1993
B.Sc. Physics, University of Pune, India 1991

Awards and Honors

- **2018 National Innovation Award** from Techconnect on Portable Ultrananocrystalline Diamond based Field Emission Electron Sources for Linear Accelerators
- **Pacesetter Award**, Argonne National Laboratory, 2018
- Top 100 finalist **Chicago Innovation Award** 2017
- **Pinnacle of Education Award** from Board of Governors for Argonne National Laboratory for teaching youth nanotechnology and developing Next Gen STEM Kit
- **2017 National Innovation Award** from TechConnect on developing wafer-scale method to grow single and multilayer graphene on dielectric substrate in 1 min
- **2016 National Innovation Award** from TechConnect on developing graphene-nanodiamond based solution to achieve superlubricity
- **2014 R&D 100 Award** for the development of NanofabLab…in a Box
- **2014 NASA Tech Brief Magazine Award** for NanofabLab…in a Box.
- **2013 R&D 100 Award** for the development of Miraj Diamond Platform
- **2013 R&D Award** for the development of Nanocrystalline diamond Coating for Microdrill
- **2011 R&D 100 Award** for the development of Integrated RF MEMS Switch/CMOS Device based on Ultrananocrystalline Diamond
- Senior Editor of IEEE-eNano
- Listed in Who's Who in America 62nd edition 2008.
- **R. K. Bhalla Award** by Indian Physics Association for Best Research Student in Physics 1997.

Research Interests

- Nucleation and growth mechanism of CVD grown carbon materials including diamond, graphene, carbon nanotube and diamond-like carbon films.
- Superlubricity, micro/nano tribological properties of graphene and other 2D materials
- Development of MEMS/NEMS devices based on diamond
- Surface chemistry, field emission properties of carbon nanostructures
- Semiconductor electronics and fabrication of heterostructures via integration of diamond with other materials

Technologies commercialized

- My Technology development portfolio including technologies available for licensing related to Novel Nanocarbon Materials is available here: https://www.anl.gov/technology/technologies/novel-nanocarbon-materials
- Diamond coating on microdrills (US Patent 7,947,329 B2) was licensed by Intel in 2011 and is being used in their products (Product name: Confidential).

- The same technology received prestigious **R&D 100 Award** in 2013 and is also being used by Wisconsin based start-up company NCD Technologies (www.ncdtechnologies.com) for coating microdrills.
- Nanowire and microwire fabrication technique and product (US 20140027294) is licensed by United Scientific Supplies Inc. from IL in 2017 and a STEM educational product named "**Next Gen STEM Kit"** is developed based on this invention. The product is targeted for teaching high school students about nanotechnology in a most simple way. The product is currently in the market. The original technology received prestigious **R&D 100 Award** in 2014 and **NASA Tech Brief Magazine Award** for best consumer product in 2014 and was selected as Top 100 finalist in **Chicago Innovation Award** in 2017.

Research in the News

- TEDx Talk on Superlubricity (https://www.youtube.com/watch?v=ml1Rj6_W3eY)
- Generation of long-lasting superlubricity at the macroscale (http://www.stle.org/files/TLTArchives/2018/08_August/Tech_Beat_I.aspx?WebsiteKey=a70334df-8659-42fd-a3bd-be406b5b83e5)
- Slippery when dry (http://www.anl.gov/articles/slippery-when-dry)
- Nanodiamonds are forever (http://www.anl.gov/articles/nanodiamonds-are-forever)
- Argonne's TechConnect hat trick (http://www.anl.gov/articles/argonne-s-techconnect-hat-trick)
- Tribology and Lubrication Technology Magazine Interview (http://www.stle.org/files/TLTArchives/2018/04_April/20_Minutes.aspx)
- Nanotechnology moves from Cleanroom to Classroom (http://www.anl.gov/articles/nanotechnology-moves-clean-room-classroom)
- Turning Diamond into Graphene Leads To Top Industry Award (http://www.grapheneentrepreneur.com/turning-diamond-graphene/)
- Argonne-developed technology for producing graphene wins TechConnect National Innovation Award (http://www.anl.gov/articles/argonne-developed-technology-producing-graphene-wins-techconnect-national-innovation-award)
- Diamond proves useful material for growing graphene (http://www.anl.gov/articles/diamond-proves-useful-material-growing-graphene)
- Argonne-developed technology for achieving superlubricity wins 2016 TechConnect National Innovation Award (http://www.anl.gov/articles/argonne-developed-technology-achieving-superlubricity-wins-2016-techconnect-national)
- Slip sliding away: Graphene and diamonds prove a slippery combination (http://www.anl.gov/articles/slip-sliding-away-graphene-and-diamonds-prove-slippery-combination)
- Slippery when Dry (http://science.sciencemag.org/content/348/6239/1087)
- Researchers fight friction and wear with one-atom-thick graphene (http://www.anl.gov/articles/researchers-fight-friction-and-wear-one-atom-thick-graphene)
- DOE commits more than $1.7 million to help commercialize promising Argonne-associated energy technologies(http://www.anl.gov/articles/doe-commits-more-17-million-help-commercialize-promising-argonne-associated-energy)
- Graphene layers dramatically reduce wear and friction on sliding steel surfaces

(http://www.anl.gov/articles/graphene-layers-dramatically-reduce-wear-and-friction-sliding-steel-surfaces)

- Flexible, transparent thin film transistors raise hopes for flexible screens (http://www.anl.gov/articles/flexible-transparent-thin-film-transistors-raise-hopes-flexible-screens)
- Argonne wins three R&D 100 awards (http://www.anl.gov/articles/argonne-wins-three-rd-100-awards)
- Argonne claims four 2013 R&D 100 Awards (http://www.anl.gov/articles/argonne-claims-four-2013-rd-100-awards)
- The brilliance of diamonds (https://phys.org/news/2013-08-brilliance-diamonds.html)
- Diamond brightens the performance of electronic devices (https://phys.org/news/2012-03-diamond-brightens-electronic-devices.html#nRlv)
- Thin diamond films provide new material for micro-machines (http://www.anl.gov/articles/thin-diamond-films-provide-new-material-micro-machines)
- Scientists carve nanowires out of ultrananocrystalline diamond thin films (https://phys.org/news/2011-11-scientists-nanowires-ultrananocrystalline-diamond-thin.html#nRlv)
- Highlight: Mechanical energy dissipation in ultrananocrystalline diamond microresonators (https://phys.org/news/2009-08-highlight-mechanical-energy-dissipation-ultrananocrystalline.html#nRlv)
- Heavier Hydrogen On The Atomic Scale Reduces Friction (https://www.sciencedaily.com/releases/2007/11/071102163021.htm)

Professional Experience

Argonne National Laboratory - Center for Nanoscale Materials (CNM) *2009-present*
Materials Scientist

- Principle investigator and program leader, developed and leading a core research program centered around developing energy efficient systems based on carbon materials (diamond, graphene/CNT).
- Developed and managing a new program on superlubricity utilizing 2D materials in combination with nanodiamond and won three DoE Technology commercialization Funds **($1.6M**) including participation from Industry to commercialize superlubricity in dry gas seals applications.
- Successful in attracting funding support and managed various projects from DoE and outside agencies such as DARPA, NASA (total of ~ **$8M in last 10 years**) in collaboration and developing novel applications of graphene and ultrananocrystalline diamond (UNCD) such as superlubricity, RF-MEMS, NEMS switch and in field emission cathodes.
- Supporting user program in the synthesis, characterization, and nanofabrication of nanostructured carbon materials as well as tribology of graphene and other 2D materials.

Argonne National Laboratory - Center for Nanoscale Materials (CNM) *2006-2009*
Assistant Materials Scientist

- Developed large area (150-200 mm diameter wafer), low temperature(~400°C) ultrananocrystalline diamond (UNCD) thin films technology for integration of UNCD films with piezoelectric films and CMOS devices for applications in high frequency resonators and RF-MEMS.
- Directed fundamental research in understanding nucleation and growth aspects of diamond thin films and how it affects electrical and nanotribological properties.
- Supported user programs in the synthesis and characterization of nanocarbon materials.

