NANO AT NC STATE

The College of Engineering is a global leader in multidisciplinary research in nanotechnology.

Our faculty members are using nanotechnology to create fabrics that break down chemical warfare agents, save lives by tackling tough blood tests, and more.

NC State Engineering is a research powerhouse, with annual research expenditures ranked in the top 10 nationally among U.S. colleges of engineering. We are located on Centennial Campus, one of the premier research parks in North America. Raleigh, NC, is one of the fastest-growing communities in the United States and has been repeatedly recognized as one of the best places in the country to live and work.

Learn more at www. engr.ncsu.edu.

Advertisements
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Welcome from the General Chairs

On behalf of the IEEE Nanotechnology Council (IEEE NTC) and the Conference Organizing Committee, it is our pleasure to welcome all authors, reviewers, session chairs, and participants to the 16th IEEE Nanotechnology Materials and Devices Conference (IEEE NMDC) in Vancouver, BC, Canada, in December 12 - 15, 2021. The IEEE NMDC was founded in 2005 and since that time it has developed as one of the major IEEE conferences in the rapidly growing field of Nanotechnology fundamental research and applications. The IEEE NMDC is held annually on a rotational principle in different locations in IEEE Regions 1-7 & 9 (North & South America), Region 8 (Europe & Africa) and Region 10 (Asia & Pacific), with the latest editions taking place in Anchorage, AK, USA (2015), Toulouse, France (2016), Singapore (2017), Portland, OR, USA (2018), Stockholm, Sweden (2019) and Nanjing, China (2020, virtually due to the COVID-19 pandemic).

IEEE NMDC aims to develop critical assessment of existing work and future directions in nanotechnology research including nanomaterials and fabrications, nanoelectronics, nanophotonics, nanobio medical applications, devices, and integration. Its main purpose is to foster communication between physicists, chemists, microbiologists and engineers from academia and industry, interested in nanodevices and nanostructured materials, advanced preparation techniques, new material properties, standards and safety issues of nanotechnology, computer simulations and theoretical developments. The interdisciplinary exchange between academic scientists and contributions from industrial researchers, during the conference, stimulates gathering knowledge and helps inspiring new perspectives in applications on this exciting area.

IEEE NMDC 2021 is primarily sponsored by the IEEE Nanotechnology Council. Valued patrons of the conference are NC State University (NC, USA), University of Victoria (BC, Canada), CMC Microsystems (Canada), Biosensors and Micromachines by MDPI, as well as the conference media partners: IEEE TNANO, IEEE OJ-NANO and IEEE Nanotechnology Magazine.

The 16th IEEE NMDC 2021 has a particular flavor since for the first time one of the main IEEE NTC conferences is organized in co-location with one of the oldest IEEE conferences, namely the 96th IEEE Conference on Electrical Insulation and Dielectric phenomena (IEEE CEIDP 2021) of the IEEE Dielectrics and Electrical Insulation Society (IEEE DEIS). Given the challenges imposed by the pandemic of our time, COVID-19, the NMDC & CEIDP organizing committees succeeded to work in concert, in the effort to offer the conference attendees many parallel sessions, covering an enlarged panel of scientific topics and their industrial applications, organized in an excellent environment offered by the Pinnacle Harbourfront Hotel, located in the heart of Vancouver. Conference attendees that experience travel restrictions in this difficult time will be given the possibility to remotely present their contributions. Apart from the possibility of the registered participants to freely access the contributions and sessions of both conferences, they are highly encouraged to attend the NMDC & CEIDP two joint sessions and the joint workshop dedicated to topics of common interest.

The IEEE NMDC 2021 would not be successful without the commitment and contribution from many volunteers, authors, reviewers, conference participants, and partners. All are highly acknowledged for their help and support.

We wish you a productive and interesting conference and an agreeable time in Vancouver.

IEEE NMDC 2021 General Chairs

Dr. Kremena MAKASHEVA  
CNRS,  
LAPLACE

Prof. Xiaoning JIANG  
NC State University

Prof. Reuven GORDON  
University of Victoria

Prof. James B. SPICER  
Johns Hopkins University
Welcome from the Program Chair

On behalf of all my colleagues on the Technical Program Committee, it is a great honor to welcome you to the 2021 IEEE Nanotechnology Materials and Devices Conference (NMDC 2021) in Vancouver, British Columbia, Canada. This conference serves a special role among the technical meetings organized by the IEEE Nanotechnology Council (NTC) and provides an opportunity to explore new ways of connecting with the member societies of the NTC.

The program for NMDC 2021 has been developed in conjunction with the Conference on Electrical Insulation and Dielectric Phenomena (CEIDP) 2021 with colleagues in the IEEE Dielectrics and Electrical Insulation Society (DEIS). Working on the overall program with Prof. Thomas Andritsch (University of Southampton University, UK and my counterpart in CEIDP 2021) has been a rewarding experience on many levels. This collaboration in organization has introduced new ways for developing technical programs, and I hope you find the combination of NMDC with CEIDP exciting and effective.

While the integration of these conferences presented opportunities, the challenges of the global pandemic forced changes that none of us expected when the proposal for NMDC-CEIDP 2021 was first presented to the NTC leadership. The conference was envisioned as an event that would bridge organizational boundaries bringing different technical communities together. We have been unwavering in this goal, but the pandemic has made delivery of the technical program quite demanding.

The entire program of the conference will be available online with participants at the conference site enjoying all the amenities of an in-person experience. Since many participants will deliver their presentations onsite, there will be online participants who will need to attend during times of the day (or night) that are not conducive to rigorous technical exchanges and this aspect is unfortunate.

However, the program itself is vigorous and offers participants the opportunity to attend eight plenary lectures on topics ranging from quantum computing to nanomedicine. Complementing these presentations are those from our three, newly-inducted, NTC Fellows who will present aspects of their contributions to nanotechnology. We will also have several keynote addresses by Distinguished Lecturers of the NTC along with numerous invited presentations in the many technical areas on offer at NMDC 2021.

Many of the sessions relate directly to the standing Technical Committees of the NTC, and I want to thank all the chairs and members of these committees for their support of the paper solicitation, review and approval process. We also have a number of Special Topics sessions that are focused on areas that enjoy heightened activity and are particularly relevant to today's technological developments. Two of the most popular are Nanomaterials for Energy Applications and Theory and Modelling of Nanomaterials and Devices with each requiring three full sessions to accommodate all the accepted papers and abstracts in these areas.

I would like to take this opportunity to express sincere gratitude to the session organizers, workshop and tutorial organizers, panel chairs, track chairs as well as all the reviewers whose critical evaluation of various contributions were incredibly valuable in preparing the best technical content possible. Preparation of this outstanding program for NMDC 2021 would not have been possible without the dedication and efforts of so many colleagues. I hope you enjoy the technical program and I look forward to meeting you physically in Vancouver or online during IEEE NMDC 2021.

J.B. Spicer
Johns Hopkins University
NMDC 2021 TPC Chair
**Sponsors & Patrons**

**GOLD PATRON**

**NC State University**

NC State is a public land-grant university based in Raleigh, the capital of North Carolina. As a Research I university, NC State is a key part of the Research Triangle region, which is home to industry leaders such as NC State partners SAS, Cisco, IBM, GlaxoSmithKline and Lenovo. Raleigh and the surrounding area are consistently rated among the best places to live and work in the United States, and NC State is a driving force for the local, state and national economies, with 36,700+ students, 2,400+ faculty and 7,200+ staff.

https://results.ncsu.edu

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https://www.CMC.ca

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https://www.uvic.ca/
Sponsors & Patrons

**CONFERENCE BAG PATRON**

Biosensors (ISSN 2079-6374; CODEN: BIOSHU) is an international, peer-reviewed, open access journal on the technology and science of biosensors published monthly online by MDPI. Both experimental and theoretical papers are published, including all aspects of biosensor design, technology, proof of concept and application. Biosensors is covered by leading indexing services, including SCIE, Scopus, PubMed, MEDLINE, PMC, Embase, CAPPlus / SciFinder, Inspec, and other relevant databases. The latest Impact Factor (IF) is 5.519 and the CiteScore is 5.4. We look forward to receiving your contributions! If you mention the conference NMDC 2021 in your coverletter, we can offer a certain discount or waiver for your paper.

**AWARD PATRON**

Sponsor of Best Student Paper Award

Micromachines (ISSN 2072-666X, IF 2.891) is a peer-reviewed, open access journal on the science and technology of small structures, devices and systems, published monthly online by MDPI.

**SPONSOR**

IEEE Nanotechnology Council

The IEEE Nanotechnology Council (NTC) is a multi-disciplinary group whose purpose is to advance and coordinate work in the field of Nanotechnology carried out throughout the IEEE in scientific, literary and educational areas. The Council supports the theory, design, and development of nanotechnology and its scientific, engineering, and industrial applications.
IEEE Transactions on Nanotechnology

T-NANO is a peer-reviewed hybrid journal, and publishes novel and important results in engineering at the nanoscale. The scope of TNANO includes the physical basis and engineering applications of phenomena at the nanoscale level across all areas of science and engineering. TNANO publishes Regular Papers and Letters. It focuses on nanoscale devices, systems, materials and applications, and on their underlying science.

TNANO is an online publication with accepted papers published on the web as soon as they are submitted in final form. Web-published papers have a DOI (Digital Object Identifier), and are fully citable and downloadable.

IEEE Open Journal of Nanotechnology

OJ-NANO publishes novel and important engineering and scientific results at the nanoscale. Research results related to nanoscale devices, systems, materials and applications, and on their underlying science are considered for peer-review and publication in this journal. Accepted papers are published on the web (IEEE Xplore) as soon as they are submitted in approved IEEE format. Web-published papers have a DOI (Digital Object Identifier), and are fully citable and downloadable. Nanotechnology is evolving rapidly and swift publication is necessary to ensure that authors submit their best work to the OJ-NANO. Fast publication is achieved through OJ-NANO’s entirely electronic submission and review process.

IEEE Nanotechnology Magazine

IEEE Nanotechnology Magazine publishes peer-reviewed articles that present emerging trends and practices in industrial electronics product research and development, key insights, and tutorial surveys in the field of interest to the member societies of the IEEE Nanotechnology Council. IEEE Nanotechnology Magazine will be limited to the scope of the Nanotechnology Council, which supports the theory, design, and development of nanotechnology and its scientific, engineering, and industrial applications.
NMDC 2021 Committees

Organizing Committee

- **General Chairs**
  Kremena Makasheva, CNRS LAPLACE, France
  Xiaoning Jiang, North Carolina State University, USA

- **General Co-Chairs**
  Reuven Gordon, University of Victoria, Canada
  Jim Spicer, Johns Hopkins University, USA

- **Publicity Chair**
  Bonnie Gray, Simon Fraser University, Canada

- **Publication Chair**
  Yann Cressault, Paul Sabatier University, France

- **Registration Chair**
  Makhsud Saidaminov, University of Victoria, Canada

- **Exhibit/Sponsorship Chair and Co-Chair**
  Catherine Tran, Intel, USA
  Michael Adachi, Simon Fraser University, Canada

- **Local Arrangements Chair**
  Anand Shah, Powertech Labs, Canada

- **Conference Treasurer**
  Lee Oien, Portland, OR, USA

- **Website/Technology Chair**
  Ed Perkins, Portland, OR, USA

- **Assistant webmaster**
  Qianqian Cai, North Carolina State University, USA

Technical Program Committee

James Spicer, Johns Hopkins University, TPC Chair

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- Yohnhua (Tommy) Tzeng, former NTC president, National Cheng Kung University, Taiwan
- John T.W. Yeow, NTC VP Education, University of Waterloo, Canada
- Qing Zhang, Nanyang Technological University, Singapore