University of Wisconsin at Madison, WI, USA. ***2002-2006***

Staff Scientist

- Developed an HFCVD system to synthesize different forms of carbon nanostructured materials such as nanocrystalline diamond (NCD) and carbon nanotube (CNT). Studies on nucleation and growth aspects of NCD/CNT and studies on their mechanical, tribological properties. Studies on nanotribological and surface chemistry of CVD-diamond, Diamond-Like-Carbon (DLC) films by using UHV/Air-AFM-Tribometer to understand friction induced device failure mechanisms in micro-machines and MEMS devices.
- Developed a new approach based on synchrotron X-PEEM (X-ray Photoelectron Emission Microscopy) and XANES (X-ray Absorption Near Edge Spectroscopy) to probe chemical changes at micro/nano and wear/friction induced modifications in nanocarbon materials. Developed a microfabrication process to fabricate monolithic diamond/ta-C AFM probes to be used for micro/nanomanufacturing. Successful in writing research grants proposals and won about $1M worth of funding at UW-Madison within 3 years in collaboration. Advised several Ph.D. and M.S. students (see mentoring experience)

MER Corporation, Tucson, AZ, USA. **2002**

Senior Research Scientist

- Designed and built a new microwave plasma CVD system in collaboration for synthesis and processing of nanocrystalline diamond thin films using C60 precursor. Development of new applications based on nanocrystalline diamond technology in the area of MEMS, Tribology and field emission devices.

LightMatrix Technologies, Inc. NJ, USA **2001-2002**

Research Scientist

- Design, development and fabrication of next generation optical MEMS photonics switches based on nanocrystalline diamond technology. This project was in collaboration with Argonne National Laboratory. As a project leader, main responsibilities include project planning, designing, fabrication and testing of the MEMS switches as well as writing proposals, patent disclosures, and research papers. Coordinated optical-MEMS research program between LightMatrix and ANL effectively. Won two SBIR Phase-I projects ($160,000) as a PI

Materials Science Division, Argonne National Laboratory, IL, USA **1998-2001**

Post-doctoral Fellow

- Synthesis, characterization and processing of ultrananocrystalline diamond (UNCD) thin films using Microwave Plasma CVD technique. Developed a technology to improve the wear performance of mechanical shaft seals by applying UNCD coating on the SiC seal surface(currently is a product in the market by Advanced Diamond Technologies Inc.).
- Studies on mechanical, tribological, and electrical properties of UNCD. Contributed significantly in developing a micro-fabrication process for surface micro-machining of UNCD films for MEMS applications as well as the use of UNCD for field emission applications.

Post-doc Supervisors: Alan R. Krauss, Co-Supervisors: Dieter Gruen and Orlando Auciello

Department of physics, University of Pune, India **1993-1998**
Graduate Research Fellow

- Fellowships: Won fellowships from Council of Scientific and Industrial Research (CSIR) Govt. of India and Department of Atomic Energy (DAE), Govt. of India to carry out all of my Ph. D. work.
- Ph.D. Thesis: Some studies on nucleation and growth aspects of HFCVD diamond films. Designed and developed Hot Filament Chemical Vapor Deposition System (HFCVD) for synthesis of high quality diamond thin films. Contributed significantly to the design and development of STM technique. Highlights of my Ph.D. work include the use of STM and AFM techniques to understand the mechanism of nucleation and growth process in CVD diamond films. Demonstrated for the first time layered growth process in diamond films with atomic resolution using STM (APL Vol. 71, Issue 18, 2626, 1997). Demonstrated for the first time, the use of high-energy (MeV) boron ion implantation as a method to achieve doping effects with minimal surface disorder (Vacuum Vol 48, Issue 12, 1005, 1997).
  Ph.D. Advisors: Prof. Vijay P. Godbole, Co-advisor: Prof. C.V. Dharmadhikari
  Ph.D. Thesis: Some Studies on Nucleation and Growth Aspects of HF-CVD Diamond Films

Publications

1. Graphene - MoS_2 ensembles to reduce friction and wear in DLC-Steel contacts
   Kalyan C. Mutyala, Yimin A. Wu, Ali Erdemir, and ***Anirudha V. Sumant***
   Carbon, 146, 524-529 (2019)
2. Transfer of Graphene with Protective Oxide Layers
   Haim Grebel, Liliana Stan, Anirudha V. Sumant, Yuzi Liu, David Gosztola, Leonidas Ocola, Brandon Fisher
   Chem Engineering, 2(4), 58 (2018).
3. PMMA assisted plasma patterning of graphene
   Alfredo Bobadilla, Leonidas Ocola, **Anirudha V. Sumant**, Michael D. Kaminski, and Jorge M. Seminario
   Journal of Nanotechnology, vol. 2018, Article ID 8349626, 8 pages, 2018.
   https://doi.org/10.1155/2018/8349626.
4. Strain engineering in two-dimensional nanomaterials beyond graphene
   Shikai Deng, **Anirudha V. Sumant** and Vikas Berry
   Nano Today, 22, 14-35 ***(***2018), DOI: https://doi.org/10.1016/j.nantod.2018.04.013
5. An all-diamond X-ray position and flux monitor using nitrogen-incorporated ultra-nanocrystalline diamond contacts
   Mengnan Zou, Mengjia Gaowei, Tianyi Zhou, **Anirudha V. Sumant**, Cherno Jaye, Daniel A. Fisher, Jen Bohon, John Smedley and Erik M. Muller
   Journal of. Synchrotron Radiation. 25, (2018).
6. Ultrananocrystalline diamond-coated nanoporous membranes support SK-N-SH neuroblastoma endothelial cell attachment
   Kai-Hung Yang, Alexander K. Nguyen, Peter L. Goering, **Anirudha V. Sumant** and Roger J. Narayan
   Journal of the Royal Society Interface Focus, 8, 20170063 (2018).

7. Operando Tribochemical Formation of Onion-Like-Carbon Leads to Macroscale Superlubricity
   Diana Berman, Badri Narayanan, Mathew Cherukara , Subramanian Sankaranarayanan , Ali Erdemir , Alexander Zinovev, and **Anirudha V. Sumant**
   Nature Communications, 9, 1164 (2018).
8. Design of Lithium Cobalt Oxide Electrodes with High Thermal Conductivity and Electrochemical Performance Using Carbon Nanotubes and Diamond Particles
   Eungje Lee, Ruben Arash Salgado, Byeongdu Lee, **Anirudha V. Sumant**, Tijana Rajh, Christopher Johnson, Alexander A. Balandin, Elena V. Shevchenko
   Carbon, 129, 702 (2018).
9. Nanodiamond Thin Film Field Emitter Cartridge for Miniature High-Gradient Radio Frequency X-Band Electron Injector
   Jiaqi Qiu, Stanislav S. Baturin, Kiran Kumar Kovi, Oksana Chubenko, Gongxiaohui Chen, Richard Konecny, Sergey Antipov, **Anirudha V. Sumant**, Chunguang Jing, and Sergey V. Baryshev
   IEEE Transactions on Electron Devices, 65(3), 1132 (2018)
10. Life-time and line-width of individual quantum dots interfaced with graphene
    Xin Miao, David J. Gosztola, **Anirudha V. Sumant**, and Haim Grebel
    Nanoscale, 10, 7040, (2018)
11. Approaches for Achieving Superlubricity in Two-Dimensional Materials
    Diana Berman, Ali Erdemir, and **Anirudha V. Sumant**
    ACS Nano, 12, 2122, (2018) (Invited Review article)
12. Locally Resolved Electron Emission Area and Unified View of Field Emission in Nanodiamond Films
    Oskana Chubenko, Stanislav S. Baturin, Kiran K. Kovo, **Anirudha V. Sumant** and Sergey V. Baryshev
    ACS Applied Materials and Interfaces, 9, 33229 (2017). DOI: 10.1021/acsami.7b07062
13. Heterojunction Devices Using Graphene and Other Two-Dimensional Materials
    Anirudha V. Sumant
    [Guest Editorial]," in ***IEEE Nanotechnology Magazine***, vol. 11, no. 2, pp. 4-4, June 2017.
    doi: 10.1109/MNANO.2017.2679259
14. On the integration of ultrananocrystalline diamond (UNCD) with CMOs chip
    Hongyi Mi, Hao-Chih yuan, Jung-Hun Seo, Orlando H. Auciello, Derrick C. Mancini, Robert W. Carpick, Sergio P. Pacheco, **Anirudha V. Sumant**, and Zhenqiang Ma.
    AIP Advances, 7, 035121 (2017).
15. Biological evaluation of ultrananocrystalline and nanocrystalline diamond coatings
    Shelby A. Skoog, Girish Kumar, Jiwen Zheng, **Anirudha V. Sumant**, Peter Goering, Roger J. Narayan
    J Mater Sci: Mater Med. 27, 187, (2016). doi:10.1007/s10856-016-5798-y
16. Effects of Nanotopography on the In Vitro Hemocompatibility of Nanocrystalline Diamond Coatings
    Shelby A Skoog, Qijin Lu, Richard A Malinauskas**, Anirudha V Sumant**, Jiwen Zheng, Peter L Goering, Roger J Narayan, Brendan J Casey
    Journal of Biomedical Materials Research Part A DOI: 10.1002/jbm.a.35872 20 Aug 2016
17. Metal-induced rapid transformation of diamond into single and multilayer graphene on wafer scale
    Diana Berman, Sanket A. Deshmukh,,Badri Narayanan, Subramanian K. R. S. Sankaranarayanan, Zhong Yan, Alexander A. Balandin, Alexander Zinovev, Daniel Rosenmann & **Anirudha V. Sumant**
    Nature Communications, 7:12099, doi: 10.1038/ncomms12099 (2016).
18. Observation of a carbon-based protective layer on the sidewalls of boron doped ultrananocrystalline diamond-based MEMS during in situ tribotests
    Federico Buja, Jaap Kokorian, Richard Gulotty, **Anirudha V Sumant** and W Merlijn van Spengen
    Journal of Micromechanics and Microengineering, Volume 25(12), 125020 (2015).
19. Europium effect on the electron transport in graphene ribbons
    A. D. Bobadilla, L. E. Ocola, **Anirudha. V. Sumant**, M. Kaminski, N. Kumar, and J. M. Seminario
    Journal of Physical Chemistry C, 119(39), 22486, (2015).

20. Studies on Measuring Surface Adhesion Between Sidewalls in Boron Doped Ultrananocrystalline Diamond Based Microelectromechanical Devices
    F. Buja, J. Kokorian, **Anirudha. V. Sumant**, and M. Van Spengen,
    Diamond and Related Materials, 55, 22-31, (2015)
21. Nitrogen-incorporated Ultrananocrystalline Diamond Microneedle Arrays for Electrochemical Biosensing
    S. A. Skoog, P. R. Miller, R. D. Boehm, **Anirudha. V. Sumant**, R. Polsky, and R. J. Narayan
    Diamond and Related Materials, 54, 39-46, (2015)
22. Special Journal Issue of New Diamond and Nano Carbons Conference (NDNC-14), Chicago, IL USA
    Aniruda.V. Sumant, O. Auciello, G. Swain, J. A. Carlisle, D. Berman
    Diamond and Related Materials, 54, 1(2015)
23. Nanoscale Friction Properties of Graphene and Graphene Oxide
    D. Berman, A. Erdemir, A. Zinovev, and **Anirudha.V. Sumant**
    Diamond and Related Materials, 54, 91-96, (2015)
24. Macroscale Superlubricity Enabled by Graphene Nanoscroll Formation
    D. Berman, S. A. Deshmukh, S. Sankaranarayanan, A. Erdemir, and **Anirudha. V. Sumant**
    Science, 348, 1118-1122, (2015)
25. Graphene as a Protective Coating and Superior Lubricant for Electrical Contacts
    D. Berman, A. Erdemir, and **Anirudha. V. Sumant**
    Appl. Phys. Lett., 105, 231907-1-231907-4, (2014)
26. Planar Ultrananocrystalline Diamond Field Emitter in Accelerator Radio Frequency Electron Injector: Performance Metrics
    S. V. Baryshev, S. P. Antipov, J. Shao, C. Jing, K. Perez Quintero, J. Qiu, W. Liu, W. Gai, A. D. Kanareykin, and **Anirudha. V. Sumant**
    Appl. Phys. Lett., 105, 203505, (2014)
27. High-aspect-ratio nanoporous membranes made by reactive ion etching and e-beam and interference lithography
    Ralu Divan, Olga V. Makarova, Shelby Skoog, Roger Narayan, **Anirudha V. Sumant**, Cha-Mei Tang, Nicolaie Moldovan, ***Microsystem Technology,*** 20, 1797 (2014)
28. Graphene: a new emerging lubricant
    Diana Berman, Ali Erdemir and Anirudha V. Sumant
    Materials Today 17(1), 31 (2014) **Invited Review** (IF: 7.08)
29. Nitrogen incorporated ultrananocrystalline diamond based field emitter array for a flat-panel x-ray source
    Chrystian M. Posada, Edwin J. Grant, Ralu Divan, **Anirudha V. Sumant**, Daniel Rosenmann, Liliana Stan, Hyoung K. Lee and Carlos H. Castaño
    Journal of Applied Physics 115, 134506 (2014)
30. All two-dimensional, flexible, transparent, and thinnest thin film transistor
    Saptarshi Das, Richard Gulotty, Anirudha V. Sumant, and Andreas Roelofs
    Nano Letters, 14(5), 2861 (2014)
31. Atom-Probe Tomography of Meteoritic Nanodiamonds
    Philipp R Heck, Dieter Isheim, Michael J Pellin, Andrew M Davis, **Anirudha V Sumant**, Orlando Auciello, Jeffrey W Elam, Jon Hiller, David J Larson, Anil Mane, Surya S Rout, Michael R Savina, David N Seidman, Thomas Stephan
    Microscopy and Microanalysis 20 (S3), 1676-1677 (2014).

32. Electrically conducting ultrananocrystalline diamond for the development of a next generation of micro-actuators
    Federico Buja, **Anirudha V. Sumant**, Jaap Kokorian, W. Merlijn van Spengen
    Sensors and Actuators A 214, 259 (2014)
33. Effect of hydrogen flow during cooling phase to achieve uniform and repeatable growth of bilayer graphene on copper foils over large area
    Richard Gulotty, Saptarshi Das, Yuzi Liu, and **Anirudha V. Sumant**
    Carbon, 77, 341 (2014)
34. MEMS/NEMS based on mono-, nano-, and ultrananocrystalline diamond films
    Anirudha V. Sumant, Orlando Auciello, Meiyong Liao and Oliver A. Williams
    MRS Bulletin, 39(6), 511 (2014) **Invited review article**
35. Toward lithium ion batteries with enhanced thermal conductivity
    Bonil Koo, Pradyumna Goli, **Anirudha V. Sumant**, Paula Cecilia dos Santos Claro, Tijana Rajh, Christopher S. Johnson, Alexander A. Balandin, and Elena V. Shevchenko
    ACS Nano, 8(7), 7202 (2014)
36. Extraordinary macroscale wear resistance of one atom thick graphene layer
    Diana Berman, Sanket A. Deshmukh, Subramanian K. R. S. Sankaranarayanan, Ali Erdemir and **Anirudha V. Sumant**
    Advanced Functional Materials, 24(42), 6640 (2014) DOI: 10.1002/adfm.201401755
37. High quantum efficiency ultrananocrystalline diamond photocathode for photoinjector applications
    Kenneth J. Pérez Quintero, Sergey Antipov, Anirudha V. Sumant, Chunguang Jing and Sergey V. Baryshev
    Applied Physics Letters, 105, 123103 (2014),
38. Single-step route to hierarchical flower-like carbon nanotube clusters decorated with ultrananocrystalline diamond
    Deepak Varshney, **Anirudha V. Sumant,** Oscar Resto, Frank Mendoza, Kenneth Perez Quintero Majid Ahmadi, Brad R. Weiner, Gerardo Morell
    Carbon, 63, 253 (2013).
39. Reduced wear and friction enabled by graphene layers on sliding steel surfaces in dry nitrogen,
    Diana Berman, Ali Erdemir, and **Anirudha V. Sumant**
    Carbon 59, 167 (2013).
40. The interfacial dynamics of water sandwiched between graphene sheets are governed by the slit width
    Sanket A. Deshmukh, Ganesh Kamath, Gary A. Baker, **Anirudha V. Sumant**, Subramanian K.R.S. Sankaranarayanana
    Surface Science, 609, 129 (2013).
41. Few layer graphene to reduce wear and friction on sliding steel surfaces
    Diana Berman, Ali Erdemir, and **Anirudha V. Sumant**
    Carbon, 54, 454 (2013)
42. Making the diamond age a reality
    Anirudha V. Sumant
    Materials Today, 15(9), 358 (2012) **(Invited news article)**
43. Growth of carbon nanotubes on spontaneously detached free standing diamond films and their field emission properties
    Deepak Varshney, **Anirudha V. Sumant**, Brad R. Weiner, Gerardo Morell
    Diamond and Related Materials, 30, 42-47 (2012).