### Technical Program Committee Members

<table>
<thead>
<tr>
<th>Committee Member</th>
<th>Affiliation</th>
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<tbody>
<tr>
<td>Jim Spicer</td>
<td>Johns Hopkins University</td>
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<tr>
<td>Amy Foster</td>
<td>Johns Hopkins University</td>
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<tr>
<td>Andrew Eckford</td>
<td>York University</td>
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<tr>
<td>Christina Villeneuve-Faure</td>
<td>University Paul Sabatier, LAPLACE, Toulouse</td>
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<tr>
<td>David Buso</td>
<td>University Paul Sabatier, LAPLACE, Toulouse</td>
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<tr>
<td>Davide Mencarelli</td>
<td>Università Politecnica delle Marche</td>
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<tr>
<td>Dominique Baillargeat</td>
<td>University of Limoges-France</td>
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<tr>
<td>Flavien Valensi</td>
<td>University Paul Sabatier, LAPLACE, Toulouse</td>
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<td>Guangyong Li</td>
<td>University of Pittsburgh</td>
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<td>Haibo Yu</td>
<td>Shenyang Institute</td>
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<td>Hisataka Maruyama</td>
<td>Nagoya University</td>
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<tr>
<td>Jayasimha Atulasimha</td>
<td>Virginia Commonwealth University</td>
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<td>Jean Anne Incorvia</td>
<td>University of Texas at Austin</td>
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<td>Jiang-Ping Wang</td>
<td>University of Minnesota</td>
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<td>Jie Yin</td>
<td>North Carolina State University</td>
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<td>Kaikai Xu</td>
<td>University of Electronic Science and Technology of China</td>
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<tr>
<td>Lidai Wang</td>
<td>City University of Hong Kong</td>
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<td>Lixin Dong</td>
<td>City University of Hong Kong</td>
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<td>Luca Pierantoni</td>
<td>Università Politecnica delle Marche</td>
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<td>Luo Gu</td>
<td>Johns Hopkins University</td>
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<td>Malgorzata Chrzanowska-Jeske</td>
<td>Portland State University</td>
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<td>Marc Ternisien</td>
<td>University Paul Sabatier, LAPLACE, Toulouse</td>
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<td>MP Anantram (Anant)</td>
<td>University of Washington</td>
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<td>P M Raj</td>
<td>Florida International University</td>
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<td>Richard Clergereaux</td>
<td>CNRS, LAPLACE, Toulouse</td>
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<tr>
<td>Seyi Balogun</td>
<td>Northwestern University</td>
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<td>Steve Tung</td>
<td>University of Arkansas</td>
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<td>Susanna Thon</td>
<td>Johns Hopkins University</td>
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<td>Vihar Georgiev</td>
<td>University of Glasgow</td>
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<td>Wei Wu</td>
<td>University of Southern California</td>
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<td>Zheng Fan</td>
<td>University of Houston</td>
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<td>Ziliang Ye</td>
<td>University of British Columbia</td>
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<tr>
<td>Josef Weinbub</td>
<td>Technische Universität Wien</td>
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# Program at a Glance

<table>
<thead>
<tr>
<th>PDT (UTC-7)</th>
<th>Sunday December 12th</th>
<th>Monday December 13th</th>
<th>Tuesday December 14th</th>
<th>Wednesday December 15th</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:15 - 8:30</td>
<td>Opening / Introduction (Salon A)</td>
<td>Plenary Talk 1 (Salon A)</td>
<td>Plenary Talk 3 (Salon A)</td>
<td>Plenary Talk 5 (Salon A)</td>
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<tr>
<td>8:30 - 9:00</td>
<td>SS1 Workshop (Salon F)</td>
<td>Plenary Talk 2 (Salon A)</td>
<td>Plenary Talk 4 (Salon A)</td>
<td>Plenary Talk 6 (Salon A)</td>
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<tr>
<td>9:00 - 9:30</td>
<td>Break</td>
<td>Break</td>
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<tr>
<td>9:30 - 10:00</td>
<td><strong>SS2: CEIDP Workshop</strong> (Salon F)</td>
<td>Parallel Sessions (Salons A, B, E)</td>
<td>Parallel Sessions (Salons A, B, E)</td>
<td>Parallel Sessions (Salons A, B, E)</td>
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<tr>
<td>10:00 - 10:30</td>
<td>Lunch (Catered)</td>
<td>Lunch (Catered)</td>
<td>Lunch (Catered)</td>
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<tr>
<td>10:30 - 11:00</td>
<td>Break</td>
<td>Break</td>
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<tr>
<td>11:00 - 12:00</td>
<td>Parallel Sessions (Salons A, B, E)</td>
<td>Parallel Sessions (Salons A, B, E)</td>
<td>Parallel Sessions (Salons A, B, E)</td>
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<tr>
<td>12:00 - 12:30</td>
<td>SS3: Tutorial (Salon F)</td>
<td>NMDC &amp; CEIDP Joint Session (Salon A)</td>
<td>Break/Virtual Poster session 15:30 – 16:30 (Salon E)</td>
<td>Break</td>
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<tr>
<td>12:30 - 13:00</td>
<td>Lunch (Catered)</td>
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<td>13:00 - 13:30</td>
<td>Break</td>
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<tr>
<td>13:30 - 14:00</td>
<td>Parallel Sessions (Salons A, B, E)</td>
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<tr>
<td>14:00 - 14:30</td>
<td>Break</td>
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<tr>
<td>14:30 - 15:00</td>
<td>Parallel Sessions (Salons A, B, E)</td>
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<tr>
<td>15:00 - 15:30</td>
<td>Welcome Reception (Vistas - 19th Level)</td>
<td>IEEE NTC Awards (Salon A)</td>
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<tr>
<td>15:30 - 16:00</td>
<td>YP Panel Meet the Experts (Salon A)</td>
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<tr>
<td>16:00 - 16:30</td>
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<td>IEEE NMDC Awards Announcement</td>
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<td>16:30 - 17:00</td>
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<tr>
<td>18:30 - 19:00</td>
<td>Welcome Reception (Vistas - 19th Level)</td>
<td>YP Panel Meet the Experts (Salon A)</td>
<td>IEEE NTC Awards (Salon A)</td>
<td>Closing remarks NMDC Awards Announcement IEEE NMDC 2022 (Salon A)</td>
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<td>19:00 - 19:30</td>
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<td>20:00 - 21:00</td>
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<td>Banquet (Tuscany - Lobby Level)</td>
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</tbody>
</table>
Meeting Rooms

REGISTRATION: Registration in Cordova Level, Grand Foyer - look for signs

**NMDC 2021 Technical Program Sessions** are presented in three tracks in Salons A, B and E on Cordova Level. Plenary sessions are in the Salon A room. Virtual Posters in Salon E. Workshop and Tutorial are in Salon F.

Meals are in Tuscany (Lobby).
Breaks in Cordova Foyer.
Welcome Reception is in Vistas (19th Level)

<table>
<thead>
<tr>
<th>Meeting Rooms (Cordova Level)</th>
<th>Tuscany (Lobby Level) Breakfast, Lunch, Banquet</th>
<th>Vistas (19th Level) Welcome Reception</th>
<th>Salon A Plenary &amp; Track 1</th>
<th>Salon B Track 2</th>
<th>Salon E Track 3 &amp; Posters</th>
<th>Salon F Workshop &amp; Tutorial</th>
</tr>
</thead>
</table>

![Floor plan](image-url)
Plenary and Invited Speakers

PLENARY SPEAKERS

Monday December 13

- **Mark Johnson**, D-Wave Systems Inc; "Practical Quantum Computing"
- **Xiaoying Zhuang**, Department of Maths and Physics, Leibniz University Hannover; "Multiscale modelling and optimization of flexoelectric nano structures"

Tuesday, December 14

- **Naomi Halas**, Department of Electrical and Computer Engineering, Rice University; "Nanomaterials and Light for Sustainability and Societal Impact"
- **Jessica E. Koehne**, NASA Ames Research Center; "Carbon Nanomaterial Based Sensors and Devices for NASA Missions"

Wednesday, December 15

- **Tatiana Segura**, Duke University; "Annealed Hydrogel Microparticles as Scaffolds for Tissue Repair"
- **Dong Sun**, Department of Biomedical Engineering, Center for Robotics and Automation, City University of Hong Kong; "Microrobotic Systems for Cell Manipulation"

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**Nanomaterials and Light for Sustainability and Societal Impact**

**Naomi Halas, Stanley C. Moore Professor of Electrical and Computer Engineering, Rice University**

**Abstract:**

Metallic nanoparticles, used since antiquity to impart intense, vibrant color into materials, then brought to scientific attention in the 19th century as "Faraday's colloid", have more recently become a central tool in the nanoscale manipulation of light. When excited by light, metallic nanoparticles undergo a coherent oscillation of their conduction electrons—known as a plasmon—which is responsible for their strong light-matter interactions and properties. While the scientific foundation of this field has been built on noble and coinage metals (most typically gold or silver), more recently we have begun to question whether the same, or similar properties can also be realized in more sustainable materials. Aluminum, the most abundant metal on our planet, can support high-quality plasmonic properties spanning the UV-to-IR region of the spectrum.

Coupling a plasmonic nanoantenna directly to catalytic nanoparticles transforms the entire complex into an efficient light-controlled catalyst capable of driving chemical reactions under surprisingly mild, low temperature conditions. This new type of light-based catalyst can be utilized for remediating greenhouse gases, and converting them to useful molecules for industry, or benign molecules for a cleaner planet. We have previously introduced photothermal effects for biomedical therapeutics; now, years after their initial demonstration, this approach is being utilized in human trials for the precise and highly localized ablation of cancerous regions of the prostate, eliminating the highly deleterious side effects characteristic of conventional prostate cancer therapies.
Photothermal effects can also be harvested for sustainability applications, which we have most recently demonstrated in an off-grid solar thermal desalination system that transforms membrane distillation into a scalable water purification process.

Bio:

**Dr. Naomi J. Halas** holds faculty appointments in the Departments of Electrical and Computer Engineering, Physics and Astronomy, Chemistry, Materials Science and Nanoengineering, and Bioengineering. She is best known as the first person to demonstrate that controlling the geometry of metallic nanoparticles determines their color. She pursues studies of plasmonic and nanophotonic systems and their applications. She is author of more than 300 refereed publications, has more than 20 issued patents, and has presented more than 500 invited talks. She has been awarded the APS Frank Isakson Prize and Julius Lilienfeld Prize, the R. W. Wood Prize of the OSA, the ACS Award in Colloid Chemistry, and the Spiers Medal of the Royal Society of Chemistry. Halas has been elected to the National Academies of Sciences and Engineering (U.S.), and the American Academy of Arts and Sciences.

**Practical Quantum Computing**

*Mark Johnson, D-Wave*

Abstract:

Quantum computing has entered an era where differentiation is better measured in the variety and value of customer applications than it is with physical device metrics. I will review D-Wave’s recent product release, advantage, its role in D-Wave’s approach to attacking business scale problems, and some of the practical uses it is being put to. These include scheduling, logistics, portfolio optimization, risk assessment, and de novo protein design. Quantum annealing has also shown significant promise in quantum materials simulation, and I will review some of the most important results in this area. While there are no Universal Quantum Computers today, I will discuss the prospects for, and directions towards Universal Quantum Computing.