44. Influence of surface passivation on the friction and wear behavior of ultrananocrystalline diamond and tetrahedral amorphous carbon thin films
    A.R. Konicek, D.S. Grierson, **Anirudha.V. Sumant**, T.A. Friedmann, J.P. Sullivan, W.G. Sawyer, and R.W. Carpick,
    Physical Review B 85, 155488 (2012).
45. Ultrananocrystalline diamond-coated microporous silicon nitride Membranes for medical implant applications
    Shelby A. Skoog, **Anirudha V. Sumant**, Nancy A. Monteiro-Riviere, Roger J. Narayan
    Journal of Materials, 64(3), 520 (2012).
46. Graphene-on-diamond devices with increased current-carrying capacity: Carbon sp2-on-sp3 planar technology
    Jie Yu, Guanxiong Liu, **Anirudha V. Sumant**, Vivek Goyal, Alexander A. Balandin
    Nano Letters, 12(3), 1603 (2012).
47. Direct low-temperature integration of nanocrystalline diamond with GaN substrates for improved thermal management of high-power electronics
    Vivek Goyal, Anirudha V. Sumant, Desalegne Teweldebrhan, Alexander Balandin
    Advanced Functional Materials, 22(7), 1525 (2012).
48. Nanopatterning of ultrananocrystalline diamond (UNCD) nanowires
    Xinpeng Wang, Leo Ocola, Ralu Divan, Anirudha V. Sumant
    Nanotechnology, 23, 075301 (2012).
49. Medical applications of diamond particles & surfaces
    Roger J. Narayan, Ryan D. Boehm, and **Anirudha V. Sumant**
    Materials Today (**Invited Review article**), 14(4), 154, (2011).
50. Electroplate and lift lithography for patterned micro/nanowires using ultrananocrystalline diamond (UNCD) as a reusable template.
    David Seley, Daniel Dissing, **Anirudha V. Sumant**, Ralu Divan, Suzanne Miller, Orlando Auciello, Lori Lepak, Eric Terrell, Tyler Shogren, Daryl Fahrner, James Hamilton, Michael Zach
    Applied Materials & Interfaces (front cover article), 3(4), 925 (2011).
51. Nanofabrication of x-ray zone plates using ultrananocrystalline diamond molds and electroforming.
    Michael J. Wojcik, Vishwanath Joshi, **Anirudha V. Sumant**, Ralu Divan, Leonidas E. Ocola, Ming Lu, Derrick C. Mancini
    Journal of Vacuum Science and Technology: B 28(6), C6P30, (2010)
52. Status review of the science and technology of ultrananocrystalline diamond (UNCD™) films and application to multifunctional devices
    Orlando Auciello and **Anirudha V. Sumant**
    Diamond and Related Materials **(Invited Review Article)**, 19(7), 699 (2010).
53. Nanopatterning of ultrananocrystalline diamond thin films via block copolymer lithography
    M Ramanathan, SB Darling, **Anirudha V. Sumant**, O Auciello
    Journal of Vacuum Science & Technology A 28 (4), 979-983 (2010).
54. Cryogenic inductively coupled plasma etching for fabrication of tapered through-silicon vias
    A Kamto, R Divan, **Anirudha V. Sumant**, SL Burkett
    Journal of Vacuum Science & Technology A 28 (4), 719-725 (2010).
55. Preventing nanoscale wear of atomic force microscopy tips through the use of monolithic ultrananocrystalline diamond probes
    J. Liu, D. S. Grierson, N. Moldovan, J. Notbohm, S. Li, P. Jaroenapibal, S. D. O'Connor, **Anirudha V. Sumant**, N. Neelakantan, J. A. Carlisle, K.T. Turner, R. W. Carpick
    Small, 6(10), 1140 (2010).

56. Ultrananocrystalline and nanocrystalline diamond thin films for MEMS/NEMS applications
Anirudha V Sumant, Orlando Auciello, Robert W Carpick, Sudarsan Srinivasan, James E Butler
***MRS Bulletin* (Invited Review Article)**, 35 (04), 281-288 (2010).
57. Thermal stability and rehybridization of carbon bonding in tetrahedral amorphous carbon
David S Grierson, **Anirudha V. Sumant,** AR Konicek, TA Friedmann, JP Sullivan, Robert W Carpick
Journal of Applied Physics, 107 (3), 033523 (2010).
58. Characterization of microscale wear in a polysilicon-based MEMS device using AFM and PEEM–NEXAFS spectromicroscopy
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Conference Proceedings