Bio:

**Mark Johnson** Ph.D., Vice President of Quantum Products. Mark joined D-Wave in 2005 as an experimental physicist and superconducting circuit design engineer. He continues to work with the D-Wave’s Quantum Processor Development Team as it has developed and delivered five generations of commercial Quantum Annealing Systems. Prior to joining D-Wave, Mark worked as a Scientist with the Superconductive Electronics Organization in TRW, Inc.
Carbon Nanomaterial Based Sensors and Devices for NASA Missions
Jessica E. Koehne, NASA Ames Research Center

Abstract:
Carbon nanomaterials have been investigated for their use in NASA missions due to their interesting electronic, mechanical, optical, and thermal properties. At NASA Ames Research Center, we have evaluated carbon nanotubes (CNTs), carbon nanofibers (CNFs), and graphene for electrochemical sensor and electronics applications, including crew health and environmental monitoring. In our earliest work, carbon nanomaterials were controllably grown by chemical vapor deposition to create high-ordered structures capable of high sensitivity and low background measurements. Sensor devices with these structures were manufactured as sensor arrays in combination with traditional photolithography for wafer-scale manufacturing. These sensor arrays have been demonstrated as multiplexed sensors for rapid crew health screening. More recently, carbon nanomaterials have been tailored and processed as printable inks for highly tunable, additive manufacturing of electrochemical sensors and electronics. These printed sensor devices enable on-demand manufacturing in the microgravity environment of space. In this work, we have explored multiple materials, device architectures, and printing methodologies, all suitable for in-space manufacturing of crew health monitoring sensor devices. This presentation will explore the benefits of both manufacturing approaches, on silicon and printed, and highlight their use towards NASA missions.

Bio:
Dr. Jessica E. Koehne is a Physical Scientist at the NASA Ames Center for Nanotechnology. She received a Ph.D. in Chemistry from the University of California, Davis in 2009, while in collaboration with NASA Ames Research Center. She has spent the past 20 years developing a carbon nanofiber, carbon nanotube, and graphene-based sensor platforms for detection of DNA, rRNA, proteins and neurotransmitters, with applications ranging from point-of-care for astronaut health monitoring including implantable and wearable sensors to the detection of life signatures for planetary exploration. With significant experience in device fabrication including nanomaterial growth and integration, surface chemistry, electrochemical characterization, and sensor validation, she currently leads the highly interdisciplinary Nano-Biosensor Team. She has authored 64 articles in peer-reviewed journals and made 38 scientific presentations, including 21 invited talks. Dr. Koehne received numerous honors and awards including the 2011 Presidential Early Career Award for Scientists and Engineers (PECASE) and the 2018 Women in Aerospace Achievement Award. She serves as the chair of the Electrochemical Society’s Sensor Division, has served on several Ph.D. thesis committees, and is an Adjunct Graduate Faculty member at Boise State University.
Annealed Hydrogel Microparticles as Scaffolds for Tissue Repair
Tatiana Segura, Duke University

Abstract:
Injectable materials that can conform to the shape of a desired space are used in a variety of fields including medicine. The ability to fill a tissue defect with an injectable material can be used for example to deliver drugs, augment tissue volume, or promote repair of an injury. This talk will explore the development of injectable materials that are based on assembled particle building blocks, for tissue repair. We find that using microparticle building blocks to build the scaffold generates a porous network by the space left behind between adjacent building blocks. Due to the injectability of this microporous material we have explored its wide applicability to tissue repair applications ranging from skin to brain wounds. We find that in the skin our particle scaffold promotes wound closure and granulation tissue thickness more than widely used polymeric crosslinked hydrogels. In both the brain and the skin our particle scaffolds result in reduced inflammation.

Bio:
Tatiana Segura, Professor of Biomedical Engineering, Neurology and Dermatology at Duke University. She received her BS degree in Bioengineering from the University of California Berkeley and her doctorate in Chemical Engineering from Northwestern University working with Lonnie Shea. She joined Jeffrey A. Hubbell’s laboratory for her postdoctoral work. In 2006 she joined the Chemical and Biomolecular Engineering Department at University of California Los Angeles as a tenure track Assistant Professor, a position she secured in 2004 before beginning her postdoctoral appointment. In 2012 she received tenure and was promoted to Associate Professor. In 2016 she was promoted to the title of Professor. She joined the Duke faculty in 2018. Segura has received numerous awards and distinctions during her career, including the 2020 Acta Biomaterialia Silver Medal, a CAREER Award from the National Science Foundation, an Outstanding Young Investigator Award from the American Society of Gene and Cell Therapy and a National Scientist Development Grant from the American Heart Association. She was also named a Fellow of the American Institute for Medical and Biological Engineers in 2017. Prof. Segura has published over 150 peer reviewed papers and reviews and has over 6,000 citations. Her laboratory has been continuously funded with several grants from the National Institutes of Health (NIH) since 2008. She currently serves as a permanent member of the Gene and Drug Delivery Study section at NIH.
Microrobotic Systems for Cell Manipulation

Dong Sun, Department of Biomedical Engineering, Center for Robotics and Automation, City University of Hong Kong

Abstract:
The application of robot technology to achieve early diagnosis and treatment of diseases at the cellular level represents a new frontier in the development of contemporary medical robots. Microrobotic system for cell therapy is an entirely new emerging theme that is enabled with specially designed automated micromanipulation tools to perform medical diagnosis and treatment on single cells at large scale.

This talk will introduce our development of combining robotics technologies with micromanipulation tools including optical tweezers, micro-needles and electromagnetic devices, to accomplish various cell manipulation tasks. With this emerging technology, numerous cell surgical operations can be achieved, which include cell transportation and rotation, cell biopsy and microinjection, and precise delivery of cells with magnetic actuation. These inventions will permit many new unforeseen clinical applications previously thought impossible, and profoundly affect therapeutic treatment in precision medicine.

Bio:

Dong Sun is currently the head and Chair Professor of the Department of Biomedical Engineering and Director of the Center for Robotics and Automation, City University of Hong Kong. He is among the leading contributors worldwide in pioneering work in robotic manipulation of biological cells. His research has breakthrough in the use of combined robotics and various micro-engineering tools including optical tweezers, micro-needles and electromagnetic devices to achieve cell manipulation, diagnosis and micro-surgery at the single cell level. He has published 20 books and book chapters, 430 papers in referred journals and conference proceedings, and holds 18 international patents. He has directed more than 40 PhD students to graduate in Hong Kong. Dr. Sun organizes several international flagship conferences including the world largest intelligent robot conference (IROS 2019). Dr. Sun also actively participated in industrial activities, such as co-founding a high-tech company in the Hong Kong Science and Technology Park and winning Hong Kong Industry Awards. He is Fellow of the Canadian Academy of Engineering and Fellow of IEEE.
**Multiscale modelling and optimization of flexoelectric nano structures**  
Xiaoying Zhuang, Chair of Computing Science and Simulation Technology, Institute of Photonics, Department of Maths and Physics, Leibniz University Hannover

**Abstract:**

Flexoelectricity is the generation of electric polarization under mechanical strain gradient or mechanical deformation subjected to an electric gradient (converse-flexo). Flexoelectricity is a more general phenomenon than the linear change in polarization due to stress, the piezoelectric effect. In contrast to piezoelectricity, flexoelectricity exists in wider range of centrosymmetric materials especially nontoxic material useful for biomedical application. Flexoelectricity grows dominantly in energy density when scale reduces to submicro or nano, meaning the promise of enabling self-powered nano device such as body implant and small-scale wireless sensor. In Hannover, multiscale characterization of flexoelectric materials and design of flexoelectric structures based are being carried out including topological optimization for single/multi-phase materials, 2D flexoelectric materials characterization, and atomistic to continuum dynamic flexoelectric modelling. Phononic metamaterials for enhancing the flexoelectricity is being utilized and integrated in the design to outperform the current design of nano energy harvesters. Interesting phenomenon of utilizing topological insulators and metaplates of phononic structures will be shown that can enhance the performance of nano energy harvester.

**Bio:**

**Dr. Xiaoying Zhuang** ’s key research area is computational materials design for nano composites, metamaterials and nanostructures as well as computational methods for multiphysics and multiscale modelling. Dr. Xiaoying Zhuang obtained her PhD in Durham University, UK in 2011, which is followed by her postdoc in Norwegian University of Technology in Trondheim and then as a faculty staff in Tongji University. In 2015, she was awarded with the Sofja Kovalevskaja Programme from Alexander von Humboldt Foundation that brought her to Germany and she focused on the modelling and optimization of polymeric nanocomposite. Her ongoing ERC Starting Grant is devoted to the optimization and multiscale modelling of piezoelectric and flexoelectric nano structures. In 2018, she was awarded with Heinz-Maier-Leibnitz Prize from DFG (German Research Foundation) and in 2020 awarded with Heisenberg-Professor Programme of DFG.
**Piezoelectric Nanofibers for Smart Material Development**

Davide Fabiani, University of Bologna

**Abstract:**

This paper illustrates that multifunctional materials with piezoelectric properties can be used self-sensing structural material and for energy harvesting applications: PVdF nanofibers, in particular with core-shell configuration show the best features for sensing applications while PZT nanofibers can be used more effectively for energy harvesting devices.

**Bio:**

Davide Fabiani is Associate Professor at the University of Bologna since 2014. His research interests in the field of Electrical Engineering are focused in particular on the development of nanomaterials for electrical, electronic and energy applications, the study of aging and diagnostics of electrical insulators. Currently he focuses his research on piezoelectric nanofibers for smart material manufacturing and on the development of non-destructive diagnostic techniques to evaluate the state of electric cable insulation. He graduated in Electrical Engineering with honors in 1997 and in 2001 he obtained the Ph.D. in Electrical Engineering at the University of Bologna.
Giant Polarization in Nanodielectrics
Christopher Homes, Brookhaven National Laboratory

Abstract:
The static dielectric constant of a material $\varepsilon_0$ is a scaling factor for capacitors and the devices based upon them; the larger the dielectric constant, the greater the degree of miniaturization. Materials with a dielectric constant greater than that of silicon nitride ($\varepsilon_0 \sim 7$) are referred to as high-dielectric constant materials. Values of $\varepsilon_0 \sim 100$ are typical in rutile (titanium dioxide); however, values in excess of 104 are observed in barium titanate in the region of the ferroelectric transition – while this value is impressive, it is not very useful due to the strong temperature dependence. The observation of $\varepsilon_0 \sim 105$ in the calcium copper titanate (CaCu3Ti4O12) material sparked considerable interest because it showed little temperature dependence between 100 – 600 K. Optical and impedance spectroscopies revealed that the high dielectric constant in this material was ultimately due to the extrinsic internal boundary layer capacitance effect. Unfortunately, the dielectric losses in these materials are relatively high. A new strategy to achieve high dielectric permittivity with low loss involves using localized lattice defect states through ambipolar co-doping; these intrinsic defect complexes give rise to strong dipoles that are responsible for $\varepsilon_0$ in excess of 104, with exceptionally low dielectric losses over most of the radio frequency range and excellent thermal stability, will allow further scaling advances in electronic devices.

Bio:
Christopher Homes is a Physicist (with tenure) and a member of the Electron Spectroscopy Group in the Condensed Matter Physics and Material Science Department at Brookhaven National Laboratory (BNL). His research is focused on the complex optical properties of quantum materials, including topological and strongly correlated electron systems, with an emphasis on emergent phenomena. Previous work has examined the optical properties of the cuprate and iron-based superconductors, as well as high-dielectric constant materials; recent work deals mainly with the Dirac and Weyl semimetals. Prior to arriving at BNL in 1996, he was a postdoctoral fellow at Simon Fraser and McMaster University. He received his M.Sc. and Ph.D. in physics from the University of British Columbia, and his B.Sc. in physics from McMaster University. He is a Fellow of the American Physical Society and a recipient of the Brookhaven Science and Technology Award.

Merging Nanotechnology & Synthetic Biology toward Directed Evolution of Energy Materials
Elena A. Rozhkova, Argonne National Laboratory

Abstract:
The biological use of solar energy for synthesis of fuels from water and carbon dioxide inspires researchers and engineers in their efforts to replace exhaustible energy sources with renewable technologies. Eco-friendly photocatalytic energy conversion, known as artificial photosynthesis, along with inorganic materials, also uses biological structures, such as molecules, enzymes,
machineries or whole microorganisms that can capture light, break down water, and reduce carbon dioxide and protons.

In this talk, I will show that merging nanotechnology, biotechnology and synthetic biology approaches allows for systemic manipulation at the nanoparticle–bio interface toward directed evolution of energy materials, novel environmentally friendly catalytic, “artificial life” systems and, ultimately, to circular economy. For example, purple membranes isolated from Halobacteria or, more recently, obtained via cell-free synthetic biology approaches, were integrated with TiO2 nanoparticles to produce hydrogen or reduce carbon dioxide to value-added chemicals. These new functions are not typical of the host microorganism. On the other hand, interplay between plasmon resonance of noble metal nanostructures and the natural mechanisms of these light-sensitive membranes in the engineered hollow hybrids led to an “artificial cell” capable of photosynthesis of adenosine triphosphate (ATP), a universal energy-carrying biomolecule.

Bio:

Dr. Elena Rozhkova earned her Ph.D. in Chemistry at the Moscow State Institute for Fine Chemical Technology. She worked in Japan as a Japan Society for Promotion of Science (JSPS) postdoctoral fellow at the Institute of Multidisciplinary Research for Advanced Materials, Tohoku University. After moving to the US in 2003, she became a research staff member at the Chemistry Department of Princeton University, and later she moved to Chicago.

Since joining the Center for Nanoscale Materials at Argonne National Laboratory in 2007, Elena has been focusing on a general theme of Nano-Bio Interfaces, one of the most exciting interdisciplinary research fields of our time. Success in this area can lead to the solution of emerging problems of civilization, for example, to provide alternative sustainable energy, to advance medical technologies in the diagnosis and treatment of incurable diseases. Rozhkova is a recipient of JSPS fellowship (2000), Brain Research Foundation Fay/Frank Women’s Council Award (2007), the U. of Chicago Argonne LLC Board of Governors Distinguished Performance Award and a medal (2013), Prof. M. J. Nanjan Fourth Endowment Lecture Award “For outstanding contributions in the field of nano-biotechnology” (2018). She was named an IEEE Nanotechnology Council Distinguished Lecturer 2021.

Development, Testing, and Integration of Silicon and Glass Substrates for Advanced Ion Trap Design

Chuan Seng Tan, Nanyang Technological University, Singapore

Abstract:

Surface electrode ion trap is a promising candidate for quantum information processing (QIP), due to its feasibilities towards large-scale fabrication and on-chip electro-optical integration. In this paper, surface electrode ion traps on different substrates (e.g., high-resistivity silicon, silicon with ground plane and glass) are fabricated, assembled and tested.
To simultaneously leverage the established fabrication technique of silicon and superior insulation property of glass, we further demonstrate a novel ion trap design with heterogenous integration of silicon and glass, acting respectively as ion trap and interposer substrates. The vertical connection between the silicon ion trap and the glass interposer is achieved by through silicon via (TSV) and micro bump. This silicon-glass integrated system advances the development of ion trap and enriches the toolbox of scalable QIP.

Bio:

Chuan Seng Tan (SMIEEE, FIMAPS) received his B.Eng. degree in electrical engineering from University of Malaya, Malaysia, in 1999. Subsequently, he completed his M.Eng. degree in advanced materials from the National University of Singapore under the Singapore-MIT Alliance (SMA) program in 2001. He then joined the Institute of Microelectronics, Singapore, as a research engineer where he worked on process integration of strained-Si/relaxed-SiGe heterostructure devices. In the fall of 2001, he began his doctoral work at the Massachusetts Institute of Technology, Cambridge, USA, and was awarded a Ph.D. degree in electrical engineering in 2006. He was the recipient of the Applied Materials Graduate Fellowship for 2003-2005. In 2003, he spent his summer interning at Intel Corporation, Oregon.

He joined NTU in 2006 as a Lee Kuan Yew Postdoctoral Fellow and since July 2008, he was a holder of the inaugural Nanyang Assistant Professorship. In March 2014, he was promoted to the rank of Associate Professor (with tenure). In September 2019, he was promoted to the rank of Full Professor. His research interests are semiconductor process technology and device physics. Currently he is working on process technology of three-dimensional integrated circuits (3-D ICs), as well as engineered substrate (Si/Ge/Sn) for group-IV photonics. He has numerous publications (journal and conference) and IPs on 3-D technology and engineered substrates. Nine of his inventions have since been licensed to a spin-off company. He co-edited/co-authored five books on 3D packaging technology.

Dilute Nanocomposites - A New Class of Polymer Nanocomposites That Exploit Nanointerface Effects in Enhancing Dielectric Performance

Qiming Zhang, Pennsylvania State University

Abstract:

Dielectric polymers have been used widely in many electrical and electronic applications. Dielectric constant, dielectric loss, dielectric breakdown strength and operating temperature are key performance parameters of dielectrics for these applications. Polymer nanocomposites in which high volume loading of inorganic nanofillers in polymers have been investigated for many decades with the aim of enhancing/improving dielectric constant and breakdown strength.
This talk will present a new class of polymer nanocomposites: dilute nanocomposites, in which very low volume loading of nanofillers generate interfacial regions in polymers that greatly enhance the dielectric performance of many widely used high temperature polymers.

Bio:

**Qiming Zhang** is a Distinguished Professor of Electrical Engineering and Material Science Engineering at Penn State University and an IEEE fellow. He received his BS in Electronic Physics from Nanjing University, and the PhD in Solid State Physics from Penn State University.

As a leading expert in electroactive polymers in the world, he has over 260 publications and 9 patents in this field. He also has co-edited 4 books and contributed many chapters in electroactive polymers and related technologies. His group discovered and developed electrostrictive polymers with high strain responses, developed microfluidic devices and microactuators based on EAPs, proposed and demonstrated ultrahigh dielectric constant hybrid nanometamaterials based on delocalized electron system, and more recently, the dielectric polymers with high electric energy density for capacitor applications. His research has been funded by NIH, DOE, DOD, NSF, and many companies.

He received Lee Hsun Lecture Award on Materials Science from the Institute of Metal Research, Chinese Academy of Science in 2020, the Zijing Distinguished Lecture, Tsinghua University, Graduate School at Shenzhen, in 2018 and the Humboldt Research Award, Humboldt Foundation, in 2018.
NTC FELLOW KEYNOTES

- **Deji Akinwande**, University of Texas - Austin; "Adventures with Atomic Materials: from Flexible/Wearable Electronics to Memory Devices"
- **David Gracias**, Professor, Department of Chemical and Biomolecular Engineering, Johns Hopkins University, Baltimore, MD; "3D Nanofabrication by curving, bending, and folding"
- **Paul S. Weiss**, UCLA; "Atomically Precise Chemical, Physical, Electronic, and Spin Contacts and Interfaces"

Adventures with Atomic Materials: from Flexible/Wearable Electronics to Memory Devices

Deji Akinwande, University of Texas – Austin
WS1: Theory and Modelling of Nanomaterials and Devices II

Abstract:

This talk will present our latest research adventures on 2D nanomaterials towards greater scientific understanding and advanced engineering applications. In particular, the talk will highlight our work on flexible electronics, zero-power devices, monolayer memory (atomristors), non-volatile RF switches, and wearable tattoo sensors. Non-volatile memory devices based on 2D materials are an application of defects and is a rapidly advancing field with rich physics that can be attributed to sulfur vacancies or metal diffusion. Atomistic modeling and atomic resolution imaging are contemporary tools under use to elucidate the memory phenomena. Likewise, from a practical point, electronic tattoos based on graphene have ushered a new material platform that has highly desirable practical attributes including optical transparency, mechanical imperceptibility, and is the thinnest conductive electrode sensor that can be integrated on skin for physiological measurements. Much of these research achievements have been published in nature, advanced materials, IEEE and ACS journals.

Bio:

**Deji Akinwande** is an Endowed Full Professor at the University of Texas at Austin. He received the PhD degree from Stanford University in 2009. His research focuses on 2D materials and nanoelectronics/technology, pioneering device innovations from lab towards applications.

Prof. Akinwande has been honored with the 2019 Fulbright Specialist Award, 2017 Bessel-Humboldt Research Award, the U.S Presidential PECASE award, the inaugural Gordon Moore Inventor Fellow award, the inaugural IEEE Nano Geim and Novoselov Graphene Prize, the IEEE “Early Career Award” in Nanotechnology, the NSF CAREER award, several DoD Young Investigator awards, and was a past recipient of fellowships from the Kilby/TI, Ford Foundation, Alfred P. Sloan Foundation, 3M, and Stanford DARE Initiative. His research achievements have been featured by Nature news, Time magazine, BBC, Discover magazine, and many media outlets.
David Gracias, Professor, Department of Chemical and Biomolecular Engineering, Johns Hopkins University

Abstract:
Conventional VLSI lithographic patterning approaches have revolutionized modern engineering, but they are inherently planar. Recently, researchers have discovered that the interplay between out-of-plane stresses, capillary forces or swelling vs bending rigidity of patterned thin films can be engineered so as to cause spontaneous 2D to 3D shape transformations by curving, bending, and folding in a reproducible and high-throughput manner.

In this talk, the design, assembly, and characterization of such 3D nanostructured materials and devices will be described. The emphasis of our approach has been on enabling mass-production of lithographically micro, nano, and smart 3D devices in a high-throughput manner with diverse materials such as 2D layered materials (e.g. graphene, MoS\textsubscript{2}), silicon and related materials, polymers (e.g. SU8) and hydrogels. By leveraging the precision of planar lithography approaches such as photo, e-beam, and nanoimprint methodologies, a range of functional patterns can be incorporated into these thin film self-assembling systems so as to provide enhanced functionality for optics, electronics, and medicine. Assembled devices include metamaterials, flexible biosensors, curved microfluidics, drug-delivery capsules, anatomically realistic models for tissue engineering, antennas, e-blocks, sensors, soft-robotic actuators, and untethered surgical tools.

Bio:

David Gracias is a Professor at the Johns Hopkins University (JHU) in Baltimore. He did his undergraduate at the Indian Institute of Technology, received his PhD from UC Berkeley, did post-doctoral research at Harvard University and worked at Intel Corporation prior to starting his independent laboratory at JHU in 2003. Prof. Gracias has pioneered the development of 3D, integrated micro and nanodevices using a variety of patterning, self-folding and self-assembly approaches. He has co-authored over 190 technical articles, holds 33 issued patents and has delivered over 100 invited technical talks. Prof. Gracias has received a number of major awards including the NIH Director’s New Innovator Award, Beckman Young Investigator Award, NSF Career Award, Camille Dreyfus Teacher Scholar Award, Beckman Young Investigator Award, and Friedrich Wilhelm Bessel Award. He is a Fellow of the American Institute for Medical and Biological Engineering (AIMBE), Royal Society of Chemistry (RSc), American Association for the Advancement of Science (AAAS) and the Institute of Electrical and Electronics Engineers (IEEE).
Atomically Precise Chemical, Physical, Electronic, and Spin Contacts and Interfaces

Paul S. Weiss, California NanoSystems Institute and Departments of Chemistry & Biochemistry, Bioengineering, and Materials Science & Engineering, UCLA

WS4: Nanoelectronics II

Abstract:
Two seemingly conflicting trends in nanoscience and nanotechnology are our increasing ability to reach the limits of atomically precise structures and our growing understanding of the importance of heterogeneity in the structure and function of molecules and nanoscale assemblies. By having developed the “eyes” to see, to record spectra, and to measure function at the nanoscale, we have been able to fabricate structures with precision as well as to understand the important and intrinsic heterogeneity of function found in these assemblies. The physical, electronic, mechanical, and chemical connections that materials make to one another and to the outside world are critical. Just as the properties and applications of conventional semiconductor devices depend on these contacts, so do nanomaterials, many nanoscale measurements, and devices of the future. We discuss the important roles that these contacts can play in preserving key transport and other properties. Initial nanoscale connections and measurements guide the path to future opportunities and challenges ahead. Band alignment and minimally disruptive connections are both targets and can be characterized in both experiment and theory. Chiral assemblies can control the spin properties and thus transport at interfaces. I discuss our initial forays into these areas in a number of materials systems.