1. Developing field emission electron sources based on ultrananocrystalline diamond for accelerators
Sergey V. Baryshev, Chunguang Jing, Jiaqi Qiu, Sergey Antipov, Vadim Jabotinski, Jiahang Shao,Wei Gai, and **Anirudha V. Sumant**
2016 29th International Vacuum Nanoelectronics Conference (IVNC) Proceedings, Vancouver, BC, 2016, pp. 1-2. doi: 10.1109/IVNC.2016.7551471
2. First adhesion measurements of conductive ultrananocrystalline diamond MEMS sidewalls
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3. Electron emission from nano-and micro-engineered materials relevant to electric propulsion
Y Raitses, ID Kaganovich, **Anirudha V. Sumant**
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4. Construction of a Ultrananocrystalline Diamond Based Cold Cathode Arrays for Flat-Panel X-ray Source
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5. Nitrogen incorporated ultrananocrystalline diamond thermal actuators: Design, fabrication and actuation
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Solid-State Sensors, Actuators and Microsystems (TRANSDUCERS & EUROSENSORS XXVII), 2013 Transducers & Eurosensors XXVII: The 17th International Conference. Pages 2349-2352 (2013).
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7. Graphene-diamond-silicon devices with increased current-carrying capacity: sp 2-Carbon-sp 3-Carbon-on-Silicon technology
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9. Electrochemical Deposition of Bismuth Micro-and Nanowires Using Electroplate and Lift Lithography
Timea Hohl, Lori A Lepak, Andrew Zimmerman, Samuel Hempel, **Anirudha V Sumant**, Ralu Divan, C Suzanne Miller, Daniel Rosenmann, Christopher Verzani, Endre Takács, Michael P Zach
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11. Patterned Micro/Nanowires by Electroplate and Lift Lithography on Reusable Ultrananocrystalline Diamond Template
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13. Deposition of Bronze Microwires on Ultrananocrystalline Diamond (UNCD) Electrodes
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14. Hard X-ray Zone Plates Using Ultrananocrystalline Diamond Molds
MJ Wojcik, V Joshi, **Anirudha V. Sumant**, R Divan, LE Ocola, M Lu, DC Mancini
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16. Top-Gate Graphene-on-UNCD Transistors with Enhanced Performance
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17. Charging characteristics of ultra-nano-crystalline diamond in RF MEMS capacitive switches
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20. Comparing the adhesion of aluminum to nanocrystalline diamond and tungsten carbide: Consequences for micromanufacturing
Vivekananda P Adiga, Saahil Sanon, Christopher D Torres, Patrick J Heaney, **Anirudha V Sumant**, Frank E Pfefferkorn, Robert W Carpick
International Conference on MicroManufacturing, Wisconsin, 2010
21. Temperature dependence of mechanical stiffness and dissipation in ultrananocrystalline diamond
Vivekananda P Adiga, **Anirudha V Sumant**, S Suresh, C Gudeman, O Auciello, JA Carlisle, RW Carpick
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23. Large-area low-temperature ultrananocrystalline diamond (UNCD) films and integration with CMOS devices for monolithically integrated diamond MEMS/NEMS-CMOS systems
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24. Temperature dependence of mechanical stiffness and dissipation in ultrananocrystalline diamond resonators
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American Physical Society, 2009 APS March Meeting, March 16-20, 2009,
25. Compositional analysis of ultrananocrystalline diamond (UNCD) films using ion beam scattering
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Muruganathan Ramanathan, Seth B Darling, **Anirudha V Sumant**, Orlando Auciello
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27. Characterizing Performance and Impact of Nanocrystalline Diamond Coatings on Micro End Milling
Christopher D Torres, Patrick J Heaney, Matthew A Hamilton, **Anirudha V Sumant**, Robert W Carpick, Frank E Pfefferkorn
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28. Environmental performance limits of ultrananocrystalline diamond films
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29. Science and Technology of Piezoelectric/Diamond Hybrid Heterostructures for High Performance MEMS/NEMS Devices
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    Patrick Heaney, Chris Torres, **Anirudha V. Sumant**, Robert W Carpick, Frank Pfefferkorn
    ICOMM, Urbana, IL 2006
31. Science and technology of ultrananocrystalline diamond (UNCD) thin films for multifunctional devices
    Orlando H Auciello, Dieter M Gruen, Alan R Krauss, A Jayatissa, **Anirudha V. Sumant**, John Tucek, Derrick C Mancini, Nicolai A Moldovan, A Erdemir, D Ersoy, Michael N Gardos, Hans Gerd G Busmann, EM Meyer
    Proc. SPIE 4235, Smart Structures and Devices, 10 (March 21, 2001); doi:10.1117/12.42085726.
32. Fabrication of low voltage gated microtip arrays with low work function Cu-Li alloy or amorphous diamond coatings and comparison of field emission properties
    O Auciello, JC Tucek, **Anirudha V. Sumant**, JA Carlisle, DM Omen, MQ Ding, M Angadi
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33. Two and three dimensional ultrananocrystalline diamond (UNCD) structures for a high resolution diamond based MEMS technology
    J Tucek, **Anirudha V. Sumant**, A, Jayatissa, N. Moldovan, D. C. Mancini, M. N. Gardos
    Materials Science of Microelectromechanical Systems (MEMS) Devices II Vol. 605, page 73, 2000.
34. The deposition of ultra nanocrystalline diamond films using a Ar/H2//CH4 microwave discharge
    W.S. Huang ; J. Asmussen ; B. Wright ; A.R. Krauss ; D.M. Gruen ; **Anirudha V. Sumant**
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35. Fabrication of MEMS components based on ultrananocrystalline diamond thin films and characterization of mechanical properties
    Anirudha V Sumant, O Auciello, AR Krauss, DM Gruen, D Ersoy, J Tucek, A Jayatissa, E Stach, N Moldovan, D Mancini, HG Busmann, EM Meyer
    MRS Proceedings, 657 Pages, EE5. 33, 2000, DOI: https://doi.org/10.1557/PROC-657-EE5.33
36. Two-and Three-dimensional Ultrananocrystalline Diamond (UNCD) Structures for a High Resolution Diamond-based MEMS Technology
    O Auciello, AR Krauss, DM Gruen, EM Meyer, HG Busmann, J Tucek, **Anirudha V. Sumant**, A Jayatissa, N Moldovan, DC Mancini, MN Gardos
    MRS Proceedings, Vo. 605, 73, 1999, DOI: https://doi.org/10.1557/PROC-605-73

Book Chapters

1. Graphene-on-Diamond Devices and Interconnects: Carbon sp2-on-sp3 Technology
   Jie Yu, Guanxiong Liu, Alexander A. Balandin, and **Anirudha V. Sumant**
   Nanoelectronic Device Applications Handbook, James E. Morris & KrzysztofIniewski (editors). CRC Press (Taylor & Francis Group), June 17, 2013
   http://www.crcpress.com/product/isbn/9781466565234
2. Medical applications of diamond particles & surfaces
   Roger J Narayan, Ryan D. Boehm, and **Anirudha V. Sumant**
   Diamond based materials for biomedical applications Edited by Roger Narayan
   Woodhead publishing Ltd. March 2013
   http://www.woodheadpublishing.com/en/book.aspx?bookID=2516

Anirudha Sumant

Invited Talks

Invited/Plenary/Keynote talks at Major Conferences and Symposia:

1. Superlubricity-near zero friction from nanodiamonds (**TEDx Talk**)
   November 10, 2018, Naperville, IL
2. Changing the landscape of the lubricant industry with graphene-based solid lubricant (**Plenary Talk**)
   Global Graphene Expo and Conference, Austin, TX, October 15-17, 2018
3. Towards Developing Energy Efficient Systems Based on Novel Carbon Materials (**Invited Talk**)
   Advanced Manufacturing & Carbon Materials Workshop, Rice University, Houston, TX, August 28, 2018
4. Taking Nanotechnology from Cleanroom to Classroom (**Invited Talk**)
   Moraine Valley Community College, Palos Hills, IL, March 27, 2018
5. Taking Nanotechnology from Cleanroom to Classroom (**Invited Talk**)
   9th Annual Nano-Link Conference, Skokie, IL 60077, April 27-28, 2018.
6. Wafer-scale growth of single and multilayer graphene on insulating diamond/Si wafer for electronics applications (**Invited Talk**)
   Techconnect World Innovation Conference and Expo, Anaheim, CA, May 13-16, 2018
7. Nanoscale tribochemical reaction driven superlubricity at macroscale with 2D materials-nanoparticles ensembles (**Keynote Talk**)
   2nd International Conference on Diamond, Graphite and Carbon Materials, Las Vegas, April 16-17, 2018.
8. Graphene: The Next Emerging Solid Lubricant (**Plenary Talk**)
   Graphene Innovation Summit and Exhibition, Nashville, TN Oct.29-31, 2017
9. Towards developing energy efficient systems based on novel carbon Materials(**Keynote Talk**)
   International Conference on Diamond and Carbon Materials, Chicago in July 17-18, 2017.
10. Manipulating friction with 2D materials-nanoparticles ensembles (**Keynote Talk**)
    Techconnect World Innovation Conference, Washington, DC May 14-17, 2017.
11. Novel Carbon Materials for battery Applications (**Keynote Talk**)
    International Conference on Advanced Rechargeable Batteries and Allied Materials, Pune, India 8-10 March 2017.
12. Novel Nanocarbon Materials and their New Emerging Applications
    Nano-Link Conference organized under NSF funds, Minneapolis. MN Nov.17-19, 2016.
13. Achieving sustained and, reproducible superlubricity at macroscale using graphene/nanodiamond ensembles
    20th International Colloquium Tribology conference in Ostfildern, Germany, Jan.12-14, 2016
14. Superlubricity at macroscale using graphene/nanodiamond ensembles (**Keynote Talk**)
    Techconnect Conference at Washington DC, March 22-26, 2016
15. Realization of Macroscale Superlubricity Through Graphene-nanodiamond Nanoscrolls
    International Conference on Metallurgical Coatings and Thin Films, San Diego, CA, April 25-29, 2016
16. Sustained, reproducible superlubricity at macroscale using graphene/nanodiamond ensembles
    Carbon 2016, Penn State University, State College, PA July11-15, 2016
17. Ultrananocrystalline Diamond: New Opportunities for the Fabrication of Novel Sensors and Actuators, Corning Inc. Elmyra, NY, October 12, 2015
18. Origin of achieving superlubricity at macroscale using graphene-nanodiamond ensembles.
    XIN Workshop on Superlubricity: Fundamentals and Applications. Beijing, China, Oct.18-20, 2015
19. Argonne's graphene/nanodiamond technology
    4th Nano-Carbon Enhanced materials Consortium, Houston, TX Nov.18-19, 2015