Bio:

Paul S. Weiss graduated from MIT with S.B. and S.M. degrees in chemistry in 1980 and from the University of California at Berkeley with a Ph.D. in chemistry in 1986. He is a nanoscientist and holds a UC Presidential Chair and a distinguished professor of chemistry & biochemistry, bioengineering, and materials science & engineering at UCLA, where he was previously director of the California NanoSystems Institute. He also currently holds visiting appointments at Harvard’s Wyss Institute and several universities in Australia, China, and South Korea.

He studies the ultimate limits of miniaturization, developing and applying new tools and methods for atomic-resolution and spectroscopic imaging and patterning of chemical functionality. He and his group apply these advances in other areas including neuroscience, microbiome studies, tissue engineering, and high-throughput gene editing. He led, coauthored, and published the technology roadmaps for the BRAIN Initiative and the U.S. Microbiome Initiative. He has won a number of awards in science, engineering, teaching, publishing, and communications. He is a fellow of the American Academy of Arts and Sciences, American Association for the Advancement of Science, American Chemical Society, American Institute for Medical and Biological Engineering, American Physical Society, American Vacuum Society, Canadian Academy of Engineering, IEEE, Materials Research Society, and an honorary fellow of the Chinese Chemical Society and Chemical Research Society of India. He is the founding and current editor-in-chief of ACS Nano.
INVITED SESSION KEYNOTES

- **Oluwaseyi Balogun**, Northwestern University, "Thermal Conductivity of Encapsulated Semiconducting Crystals with Intrinsic Magnetism"
  WS9: Nanoacoustics II

  WS2: Nanoacoustics I

- **Christopher H Bennett**, Sandia National Labs, "Quantized Domain-Wall Magnetic Tunnel Junction (DW-MTJ) Neural Networks Optimized for Rapid, Energy Efficient Edge Inference"
  TS6: Neuromorphic/AI/VR/Energy NanoDevices

- **Joseph S. Friedman**, The University of Texas at Dallas, "Unsupervised Learning & Reservoir Computing Leveraging Analog Spintronic Phenomena"
  TS6: Neuromorphic/AI/VR/Energy NanoDevices

  TS5: Nanophotonics, Plasmonics and Metamaterials II

- **Axel Hoffmann**, University of Illinois at Urbana Champaign, "Hybrid Magnon Modes"
  MS9: Nanosensors and Nanoactuators I

- **Maria Kamenetska**, Boston University, “Self-Assembled Organometallic Molecular Wires in Single Molecule Circuits”
  MS4: Nanomaterials

- **Valentin Mazières**, Université de Toulouse, "Time Reversal Plasmas as a Versatile Space-Time Patterning Deposition Method"
  MS6: Nanoscale Dielectrics and Smart Dielectric Materials Applications

- **Markondeya Raj Pulugurtha**, Florida International University, “Bioelectronic System Scaling Solutions with Nanopackaging”
  WS7: Biomedical Applications, Drug Delivery, Tissue Engineering

- **Soren Smidstrup**, Synopsys QuantumATK, Denmark, “Atomic-Scale Modeling of 2D Material Based Contacts and Transistors for Nanoscale Electronics”
  WS5: Theory and Modelling of Nanomaterials and Devices III

- **Xihua Wang**, University of Alberta, "Engineering Surface Ligands on Colloidal Quantum Dots for Solar Energy Harvesting"
  MS2: Low-Dimensional Devices and/or Quantum Dot Devices for Energy Applications

- **DingYing (David) Xu**, Intel; "Nanomaterials in Semiconductor Packaging: Challenges and Opportunities"
  MS7: Nanopackaging and Heterogeneous System Integration

- **Yan Yao**, University of Houston, “Elucidating Polymer Binder Effect in Processing All-Solid-State Lithium Batteries”
  WS3: Nanomaterials for Energy Applications III
"Thermal Conductivity of Encapsulated Semiconducting Crystals with Intrinsic Magnetism"

Oluwaseyi Balogun, Northwestern University

WS9: Nanoacoustics II

Abstract:
This paper examines the role of encapsulation on the thermal conductivity of few-layer two-dimensional (2D) chromium triodide (CrI3) films. 2D CrI3 has attracted attention recently because it exhibits intrinsic magnetism even at the limit of a single monolayer. We studied the thermal conductivity of CrI3 films based on experiments conducted using the optothermal Raman spectroscopy and frequency domain thermal reflectance techniques. I will present measurements of the thermal conductivity of CrI3 crystals encapsulated by atomic layer deposited alumina and a thin PTCDA organic layer. I will discuss the role of sample thickness and the PTCDA layer on the thermal conductivity.

"Photoacoustic Laser Streaming: Principles, Devices and Applications"

Jiming Bao, University of Houston

WS2: Nanoacoustics I

Abstract:
Photo-actuation of liquid has been widely investigated for microfluidic and biomedical applications. The manipulation of liquid with the conventional methods has been limited in microscale, whereas driving macroscopic liquid flow with laser has long been a challenge. Here, we report the macroscopic and high-speed water flow by combing the photoacoustic effect and acoustic streaming with a pulsed laser beam. The mechanism of laser streaming is studied by single jet evolution and high-speed shadowgraphs. The photoacoustic laser streaming opens up new applications in microfluidics and biomedical science.

"Quantized Domain-Wall Magnetic Tunnel Junction (DW-MTJ) Neural Networks Optimized for Rapid, Energy Efficient Edge Inference"

Christopher H. Bennett, Sandia National Labs

TS6: Neuromorphic/AI/VR/Energy NanoDevices

Abstract:
We evaluate the use and implication of emerging domain-wall magnetic tunnel junctions (DW-MTJ) in hybrid convolutional systems, where they can play the role of both synapse and neuron. We demonstrate that these devices are an opportunity for energy-efficient inference (neural network prediction) applications at the periphery.
"Unsupervised Learning & Reservoir Computing Leveraging Analog Spintronic Phenomena"

Joseph S. Friedman, The University of Texas at Dallas

Abstract:
We have proposed three distinct spintronic neural network approaches that leverage analog spintronic phenomena: 1) Unsupervised learning systems with spin-transfer torque magnetoresistive random-access memory (STT-MRAM) in which analog behavior is produced by stochastic STT switching; 2) Unsupervised learning systems with three- and four-terminal MTJs in which analog behavior is produced by magnetic domain wall motion; and 3) Reservoir computing systems with irregular arrays of nanomagnets in which analog behavior is produced by frustrated nanomagnetism. All three spintronic neural network approaches exploit the hysteresis intrinsic to binary spintronic memory devices while providing analog behavior with significant advantages over analog memory devices.

"Nanoplasmonics: Quantum, Nonlinear, and Single Molecule Regimes"

Reuven Gordon, University of Victoria

Abstract:
In this talk, I will discuss the benefits of nanoplasmonics for emerging technologies and look at the extreme limits of quantum, of nonlinear and of single molecule regimes [1-5]. In the quantum regime, tunneling based artificial switchable metamaterials will be presented [2,4]. In the nonlinear regime, new perspectives will be described on the nonlinear response of metals, particularly engaging the Lorentz response [5]. Finally, single molecule measurements that probe the natural vibrations of single proteins and their interactions will be overviewed [1,3]. The potential application of these approaches to future technologies will be discussed.

"Hybrid Magnon Modes"

Axel Hoffmann, University of Illinois at Urbana Champaign

Abstract:
Hybrid dynamic magnons excitations are of interest, since they can be tuned by external magnetic fields and interact with a wide range of other excitations, such as microwave and optical photons, phonons, and other magnons. We have explored the integration of permalloy structures into hybrid magnon systems. By combining permalloy with high-quality superconducting microwave resonators, we demonstrated strong magnon-photon coupling in co-planar, on-chip geometry. Furthermore, we demonstrated strong coupling of permalloy magnons to standing magnon modes in yttrium iron garnet films. Lastly, we investigated the coupling between magnons in Ni and surface acoustic waves in LiNbO3.
“Self-Assembled Organometallic Molecular Wires in Single Molecule Circuits”

Maria Kamenetska, Boston University

Abstract:
The formation and incorporation of 1D organometallic wires with desirable electronic or magnetic properties into circuits or devices for use in next generation technologies remains a challenge. Here, I will demonstrate a strategy for assembling and electrically probing a quasi-1D organometallic coordination complexes in a single molecule circuit using imidazole linkers activated by pH. We find that these structures assemble in situ between two electrodes during junction stretching and hypothesize that they have an overall spin $\frac{1}{2}$ character. These results identify successful chemical strategies for incorporating molecular and low dimensional materials into next generation electronics or energy devices.

"Time Reversal Plasmas as a Versatile Space-Time Patterning Deposition Method"

Valentin Mazières, Université de Toulouse

Abstract: One of the challenges faced by nanocomposite deposition technologies is development of methods allowing an accurate control of the deposition pattern (shape, thickness…) over large areas. The aim of this communication is to discuss the possibility of using an innovative plasma source that we have developed recently as an original versatile space-time patterning deposition method. This source, based on Time Reversal, allows the dynamical control of plasmas in large cavities. These unprecedented capabilities could lead to the development of an original and versatile method allowing the space-time patterning of complex 2D or 3D structures on large areas.

“Bioelectronic System Scaling Solutions with Nanopackaging”

Markondeya Raj Pulugurtha, Florida International University

Abstract:
Biomedical systems rely on wireless power and data telemetry for detecting the physiological signals and communicating them to an external reader for close-loop therapeutic solutions. This talk will highlight three advances in the nanomaterial and embedding technologies to realize performance, long-term stability and reliability while meeting the critical system scaling trends: a) Telemetry components and their heterogeneous integration to meet the power density and data rate needs, b) Component embedding with flexible fan-out interconnections with nanoscale printed adhesives, c) Low-impedance electrodes and low-temperature hermetic encasing with feedthroughs to achieve the performance and reliability targets with robustness.
“Atomic-Scale Modeling of 2D Material Based Contacts and Transistors for Nanoscale Electronics"

Soren Smidstrup, Synopsys QuantumATK, Denmark

WS5: Theory and Modelling of Nanomaterials and Devices III

Abstract:
In this work, we use atomistic Density Functional Theory with Non-equilibrium's Green's function (NEGF) transport simulations, DFT-NEGF, in QuantumATK to accurately simulate such 2D heterophase MoTe2 T'-H devices. Schottky barriers of MoTe2 T'-H metal-semiconductor junctions with varying levels and types of doping, are studied along with IV characteristics of MoTe2 T'-H-T' FETs with 10-20 nm channel lengths and a back-gate. We show that the local atomic configuration at the interface completely dominates the Schottky barrier height, depletion width, and charge transfer.

"Engineering Surface Ligands on Colloidal Quantum Dots for Solar Energy Harvesting"

Xihua Wang, University of Alberta

MS2: Low-Dimensional Devices and/or Quantum Dot Devices for Energy Applications

Abstract:
The surfaces of as-synthesized colloidal quantum dots (CQDs) are covered with long-chain molecular ligands. These surface ligands stabilize CQDs in organic solvents but need to be replaced with short-chain molecules in CQD devices. If such process is done when CQD films are formed in the device, it is called solid-state ligand exchange. When the ligand exchange happens in organic solvents, it is called solution-phase ligand exchange (SPLE) which provides more flexibility for integrating CQDs into devices. I will present two applications of SPLE-produced CQDs for solar energy harvesting - solar cells and luminescent solar concentrators.