20. Sustained, reproducible superlubricity at macroscale using graphene/nanodiamond ensembles
    MRS Fall Meeting, Boston, MA Dec.1-4, 2015
21. Graphene: A new emerging lubricant **(Keynote Talk)**
    2015 Hydrogenius & I2CNER Tribology Symposium, Kyushu University, Feb.3-4, 2015, Japan
22. Sustained, reproducible superlubricity at macroscale using graphene/nanodiamond Ensembles,
    Annual Meeting of Society for Tribologist and Engineers (STLE), Dallas, TX, 17-21 May, 2015
23. Sustained graphene enabled superlubricity a manscoscale
    New Diamond and Nano Carbons Conference, May 24-29, Japan 2015
24. Enhancing application potential of graphene by its integration with 3D and 2D
    Materials, Workshop on Multifunctional Materials, University of Puerto Rico, San Ruan, PR Jan.14-16, 2015
25. Unfolding the origin of superlubricity at macroscale with graphene-nanodiamond ensembles
    Quantum Science Symposium & Crystal/Graphene Science symposium, Boston, MA, Sep. 21-22, 2015.
26. Few layer graphene: The next solid lubricant?
    International Conference on Metallurgical Coating and Thin Films, San Diego, April 28-May 2, 2014)
27. Few layer graphene: A new emerging solid lubricant?
    Nanomaterials for Industry, San Diego, April 6-9, 2014
28. Graphene growth on diamond in seconds at wafer-scale and device fabrication
    Graphene World Summit, Berkeley, September 15-16, 2014
29. Converting diamond into graphene in seconds at wafer scale
    International Conference on Diamond and Carbon Materials, Madrid, Spain, September 7-11, 2014
30. Graphene-on-Diamond: Wafer-scale Growth of Graphene on Diamond and Device Fabrication
    IEEE-NMDC, Taiwan, October 6-9, 2013
31. Ultrananocrystalline Diamond: New Opportunities for Fabrication of Novel Sensors and Actuators
    IEEE-Sensors, Baltimore, MD November 3-6, 2013
32. Diamond based MEMS and NEMS
    New Diamond and Nano carbon Conference, Singapore, May 2013.
33. Diamond based micro and nano systems
34. Electron Ion and Photon Beam (EIPBN) Conference, Nashville, KY, June 2013.
35. Graphene-on-diamond: A new platform for carbon based electronics **(Plenary Talk)**
    NANOSMAT conference, March, 2012 in Tampa, FL
36. Diamond thin films: A new platform for developing high performance electronic devices
    Plenary talk at New Diamond and Nanocarbon Conference, May 20-24, 2012 in Puerto Rico.
37. Synthesis and Applications of Ultrananocrystalline Diamond Thin Films
    "Frontiers of Diamondoid Science" symposium held in June 18-19, 2012 at Stanford University, CA.
38. Diamond thin films as a new platform for efficient thermal management of electronic devices
    Keynote talk at the Advancements in Thermal Management 2012 held at Denver, Colorado Sep. 18-19, 2012.
39. Direct integration of low temperature grown nanocrystalline diamond with GaN for efficient thermal management
    DARPA workshop on Growth, Fabrication and Characterization of Diamond Thermal Substrates, held at Arlington, VA on September 12, 2012.
40. Fabrication of functional nanostructures in ultrathin ultrananocrystalline diamond films by using water- based solution containing nanodiamond
    MRS-Spring Meeting, April 2012, San Francisco, CA

41. Ultrananocrystalline Diamond for MEMS and NEMS: Opportunities and Issues
    CNM Annual User Meeting, Workshop on MEMS, Argonne National Laboratory, October 5-7, 2009
42. Novel Applications of Ultrananocrystalline Diamond.
    Stellatron, Inc, Urbana-Champaign, IL, Aug, 2001.
43. Synthesis and Tailoring the Surface Chemistry of Ultrananocrystalline Diamond for Applications in MEMS and NEMS
    Institute of Functional Nanomaterials, University of Puerto Rico, San Juan, Nov. 26, 2008.
44. Synthesis and Tailoring the Surface Chemistry of Nanostructured Carbon Materials for Applications in Micro/nano Systems.
    CNM Nanoscience Seminar, Argonne National Laboratory, June 28, 2008.
45. Integration of Piezoelectric and Ultrananocrystalline Diamond films for Monolithically Integrated Piezoactuated Diamond MEMS/NEMS with CMOS
    Annual Users Meeting Argonne National Laboratory, Argonne, IL May 11, 2007.
46. Synthesis and Tailoring the Surface Chemistry of Ultrananocrystalline Diamond for Applications in Micro/Nano Systems
    Argonne National Laboratory. Argonne, IL July 2006.
47. Synthesis and Tailoring the Surface Chemistry of Nanostructured Carbon Materials for Applications in Micro/Nano Systems
    Missouri State University, Springfield, MO June 19, 2006.
48. Ultrananocrystalline Diamond: Studies Relevant to MEMS Applications.
    NNRC Seminar at University of South Florida at Tampa, May 16, 2003.
49. Science and Technology of Ultrananocystalline Diamond Films for Multifunctional MEMS Devices.
    Zyvex Inc., Richardson, TX. Aug. 2001.

Invited talks/colloquium at Institutions/Universities:

50. Taking Nanotechnology from Cleanroom to Classroom
    Moraine Valley Community College, Palos Hills, IL March 29, 2018
51. Towards developing energy efficient systems based on nanocarbon materials
    Microelectronics Research Center Distinguished lecture series at UT-Austin, Oct.13, 2016

52. Towards developing energy efficient systems based on nanocarbon materials
    Chemical Engineering Department colloquium series, University of Illinois, Chicago. June 7, 2016
53. Field Emission Electron Source Based on Ultrananocrystalline Diamond Films for Electron Accelerators Applications, Stanford Linear Accelerator Laboratory, Stanford University, CA July 1, 2016
54. Unfolding the origin of superlubricity at macroscale with graphene-nanodiamond ensembles
    Invited Colloquium talk at Tu Delft University, Netherlands, Sep. 15, 2015.
55. Exploring the flatland of 2D materials for tribological manipulation
    Physics Colloquium Talk, Vanderbilt University, Nashville, TN March 19, 2015
56. Graphene as new emerging lubricant
    Bluestar Silicones Inc. Charlotte, C, April 23-24, 2015
57. Unfolding the origin of superlubricity at macroscale with graphene-nanodiamond ensembles
    Open Mic Invited Presentation at Argonne, July 21, 2015
58. Energy efficient systems based on graphene and other 2D materials
    EFRC presentation, June 5, 2015, Argonne

59. Nanoscale origin of achieving superlubricity at macroscale using graphene-nanodiamond ensembles
    PSE Review Meeting September 29, 2015, Argonne
60. Advanced technologies based on carbon nanomaterials
    Presentation to John Crane Inc. arranged by TDC at Argonne, March 4, 2015
61. Advanced Nanotechnologies Based on Carbon Materials
    Presentation to Boing at TDC, Argonne 2014
62. Few Layer Graphene: The Next Solid Lubricant?
    Presentation at Molex Inc. Lisle, IL, June 2014
63. Diamond thin films: A new platform for developing high performance electronic devices
    Invited colloquium talk at Case Western Reserve University, Oct. 9, 2012, Cleveland, OH.