Nanomaterials in Semiconductor Packaging: Challenges and Opportunities

David Xu, Intel

MS7: Nanopackaging and Heterogeneous System Integration

Abstract:
Packaging of semiconductor devices essentially transforms semiconductor devices into functional electronic products. Packaging technology not only establishes the shape, size, and weight of chips, but also determines the chip reliability. While packaging has always been an important technology enabler, in recent years with increasing need for heterogeneous integration, the scope and demand on packaging materials has been expanded to include the newer and increasingly diverse high-density packaging architectures for system in package (SiP). These include 2D and 3D architectures and cover wafer level packaging, integrated passive device (IPD), through silicon via (TSV), 3D packaging, etc. Packaging materials are becoming critical for enabling the heterogeneously integrated next-generation chips and their intra-package and inter-package
interconnects. This calls for innovations in packaging materials to deliver the optimized electrical, thermal, and mechanical properties. Certainly, nanomaterials and nanotechnology have been used in packaging technologies for the past few decades, and nanoparticles will continue to play an important role in providing solutions for future packaging challenges and bottlenecks. In this talk, we plan to provide insights into nanomaterials which have demonstrated potentials for electronic packaging applications as well as highlight the emerging nanotechnology trends. We end with a call to all academic and industrial partners to collaborate and deliver on the promise.

Bio:

David Xu received his Ph.D. in Chemistry from Virginia Tech, and M.S. in Polymer Science and Engineering from Lehigh University. David joined Intel in 2004 in Materials Technology Development in Chandler as a Sr. Packaging Engineer developing assembly materials for communication and wireless packages. He went on to lead materials pathfinding and development for various assembly materials for IC packaging over the last 16 years.

His area of expertise is in various polymer materials/encapsulant, adhesives, films for IC packaging assembly. He has developed a number of novel materials technologies that have enabled critical Intel assembly package assembly and process. In recent years, he assumed the role of assembly materials pathfinding lead and is responsible for setting strategic direction and developing materials technology roadmap to enable Intel’s next generation heterogenous packaging.

“Elucidating Polymer Binder Effect in Processing All-Solid-State Lithium Batteries”

Yan Yao, University of Houston

WS3: Nanomaterials for Energy Applications III

Abstract:

All-solid-state lithium batteries (ASSLBs) have the potential to increase energy density, improve safety, and allow for lower manufacturing cost. A scientific gap of research is to develop scalable process for manufacturing ASSLBs and to understand processing-performance relationship. Current processing methods can be categorized as either a wet, solution-based method or as a dry process. This work compares the performance of a "wet" and a "dry" method for fabricating mechanically self-supporting composite cathodes designed for a thin, highly conductive argyrodite-based solid electrolyte.
Workshop and Tutorial

SS1: Workshop on NanoElectroAcoustics for Dielectric Materials Characterization

Sunday, December 12th
Time: 8:30 - 10:30 am
Salon F

Speakers:

- *Needs for Nanoscale Characterization - Current Limitations with Classical Perturbation-based Methods for Probing Charges* Gilbert Teyssedre, LAPLACE, Université Paul Sabatier

- *Measurement of electric charge distribution in insulators with elastic waves: A search for high spatial resolution* Stéphane Holé, Sorbonne Université

- *Nanoscale ultrasonic characterization using ultrafast and near-field optical methods* James B. Spicer, Johns Hopkins University

**Gilbert Teyssedre** was born in May 1966 in Rodez, France. He received his engineer degree in materials physics and graduated in solid state physics in 1989 at the National Institute for Applied Science (INSA). Then he joined the Solid State Physics Lab in Toulouse and obtained his Ph.D. degree in 1993 for work on ferroelectric polymers. He entered the CNRS in 1995 and has been working since then at the Electrical Engineering Lab (now LAPLACE) in Toulouse. His research activities concern the development of luminescence techniques in insulating polymers with focus on chemical and physical structure, degradation phenomena, space charge and transport properties. He is currently Research Director at CNRS and is leading a team working on the reliability of dielectrics in electrical equipment. e-mail: gilbert.teyssedre@laplace.univ-tlse.fr.

**Stéphane Holé**, born in 1968 (France), studied electronics and instrumentation at Université Pierre et Marie Curie-Paris6 (Paris, France). He joined Laboratoire d’Électricité Générale of École Supérieure de Physique et de Chimie Industrielles (Paris, France) to study an instrument for measuring fast development of space charges in insulators under rapid voltage variations. It was the topic of his PhD he received in 1996 and he obtained his Habilitation in 2007. Currently Professor at Sorbonne Université, he conducted his researches with Laboratoire des Instruments et Systèmes d’Ile de France from 1997 to 2007 and leads the Instrumentation Group with Laboratoire de Physique et d’Étude des Materiaux since 2007. His main research topics are space charge in insulators and semiconductors (main topic), non-destructive testing and sensors. He teaches solid state physics, electronics and sensor physics. He is coordinator of the sensors, instrumentation & measurements master at Sorbonne
Université since 2009. His current address is: LPEM-SU/ESPCI/CNRS, 10 rue Vauquelin, 75005 Paris, France, e-mail: stephane.hole@espci.fr.

James (Jim) Spicer is a professor of Materials Science and Engineering at The Johns Hopkins University in Baltimore, Maryland. He is the chair of Materials Science and Engineering Program in the Engineering for Professionals Program and is a member of the Principal Professional Staff at The Johns Hopkins Applied Physics Laboratory. His research focuses on laser-material interactions for advanced processing and materials characterization including ultrafast studies of nanoscale thermal and acoustic transport, polymer matrix nanocomposite processing and characterization, optical and ultrasonic characterization of additively manufactured materials, development of opto-thermal barrier coatings for space probes and characterization of high-energy laser materials. He is a member of the IEEE Nanotechnology Council, the IEEE Ultrasonics, Ferroelectrics and Frequency Control Society and the IEEE Sensors Council. He teaches graduate courses on electronic, optical and magnetic properties of materials as well as undergraduate courses on materials sustainability. e-mail: spicer@ieee.org.

SS3: Using nanoHUB.org in Research and Education - a Hands-on Tutorial

Sunday, December 12th

Time: 14:00 - 16:30 pm

Salon F

Program Description

If you had access to interactive modeling and simulation tools that run in any browser, could you introduce interactive learning into your classes? If you had easy access tools, which need no installation, could you use them to help guide your experiments? If you did not have to worry about compute cycles, would you benchmark your own tools against other state-of-the-art approaches? If you had your own tools and could easily share them with the community, would you do it? This tutorial will provide an overview of these processes and their impact as they are supported on nanoHUB.org today.

Presenters:

Gerhard Klimeck is an Electrical and Computer Engineering faculty at Purdue University and leads two research centers in Purdue's Discovery Park. He helped to create nanoHUB.org which now serves over 2.0 million users globally. Previously he worked with Texas Instruments and NASA/JPL/Caltech. His research interest is in computational nanoelectronics, high performance computing, and data analytics. NEMO, the nanoelectronic modeling software built in his research group established the state-of-the-art in atomistic quantum transport modeling. NEMO is now being used at Intel for advanced transistor designs and commercialized. He published over 525 printed scientific articles that resulted in over 20,000
citations and an h-index of 69 in Google scholar. He is a fellow of the Institute of Physics (IOP), a fellow of the American Physical Society (APS), a Fellow of IEEE, a Fellow of AAAS and a Fellow of the Alexander von Humboldt Stiftung (Germany). Together with physicist Michelle Simmons of the University of New South Wales, he "devised a way to make a single-atom transistor", which ranked #29 top invention of 2013 by Discover Magazine. In 2020 the nanoHUB team was awarded a R&D 100 award for "nanoHUB: Democratizing Learning and Research". In Oct. 2020 he was elected Fellow of American Association for the Advancement of Science (AAAS), "For the quantum mechanical modeling theory and simulation tools to design today's nanotransistors and for leadership of the global nanotechnology community as Director of nanoHUB."

**Elif Ertekin** is Associate Professor, Andersen Faculty Scholar, and current Director of the Mechanics program in the Department of Mechanical Science and Engineering at the University of Illinois at Urbana-Champaign. She is currently the Director of the Network for Computational Nanotechnology Nanomanufacturing Node, which focuses on the development of advanced cyberinfrastructure tools for research, education, and industrial deployment of integrated, nanoscale manufacturing processes across areas including directed assembly, self-assembly, synthesis, nanolithography, printing and coating, deposition, etching and other emerging nanoscale processes. She has received the NSF CAREER Award, the TMS Early Career Faculty Fellow Award, the University of Illinois Rose Award for Teaching Excellence, and Emerging Leader Award from the Society of Women Engineers.

**Alejandro Strachan** is a Professor of Materials Engineering at Purdue University, Director, DoD ONR MURI "Predictive Chemistry and Physics at Extreme Conditions", PCP@Xtreme, and the Deputy Director of NSF's nanoHUB. Before joining Purdue, he was a Staff Member in the Theoretical Division of Los Alamos National Laboratory and worked as a Postdoctoral Scholar and Scientist at Caltech. He received a Ph.D. in Physics from the University of Buenos Aires, Argentina. Prof. Strachan's research focuses on the development of predictive atomic and multiscale models to describe materials from first principles and their combination with data science to address problems of technological or scientific importance. Areas of interest include: high-energy density and active materials, metallic alloys for high-temperature applications, materials and devices for nanoelectronics and energy, as well as polymers and their composites. In addition, Strachan's scholarly work includes cyberinfrastructure to maximize the impact of and democratize access to models and data for research and education. Prof. Strachan has published over 180 peer-reviewed scientific papers and his contributions to research and education have been recognized by several awards, including the Early Career Faculty Fellow Award from TMS in 2009, his induction as a Purdue University's Faculty Scholar (2012-2017), and the R&D 100 award in the area of software and services for nanoHUB.
Panel discussion “Meet the Experts” by IEEE NTC Young Professionals

Monday, December 13 18:30 - 19:45
Salon A

Moderators: José Alvim Berkenbrock and Anand Shah

Panelists:
- **Seyi Balogun**, Northwestern University, NTC distinguished lecturer
- **Bonnie Gray**, Professor, Engineering Science, Simon Fraser University
- **Kremena Makasheva**, Senior Researcher, CNRS, LAPLACE, Université Paul Sabatier, Toulouse
- **Paul S. Weiss**, California NanoSystems Institute and Departments of Chemistry & Biochemistry, Bioengineering, and Materials Science & Engineering, UCLA
- **Rafal Sliz**, Assistant Professor, University of Oulu, Finland IEEE NTC YP Chair

IEEE NTC Young Professionals are very excited to have the opportunity to invite you to the “Meet the Experts” Panel Discussion held at the NMDC Conference in Vancouver. Our guests – distinguished scientists and engineers, and prominent IEEE members will have the opportunity to share their knowledge and experiences related to their profession. The experts bring different perspectives to the panel; their diverse backgrounds in various domains will help participants better understand the everchanging world of nanotechnology and gain new enriching experiences on both a personal and professional level. These thought leaders and practitioners can leverage their academic and professional experiences to enable participants to develop insights on how to approach their professional challenges in fresh ways.

Bios:

**Paul S. Weiss** graduated from MIT with S.B. and S.M. degrees in chemistry in 1980 and from the University of California at Berkeley with a Ph.D. in chemistry in 1986. He is a nanoscientist and holds a UC Presidential Chair and a distinguished professor of chemistry & biochemistry, bioengineering, and materials science & engineering at UCLA, where he was previously director of the California NanoSystems Institute. He is the founding and current editor-in-chief of ACS Nano.
Bonnie L. Gray joined the School of Engineering Science (ENSC) at Simon Fraser University (SFU) in Canada in 2003, where she is now a Full Professor, the ENSC Graduate Chair, and an elected member of University Senate. Dr. Gray is an Associate Member of the School of Biomedical Physiology and Kinesiology, and sits on the Advisory Board for the Vancouver Medical Device Development Centre.