Contributed Talks: More than 120 contributed talks in various national and international conference

(Will provide the list if needed)

Patents Granted

1. Systems and methods for forming diamond heterojunction junction devices
   US, 10,186, 584 issued January 22, 2019
2. Thermally Conductive Lithium Ion Electrodes and Batteries
   US 9,991,512 issued June 5, 2018
3. Nanowire and microwire fabrication technique and product
   US 9,903,033 issued February 27, 2018
4. Superlubricating graphene and graphene oxide films
   US 9,890,345 issued on February 13, 2018
5. Graphene layer formation at low substrate temperature on a metal and carbon based substrate
   US 9,875,894 issued on January 23, 2018.
6. Ultrananocrystalline diamond contacts for electronic devices
   US 9,842,958 issued on December 12, 2017
7. Transparent nanocrystalline diamond coatings and devices
   US 9,741,561 B2 issued 22nd August, 2017
8. Piezoresistive boron doped diamond nanowire
   US 9,696,222 issued on July 4, 2017
9. Low friction wear resistant graphene films
   US 9,561,526 B2, issued on February 7, 2017
10. All 2D, high mobility, flexible, transparent thin film transistor
    US 9,548,394 B2, issued January 17, 2017
11. Ultrananocrystalline diamond contacts for electronic devices
    US 9,484,474, issued November 1, 2016
12. Low-stress doped ultrananocrystalline diamond
    US 9,475,690, issued October 25, 2016
13. Piezoresistive boron doped diamond nanowire
    US 9,441,940 B2 issued 13 September 2016
14. Planar field emitters and high efficiency photocathodes based on ultrananocrystalline diamond
    US 9,418,814 B2 issued 16 August 2016
15. Ultrananocrystalline diamond films with optimized dielectric properties for advanced RF MEMS capacitive switches, US 9,269,519 B2, issued 23 Feb., 2016

16. Method to fabricate portable electron source based on nitrogen incorporated ultrananocrystalline diamond (N-UNCD)
    US 9,299,526 B2 issued 29 March 2016
17. Graphene layer formation on a carbon based substrate
    US 9,202,684 B2 issued 1 Dec. 2015
18. Electrostatic MEMS devices with high reliability
    US 8,963,659 B1 issued Feb. 24, 2015
19. Graphene layer formation at low substrate temperature on a metal and carbon based substrate
    US 8,906, 772 B2 issued Dec. 9, 2014
20. Graphene layer formation on a carbon based substrate
    US 8,652,946 B2 issued Feb. 18, 2014
21. Simple method to fabricate nano-porous diamond membranes
    US 8,673,164 B2 issued March 18, 2014
22. Ultrananocrystalline diamond with optimized dielectric properties for advanced RF-MEMS capacitive switches
    US 8354290, Issued January 15, 2013.
23. RF MEMS capacitive switches with high reliability
    US 8525185, Issued September 3, 2013.
24. Methods of applying a nanocrystalline diamond film to a cutting tool
    US 7,947,329 B2, issued May 2011.

Technology Licensed

1. Nanowire and microwire fabrication technique and product
   Patent application US 20140027294 A, Published: Jan 30, 2014
   United Scientific Supplies Inc.
2. Methods of applying a nanocrystalline diamond film to a cutting tool
   US 7,947,329 B2, issued May 2011.
   Intel Inc.

Patents Pending

3. Direct synthesis of reduced graphene oxide films on dielectric substrates
   Patent Publication number: 20160332885 published on November 17, 2016
4. Thermally conductive lithium ion electrodes and batteries
   Patent Publication number: 20160308263, October 20, 2016
5. Piezoresistive boron doped diamond nanowire
   Patent application number PCT / US2016 / 013708 published on July 28, 2016
6. Graphene layer formation at low substrate temperature on a metal and carbon based substrate Patent application number PCT / US2015 / 064330 published on June 16, 2016
7. Low friction wear resistant graphene films
   Patent application number US 14/309,366 published on December 24, 2015
8. Transparent electronic system and method
   Patent application number US 14/682,947 published on October 15, 2015
9. Superlubricating graphene and graphene oxide films
   Patent Publication number: 20150197701 published on July 15, 2015

10. Superlubricating graphene and graphene oxide films
    Patent Application number: PCT/US2013/051121 US 14/415,499, Published on Jul 16, 2015
11. Superlubricating graphene and graphene oxide films
    Patent Application number: PCT/US2013/051121, Published on Jul 18, 2015
12. All 2d, high mobility, flexible, transparent thin film transistor
    Patent Publication number US20150303315 A1, published on Oct. 25, 2015
13. Nanowire and microwire fabrication technique and product
    Patent application US 20140027294 A, Published: Jan 30, 2014
14. Superlubricating Graphene Films
    Patent Publication number: 20140023864, published on Jan 23, 2014
15. Graphene layer formation at low substrate temperature on a metal and carbon based substrate
    Patent Application number: 14/563201, filed on December 8, 2014
16. Superlubricating graphene films
    Patent Application number PCT/US2013/051121, Filed on July 18, 2013
17. Transparent nanocrystalline diamond coating and devices
    Patent application number: 14/796527, filed on September 29, 2014

Funding Activity

1. SPP funding for NanofabLab..in a Box (PI: Anirudha Sumant)
   United Scientific Supplies Inc, Funding Amount: **$11,000**, Duration 3 months (FY18)
2. Won DOE-Technology Commercialization Fund Award for the project “Graphene based solid lubricants for automotive applications” (PI: Anirudha Sumant, NST)
   Funding Award Amount: **$650,000**, Duration: FY 17-19, Participant Industry: Magna International
3. Technical Service Contract for low temperature growth of diamond Ge and ZnS for optical applications (PI: Anirudha Sumant), Funding Amount: **12,000**, Sinmat Inc. 2017.
4. Tribology of graphene at elevated Temperatures (PI: Anirudha Sumant, NST)
   Swift LDRD, Total Funding: **$100,000**, Duration FY17
5. Technical Service Contract for low temperature growth of diamond on glass (PI: Anirudha Sumant), Funding Amount: **38,000** with Corning Inc.
6. Won DOE-Technology Commercialization Fund Award for the project "Graphene Coating for Dry Gas Seal Applications" (PI: Anirudha Sumant, NST)
   Funding Award Amount: **$679,992**, Funding duration: FY16-18, Participating Industry: John Crane Inc.
7. Won DOE-Technology Commercialization Fund Award for the project "UNCD-Based Electron Field Emission Source for Accelerator Applications" (PI: Anirudha Sumant, NST)
   Funding Award Amount:**$160,000**, Funding duration: FY17-18, Participating Industry: Euclid Techlabs Inc.
8. SPP funding for NanofabLab..in a Box (PI: Anirudha Sumant)
   United Scientific Supplies Inc, Funding Amount: **$10,000**, Duration 6 months (FY17)
9. CRADA funding "NCD Diamond Semiconductor System for Advanced Power Electronics Systems Integration(PI: Anirudha Sumant, NST)
   Funding Award Amount: **$213,000**, Funding Duration: 1 years (July 2015-July 2016)
10. Strategic Initiative LDRD Grant on Uranium and Plutonium Detection by Plasmonic Graphene-based Nanosensors (Co-PI)
    Total Funding: **$470,000**, Total Duration: 3 years (FY13-15)

11. Graphene Enabled Superlubricity: Vanishing Friction and Wear in Static and Sliding Contacts (PI: Anirudha Sumant) Funding: Materials for Energy (PSE), Duration: 1 years (FY 15-16) Total Funding: **$150,000**
12. Graphene Windows for Advancing Electron RF Guns(Co-PI) Funding: Director's Competitive LDRD Grant Total Funding: **$184,000**, Total Duration: 2 years (FY13-14)
13. New technologies for label-free antibody-based multiplexed biosensors(Co-PI) Funding: Director's Competitive LDRD Grant Total Funding: **$360,000**. Duration: 3 years (FY11-13)
14. Graphene Enabled Superlubricity: Vanishing Friction and Wear in Static and Sliding Contacts Funding: Director's Competitive LDRD Grant (PI: Anirudha Sumant) Total Funding: **$450, 000**, Duration: 3 years (FY 12-15)
15. Low power piezoactuated NEMS switch contact reliability(Co-PI) Funding Agency: DARPA-NEMS-PHASE-III Total funding: **$1,409,933,000**, Total duration: 1 year (FY11-12)
16. Fabrication of Nitrogen-Doped UNCD Field Emitters and Characterization of Emission Performance (NASA subcontract: **$50,000**) FY09-10 (Co-PI)
17. Low power piezoatuated NEMS logic (Co-PI) Funding Agency: DARPA-NEMS-Phase-I: **$800,000**, Duration: FY09-10
18. Insertion of Integrated UNCD-RF MEMS Switches/CMOS Devices into Phase Array Antennas (Co-PI) Funding Agency: (DARPA-Phase-IV: **$850,000**) FY09-10
19. Science and technology for development of high-sensitivity biosensors based on ultrananocrystalline diamond (Co-PI) Funding: (LDRD:**$300,000**), Duration: FY08-10
20. On / Off-Chip integration of multi-functional diamond MEMS technology with CMOS for DC to GHz frequency applications(Co-PI) Funding Agency: DARPA-Phase-III: **$1,400,000**, Duration: FY08-09
21. Uncovering the fundamental nature of tribological interfaces: High-resolution tribology and PEEM-NEXAFS spectroscopy of NCD films for MEMS and beyond (Co-PI) Funding Agency: AFOSR: **$478,575**, Duration: FY06-08
22. Nanocrystalline diamond coatings for ultrahigh performance machine tools Funding: I&EDR: **$40,000**), Duration: FY05
23. Nanostructured carbon-based coatings for Micro-/Meso-scale manufacturing of metals and polymers Funding(Co-PI), (I&EDR: **$39,000**), Duration: FY05
24. DURIP: Instrumentation for multifunctional surface spectroscopy(Co-PI) Funding Agency: DoD: **$189,995**, Duration: FY06-08
25. Co-integration of multi-functional diamond MEMS technology with high performance CMOS for dc to GHz frequency applications (Co-PI) Funding Agency: DARPA-Phase-II: **$150,000** Sub-contract from ANL, FY06
26. Nanocrystalline diamond MEMS based optical switches (PI: Anirudha Sumant) Funding Agency: BMDO-SBIR: **$80,000**), Duration: FY01
27. RF-MEMS switches based on ultrananocrystalline diamond MEMS technology (PI: Anirudha Sumant). Funding Agency: BMDO-SBIR: **$80,000**, Duration: FY01

Anirudha Sumant

Mentoring Experience

Visiting Fellow

1. Prof. Nihar Pradhan, Jackson State University, MS (Visiting for Summer 2018)
2. Prof. Jinlong Liu (Visiting for 1 year from University of Science and Technology Beijing)

Post-doctoral fellow supervisor:

1. Dr. Aditya Ayyagari
2. Dr. Kalyan Mutyala
3. Dr. Diana Berman (Currently Assistant Professor at University of North Texas, Denton)
4. Dr. Kiran Kumar Kovi (Currently Research Scientist at Euclid TechLabs, Bolingbrook, IL)
5. Dr. Meng Shen (Currently post-doc at Northwestern University)
6. Dr. Saptarshi Das(Co-advisor, currently Assistant Professor at Penn State)
7. Dr. Alfredo Bobadilla (Co-advisor, currently Assistant Professor in Peru)
8. Dr. Srinath Balachandran (Currently, Senior Staff Engineer at Microvision Inc.)

Ph.D. student Co-advised (Ph.D. thesis work done at CNM):

1. Shikai Deng (Ph.D. student at University of Illinois, Chicago)
2. Kai-Hang Yang (Ph.D. student from NC State University)
3. Hao Li (Visting student from China for 1 year study at CNM)
4. Dr. Richard Gulotty (Ph.D. student from University of California-Riverside, Graduated 2014, at Honeywell Inc.)
   Ph.D. Thesis:
5. Dr. Alfredo Bobadilla (Ph.D. student from Texas A&M University, Graduated 2014).
6. Ph.D. Thesis: Federico Buja (Ph.D. student from Tu Delft University, Graduated 2014, at Imec, Belgium), Ph.D. Thesis: Novel materials applications for the experimental investigation of adhesion and friction phenomena in MEMS
7. Dr. Kenneth Perez (Ph.D. student from University of Puerto Rico, Graduated 2014, at IBM Yorktown Heights, NJ), Ph.D. Thesis: Electromechanical, photoemission and field emission properties of ultrananocrystalline diamond films
8. Dr. Xinpeng Wang (Ph.D. student from University of Puerto Rico, Graduated 2012, at Nanonex Inc.) Ph.D. Thesis: Synthesis, fabrication, characterization and applications of ultrananocrystalline diamond micro and nanostructures

Ph.D. students mentored (at UW-Madison)

1. Dr. Patrick Heaney (Currently President and CTO of NCD Technologies LLC, Madison, WI.) Ph.D. Thesis: Improving Nanocrystalline Diamond Coatings for Micro End Mills
2. Dr. David Grierson (Currently Co-founder and CTO of systeMECH, LLC Madison, WI) Ph.D. Thesis: Nanotribological Properties of Nanostructured Hard Carbon Thin Films.
3. Dr. Christopher Torres, (Currently a Process Engineer, Intel)

Anirudha Sumant

Professional Service

- Advisory Board Member to Applied Physics Letters (term 2019-2022)
- Advisory Board Member for National Graphene Association
- Co-organizer for the Graphene and 2D Materials session at Techconnect 2018
- Member, IEEE Nanotechnology Council Standards Committee
- New Diamond and Nano Carbons Conference 2018, Program Committee Member
- Served as a reviewer for Molecular Foundry User proposals (on-site review panel 2017)
- Served a s Group Chair for, MEMS and NEMS Technical Group, American Vacuum Society for 8 years and currently Executive Committee Member 2016
- Executive Committee member Nanometer Scale Science Division, American Vacuum Society, 2016
- New Diamond and Nano Carbons Conference 2017 Program Committee and International Advisory committee
- Senior Editor IEEE Nanotechnology Express (eNANO)
- Guest Editor IEEE Nanotechnology Magazine
- External Reviewer for Ph.D. Thesis
- External Reviewer for European Research Council
- Served as internal reviewer and judge for the Chain reaction Innovation proposals at Argonne
- Invited as a Government Expert from DARPA-MTO for their program review of NJIT diamond based thermal management program
- Program Committee Member for New Diamond and Nano Carbons Conference 2016 held in China
- Serving on AVS MEMS and NEMS technical group as a committee member
- Served as a principle Guest editor of the special issue of Diamond and Related Materials journal covering selected paper that was presented at NDNC 2014
- Ph.D. committee member, TU Delft University, Netherlands as International external referee for the Ph.D. defense of the candidate.
- Organized a successful international conference New Diamond and Nano Carbons (NDNC) as a Conference Chair in Chicago this year in May 2014. NDNC is one of the premiere conference in the Diamond and Nano Carbon area at international level held every year. The conference held in Chicago this year broke earlier records in terms of record attendance (353 +), highest number of invited speakers 25, and great response from sponsors and exhibitors.
- Invited to serve as a panel expert for reviewing National Science Foundation Proposals.
- Organized a workshop on “Nanostructured carbon materials for MEMS/NEMS and Nanoelectronics” using CNM annual user meeting in May 2013.
- Technical Program Committee member and member of technical advisory committee for the IEEE Nano Materials and Devices Conference to be held in Taiwan, Oct.6-9, 2013.
- Editorial board member editorial Journal ISRN nanomaterials
- Have been invited to serve as a International Reviewer for the Czech Science Foundation
- Lead Symposium Organizer, International Materials Research Congress 2012, Cancun, Mexico.
- NSF panelist for ECCS division, 2012
- Session Chair in Nanodiamond and nano carbon conference held at San Juan, PR in May 2012.
- Member of advisory board for NDNC 2011 conference
- Session Organizer, SPIE Conference on Defense, Security, and Sensing, April 2010.
- Technical Program Committee Member for Topical Conference on Ink Jet Printing

Technology, AVS-56, 2009-2010

- Session Chair and Co-organizer of the “MEMS and NEMS” session at AVS conference, Nov. 04.
- Session Chair of the “X-rays in Mechanical Engineering” session at ASME conference, Nov. 04.
- Session Co-chair and Co-organizer of the “Micro/nano tribology” session at AS conference, Aug. 2005.
- Panel expert on the “Nano-manufacturing” session at ASME conference, Nov. 2004.
- Reviewer for various journals including Science, Nature Materials, Nature Nanotechnology, Nature Communications, Nano letters, ACS Nano, Advanced Materials, Nano Today, Euro Physics Letters, Carbon, Nanotechnology, Applied Physics Letters etc.