Oluwaseyi (Seyi) Balogun is an Associate Professor of Mechanical Engineering and Civil and Environmental Engineering at Northwestern University. He received his B.S. degree from the University of Lagos, Nigeria, and his M.S. and Ph.D. degrees from Boston University, all in Mechanical Engineering. Dr. Balogun’s research focuses on nanoscale heat transport measurements and thermal properties of small-scale materials, experimental mechanics of soft biological materials, and optical and elastic wave sensors.

Kremena Makasheva is Senior Researcher at CNRS, Laboratory on Plasma and Conversion of Energy (LAPLACE), Toulouse, France. She obtained a Ph.D. degree on Plasma Physics from Sofia University, Bulgaria, 2002, for her work on surface wave sustained plasmas. In 2003 she joined the Université de Montréal, Canada for almost 4 years to work on surface wave plasmas at atmospheric pressure. She currently as IEEE NTC Vice-President for Technical Activities.

Rafal Sliz is an Assistant Professor (Tenure), pursuing his research in the field of nanotechnology at the Optoelectronics and Measurement Techniques Unit, University of Oulu, Finland. His research focuses on printed electronics and development of sustainable energy storage systems. He conducted long-term research at the Flexible Display Center, Arizona State University (USA), London Centre for Nanotechnology, University College London (UK), and Sargent Group, University of Toronto (Canada).
Sunday, December 12

Sunday, December 12 9:00 - 11:00 (America/Vancouver)

SS1: Workshop on NanoElectroAcoustics for Dielectric Materials Characterization

Room: Salon F

CEIDP-NMDC

Speakers:

- Gilbert Teyssedre, LAPLACE, Université Paul Sabatier: "Needs for Nanoscale Characterization - Current Limitations with Classical Perturbation-based Methods for Probing Charges"
- Stéphane Holé, Sorbonne Université: "Measurement of electric charge distribution in insulators with elastic waves: A search for high spatial resolution"
- James B. Spicer, Johns Hopkins University: Nanoscale ultrasonic characterization using ultrafast and near-field optical methods"

Sunday, December 12 11:00 - 11:30 (America/Vancouver)

Refreshment Break

Room: Cordova Foyer

Sunday, December 12 11:30 - 13:30 (America/Vancouver)

SS2: Workshop by DEIS Nanodielectrics Working Group

Room: Salon F

CEIDP
Sunday, December 12 14:00 - 16:30 (America/Vancouver)

SS3: Using nanoHUB.org in Research and Education - a Hands-on Tutorial
Room: Salon F

NMDC

If you had access to interactive modeling and simulation tools that run in any browser, could you introduce interactive learning into your classes? If you had easy access tools, which need no installation, could you use them to help guide your experiments? If you did not have to worry about compute cycles, would you benchmark your own tools against other state-of-the-art approaches? If you had your own tools and could easily share them with the community, would you do it? This tutorial will provide an overview of these processes and their impact as they are supported on nanoHUB.org today.

Presenters:
- Gerhard Klimeck, Purdue University, co-creator nanoHUB.org
- Elif Ertekin, Andersen Faculty Scholar, Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign
- Alejandro Strachan, Professor of Materials Engineering at Purdue University, Director, DoD ONR MURI "Predictive Chemistry and Physics at Extreme Conditions", PCP@Xtreme, and the Deputy Director of NSF's nanoHUB

Sunday, December 12 18:00 - 20:00 (America/Vancouver)

NMDC-CEIDP 2021 Welcome Reception
Room: Vistas 360 (19th Level)
Monday, December 13

Monday, December 13 8:15 - 8:30 (America/Vancouver)
Opening Remarks
Room: Salon A

Monday, December 13 8:30 - 10:00 (America/Vancouver)

PL 1: Plenary Session on Quantum Computing and Flexoelectric Sensing Devices
Room: Salon A

Chairs: Reuven Gordon (University of Victoria, Canada), Xiaoning Jiang (North Carolina State University, USA)

8:30  Practical Quantum Computing
Mark Johnson (D-Wave Systems Inc., Canada)
Abstract: Quantum computing has entered an era where differentiation is better measured in the variety and value of customer applications than it is with physical device metrics. I will review D-Wave's recent product release, advantage, its role in D-Wave's approach to attacking business scale problems, and some of the practical uses it is being put to. While there are no Universal Quantum Computers today, I will discuss the prospects for, and directions towards Universal Quantum Computing.

9:15  Multiscale Modelling and Optimization of Flexoelectric Nano Structures
Xiaoying Zhuang (Leibniz University Hannover & Tongji University, Germany)
Abstract: Flexoelectricity is the generation of electric polarization under mechanical strain gradient or mechanical deformation subjected to an electric gradient (converse-flexo). Flexoelectricity is a more general phenomenon than the linear change in polarization due to stress, the piezoelectric effect. In contrast to piezoelectricity, flexoelectricity exists in wider range of centrosymmetric materials especially nontoxic material useful for biomedical application.

Monday, December 13 10:00 - 10:30 (America/Vancouver)
Refreshment Break
Room: Cordova Foyer
Monday, December 13 10:30 - 12:30 (America/Vancouver)

MS1: Theory and Modelling of Nanomaterials and Devices I

Room: Salon B

Chair: William L Livernois (University of Washington, USA)

10:30 Modeling and Investigation of Electronic Transport Properties of Boron or Nitrogen Substitution Doped Single Layer Graphene

L Chandrasekar (IIITDM Kancheepuram, India); Kumar Pradhan (Indian Institute of Information Technology Design and Manufacturing Kancheepuram, India)

10:50 Density Gradient Based Quantum-Corrected 3D Drift-Diffusion Simulator for Nanoscale MOSFETs

Tapas Dutta, Cristina Medina-Bailon, Nikolas Xeni, Vihar Georgiev and A. Asenov (University of Glasgow, United Kingdom (Great Britain))

11:10 Developing a Neural Network Potential to Investigate Interface Phenomena in Solid Phase Epitaxy

Ruggero Lot (LAAS-CNRS & SISSA, France); Layla Martin-Samos (CNR-IOM, Istituto Officina dei Materiali, Italy); Stefano de Gironcoli (SISSA, Italy); Anne Hemeryck (France)

11:30 Modeling of Sputtered Mo-Al2O3 Nanocomposites Using a Combination of FDTD Method and Maxwell-Garnett Approximation

Naznin Akter and Muhammad Mahmudul Hasan (Florida International University, USA); J. Jose Becerril-Gonzalez (CINVESTAV-IPN, Mexico); Nezih Pala and O. Ares-Muzio (Florida International University, USA)

MS2: Low-Dimensional Devices and/or Quantum Dot Devices for Energy Applications

Room: Salon E

Chair: Susanna Thon (Johns Hopkins University, USA)

10:30 Invited Presentation: Engineering Surface Ligands on Colloidal Quantum Dots for Solar Energy Harvesting

Xihua Wang (University of Alberta, Canada)

11:10 Extensive Study on Effects of Defects in CZTS/CZTSe Quantum Dots Kesterite Solar Cells

Girija Shankar Sahoo (Aditya Engineering College, India); Soumya Ranjan Routray (unknown); Guru Prasad Mishra (NIT Raipur, India)
11:30 Low-Cost, Homogeneous, and Continuous Thin Film of 2D Semiconductors: Towards Large Scale Electronic and Photonic Devices

Shahad Sulaiman Albawardi (Center of Excellence for Green Nanotechnologies, King Abdulaziz City for Science and Technology, Riyadh, Saudi Arabia); Moh. Amer (KACST-UCLA, Saudi Arabia); Olaiyan Mohammed Alolaiyan (King Abdulaziz for Science and Technology, Saudi Arabia)

11:50 Synthesis of Colloidal Quantum Dot Nanostructures for Photon Upconversion

Tory A Welsch, Jill M Cleveland, D. Bruce Chase and Matthew F Doty (University of Delaware, USA)

12:10 Advances and Opportunities in Hybrid Graphene/Quantum Dot Photodetectors for Photovoltaics and Multispectral Photodetectors

Oscar Vazquez Mena (University of California San Diego, USA)

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MS3: Nanomaterials for Energy Applications I

Room: Salon A

Chair: Zheng Fan (University of Houston, USA)

10:30 Modeling of Hysteresis in Perovskite-Silicon Tandem Solar Cells

Kumudini Ganesh and Revathy Padmanabhan (Indian Institute of Technology Palakkad, India)

10:50 Analysis of Electrical and Optical Loss in Perovskite Solar Cells Using a Semi-Analytical Model

Vanshaj Sharma (National Institute of Technology Hamirpur, India); Revathy Padmanabhan (Indian Institute of Technology Palakkad, India)

11:10 Photoluminescence-Raman/FTIR Under Variable Hydrostatic Pressure to Reveal the Origin of Luminescent Centers in Lead Halide Perovskites

Tao Chen and Chong Wang (Yunnan University, China); Jiming Bao (University of Houston, USA)

11:30 Competing Crystallization in Multi-Ion Perovskites

Makhsud Saidaminov (University of Victoria, Canada)

11:50 CTE Tailorable Copper Substrates, Heat Sinks and Heat Pipes via a nanoCopper Approach

Alfred A Zinn, Alex Capanzana, Nhi Ngo, Rob Roth and Randall Stoltenberg (Kuprion Inc., USA)

12:10 Efficiency Enhancement of CZTS Thin Film Solar Cell Using Magnesium Doped Zinc Oxide (Mg-ZnO) Window Layer

Rabin Paul and Trupti Ranjan Lenka (National Institute of Technology Silchar, India); Fazal Talukdar (NIT Silchar, India)
Monday, December 13 14:00 - 16:00 (America/Vancouver)

**MS4: Nanomaterials**

**Room**: Salon B

**Chair**: Susanna Thon (Johns Hopkins University, USA)

**14:00 Invited Presentation: Self-Assembled Organometallic Molecular Wires in Single Molecule Circuits**

Maria Kamenetska (Boston University, USA)

**14:40 Direct Electrodeposition of InSb Devices on Silicon**

Katarzyna E Hnida-Gut (IBM Research Europe, Zurich, Switzerland); Marilyne Sousa (IBM Research Zurich, Switzerland); Kirsten Emilie Moselund (unknown); Heinz Schmid (IBM Research Europe, Switzerland)

**15:00 Conductive Green Graphene Inks for Printed Electronics**

Ricardo Izquierdo (ETS, Canada)

**15:20 Inkjet-Printed High Quality Gate Oxide for Fully Printed IGZO Transistors**

Nima Arjmandi (Shahid Beheshti University of Medical Sciences & International Electrotechnical Commission, Iran); Mohammad Seraj (Azad University, Science and Research Center, Tehran, Iran); Mehrdad Najafi (Sharif University of Technology, Tehran, Iran); Seyed Ahmad Reza Ahmadi Afshar (Buali sina University, Hamedan, Iran)

**MS5: Nanomaterials for Energy Applications II**

**Room**: Salon A

**Chair**: Makhsud Saidaminov (University of Victoria, Canada)

**14:00 Thickness-Dependent Seebeck Coefficient in Hybrid 2-Dimensional Layers**

Taher Ghomian (Marshall University, USA); Nadim Darwish (Curtin University, Australia); Joshua Hihath (University of California, Davis, USA)

**14:20 Replacement of NMP Solvent for More Sustainable, High-Capacity, Printed Li-Ion Battery Cathode**

Rafal Sliz, Juho Valikangas and Pauliina Vilmi (University of Oulu, Finland); Tao Hu (University of Oulu 90570 Oulu, Finland); Ulla Lassi (University of Oulu & Kokkola University Consortium Chydenius, Finland); Tapio Fabritius (University of Oulu, Finland)
14:40 Viability of Boron Nitride Nanotubes as a Support Structure for Metal Nanoparticle Catalysts for the Plasma-Catalytic Synthesis of Ammonia

Steven K Walker (Canada, Canada); Gareth Price (McGill University, Canada); Elmira Pajootan (Colleague, Canada); Sylvain Coulombe (Research Group Leader, Canada)

15:00 Converting Parylene C into a Thin Film Piezoelectric Material

Murali Duggina and Nathan Jackson (University of New Mexico, USA)

15:20 High Performance MXene Supported Gold Nanoparticles-Based 3D Printed Anode for Non-Enzymatic Biofuel Cell

Jayapiriya Us and Sanket Goel (BITS Pilani, Hyderabad Campus, India)

15:40 Application of Ruthenium Nitride Deposited on Multi-Walled Carbon Nanotube Forest as Electrode Material for Supercapacitors

Hanie Kazari and Elmira Pajootan (McGill University, Canada); Eric Deguns and Mark Sowa (Veeco ALD, USA); Emmeline Kao (McGill University, Canada); Sylvain Coulombe (Research Group Leader, Canada)

**MS6: Nanoscale Dielectrics and Smart Dielectric Materials Applications**

**Room: Salon E**

Chairs: Alessandra Costanzo (DEI, University of Bologna, Italy), Kremena Makasheva (LAPLACE, CNRS, University of Toulouse, France)

14:00 Invited Presentation: Time Reversal Plasmas as a Versatile Space-Time Patterning Deposition Method

Valentin Mazières (Université de Toulouse, France); Romain Pascaud (ISAE-SUPAERO, Université de Toulouse, France); Laurent Liard (Université de Toulouse - UPS INPT CNRS, France); Simon Dap (Université de Toulouse, France); Richard Clergereaux (France); Olivier Pascal (Université de Toulouse - UPS INPT CNRS, France)

14:40 PMMA Nanocomposite Based Cryogenic Dielectrics for High-Temperature Superconducting (HTS) Cables

Jordan Cook, Jacob Mahon, William Emmerling, Lei Yu, Robert Krchnavek and Wei Xue (Rowan University, USA)

15:00 Monte Carlo and Circuit-Level Simulation of 2D Memristors for Neuromorphic Computing

Yifu Huang, Xiaohan Wu, Yuqian Gu, Ruijing Ge and Jiahan Zhang (University of Texas at Austin, USA); Yao-Feng Chang (Intel Corporation, USA); Deji Akinwande and Jack Lee (University of Texas at Austin, USA)
A Proposal of Energy Efficient Ferroelectric PDSOI LIF Neuron for Spiking Neural Network Applications

V Rajakumari (Indian Institute of Information Technology Design and Manufacturing, Kancheepuram, India); Kumar Pradhan (Indian Institute of Information Technology Design and Manufacturing Kancheepuram, India); Sowparna Pandaredathil (IIITDM Kancheepuram, India)

Sinter Free Inkjet Printed PEDOT: PSS/WO3/PEDOT: PSS Flexible Memory

Mohamed Salah Delfag (1650 Boulevard Lionel-Boulet & EMT-INRS, Canada); Rajesh Katoch and Yoandris Gonzalez (1650 Boulevard Lionel-Boulet, Canada); Johannes Jehn and Christina Schindler (Lothstrasse 34, Germany); Andreas Ruediger (1650 Boulevard Lionel-Boulet, Canada)

Monday, December 13 16:00 - 16:30 (America/Vancouver)

Refreshment Break

Room: Cordova Foyer

Monday, December 13 16:30 - 18:10 (America/Vancouver)

MS7: Nanopackaging and Heterogeneous System Integration

Room: Salon A

Chair: Markondeya Raj Pulugurtha (Florida International University, USA)

16:30 Invited Presentation: Nanomaterials in Semiconductor Packaging: Challenges and Opportunities

Dingying Xu (Intel Corporation, USA)

17:10 Synthesis of Face to Face Partially Fused Carbon Nanotubes for the Improvement of Thermal Management in 3D Die Stacking

Hua Xu, Jeffery C. C. Lo and Ricky Lee (HKUST, Hong Kong)

17:30 Magnetically - Tunable Multiferroic Stacks for Reconfigurable RF System Packages

Pawan Gaire, Veeru Jaiswal, Sk Yeahia Been Sayeed and John L. Volakis (Florida International University, USA); Shubhendu Bhardwaj (Florida International University & ElectroScience Laboratory, USA); Markondeya Raj Pulugurtha (Florida International University, USA)
17:50 SWCNT and PANI Nanocomposite Thin Films Fabrication for Improved EMI Shielding Effectiveness

V P R Siva Kumar Ogirala and PadmaPriya V Savithri (Geethanjali College of Engineering and Technology, India); Arunmetha S (Koneru Lakshmaiah Education Foundation, India)

**MS8: Nanofabrication and Nanomanufacturing**

Room: Salon B

Chair: James Spicer (The Johns Hopkins University, USA)

16:30 Inaugural Fellows Presentation: 3D Nanofabrication by Curving, Bending, and Folding

David Gracias (Johns Hopkins University, USA)

17:10 Reactor-Injector: Synthesis and Direct Atomization of Nanoparticles Towards Nanocomposite Coatings Assisted by Plasma Process

Guillaume Carnide (LCC); Claire Simonnet, Yohan Champouret and Eliane Amin-Chaloub (LAPLACE, France); Myrtil L. Kahn (LCC); Richard Clergereaux (http://www.laplace.univ-tlse.fr/)

17:30 Luminescent Europium (III)-Doped Mesoporous Silica Nanoparticles (SiO2-Eu NPs) Prepared via the Soaking Method

Anara Molkenova, Zhanbota Oteulina and Timur Sh. Atabaev (Nazarbayev University, Kazakhstan)

**MS9: Nanosensors and Nanoactuators I**

Room: Salon E

Chair: Ghazal Haji salem (University of Victoria, Canada)

16:30 Invited Presentation: Hybrid Magnon Modes

Axel Hoffmann (University of Illinois at Urbana Champaign, USA)

17:10 Polymer Composite with Rare Earth Hard Magnetic Particles for Flexible Reaction Injection-Moldable Microfluidic Actuators

Chelsey Currie and Bonnie Gray (Simon Fraser University, Canada)

17:30 High Performance Microcrack-Based MWCNT-Rubber Strain Sensor

Zheng Fan (University of Houston, USA)
Monday, December 13 18:15 - 19:30 (America/Vancouver)

YP: Nanotechnology Council Young Professionals Event:
"Meet the Experts" Panel

Room: Salon A

Chair: Rafal Sliz (University of Oulu, Finland)

Moderators: José Alvim Berkenbrock and Anand Shah

Panelists:
- Seyi Balogun, Northwestern University, NTC distinguished lecturer
- Bonnie Gray, Professor, Engineering Science, Simon Fraser University
- Kremena Makasheva, Senior Researcher, CNRS, LAPLACE, Université Paul Sabatier, Toulouse
- Paul S. Weiss, California NanoSystems Institute and Departments of Chemistry & Biochemistry, Bioengineering, and Materials Science & Engineering, UCLA
- Rafal Sliz, Assistant Professor, University of Oulu, Finland IEEE NTC YP Chair

IEEE NTC Young Professionals are very excited to have the opportunity to invite you to the "Meet the Experts" Panel Discussion held at the NMDC Conference in Vancouver. Our guests - distinguished scientists and engineers, and prominent IEEE members will have the opportunity to share their knowledge and experiences related to their profession. The experts bring different perspectives to the panel; their diverse backgrounds in various domains will help participants better understand the everchanging world of nanotechnology and gain new enriching experiences on both a personal and professional level. These thought leaders and practitioners can leverage their academic and professional experiences to enable participants to develop insights on how to approach their professional challenges in fresh ways.
Tuesday, December 14

PL 2: Plenary Session on Functional Optical Nanomaterials and Carbon-based Sensing Technologies

Room: Salon A

Chairs: Reuven Gordon (University of Victoria, Canada), Bonnie Gray (Simon Fraser University, Canada)

8:30 Nanomaterials and Light for Sustainability and Societal Impact
Naomi Halas (Rice University, USA)

Abstract:
Metallic nanoparticles, used since antiquity to impart intense, vibrant color into materials, then brought to scientific attention in the 19th century as "Faraday's colloid", have more recently become a central tool in the nanoscale manipulation of light. When excited by light, metallic nanoparticles undergo a coherent oscillation of their conduction electrons-known as a plasmon- which is responsible for their strong light-matter interactions and properties.

9:15 Carbon Nanomaterial Based Sensors and Devices for NASA Missions
Jessica Koehne (NASA Ames Research Center, USA)

Abstract:
Carbon nanomaterials have been investigated for their use in NASA missions due to their interesting electronic, mechanical, optical, and thermal properties. At NASA Ames Research Center, we have evaluated carbon nanotubes (CNTs), carbon nanofibers (CNFs), and graphene for electrochemical sensor and electronics applications, including crew health and environmental monitoring. More recently, carbon nanomaterials have been tailored and processed as printable inks for highly tunable, additive manufacturing of electrochemical sensors and electronics. These printed sensor devices enable on-demand manufacturing in the microgravity environment of space.

Tuesday, December 14 10:00 - 10:30 (America/Vancouver)

Refreshment Break

Room: Cordova Foyer
Tuesday, December 14 10:30 - 12:30 (America/Vancouver)

TS1: Nanophotonics, Plasmonics and Metamaterials I

Room: Salon A

Chair: James Spicer (The Johns Hopkins University, USA)

10:30 Individual Nanoflakes of Two Dimensional Materials Harmonic Generation with Ultralow Pump Power

Ghazal Haji salem and Mirali Seyed Shariatdoust (University of Victoria, Canada); Paul E. Barclay (University of Calgary, Canada); Reuven Gordon (University of Victoria, Canada); Rana Faryad Ali and Byron Gates (Simon Fraser University, Canada)

10:50 Dispersive Lossy Media for Narrowing Plasmon Linewidths

Ryan Louis Peck and Ali Khademi (University of Victoria, Canada); Juanjuan Ren (Queen's University, Canada); Alexandre Brolo and Reuven Gordon (University of Victoria, Canada)

11:10 Hexagonal Boron Nitride Second Harmonic Generation Using Gold Nanorods with Continuous Laser Source

Mirali Seyed Shariatdoust, Michael Dobinson, Ghazal Haji salem and Reuven Gordon (University of Victoria, Canada)

11:30 Enhancing and Isolating Lanthanide-Doped Nanocrystals Using Double Nanohole Optical Tweezers for Quantum Light Sources at 1550 nm

Zohreh Sharifi, Michael Dobinson, Ghazal Haji salem, Adriaan Frencken, Frank C J M van Veggel and Reuven Gordon (University of Victoria, Canada)

11:50 The Impact of Loss on Plasmonic Resonances in a Slit in a Real Metal

Zohreh Sharifi and Reuven Gordon (University of Victoria, Canada)

12:10 Negative Photoconductivity in Polycrystalline MoS2 at Room Temperature for Opto-MEMS Sensor

Pratisha Gangwar (IIT Delhi, India); Vaibhav Rana (Indian Institute of Technology Delhi, India); Akhil K Ramesh (Indian Institute of Technology Delhi, India & National Chiao Tung University (NCTU), Taiwan); Pushpapraj Singh and Samaresh Das (IIT Delhi, India)
TS2: Nanoelectronics I

Room: Salon B

Chair: Valentin Mazières (Université de Toulouse, France)

10:30 Electrical Analysis of Energy Depth of Electron Trap States in Silicon Nitride Films for Charge-Trap Flash Memory Application

Kiyoteru Kobayashi and Soichiro Nakagawa (Tokai University, Japan)

10:50 Preferential Growth of Crystalline MoS2 on Patterned Ni Channels in Contact with Au Thin Films

Neha Kondekar (Georgia Institute of Technology, USA & Lam Research, USA); Pralav Shetty, Lan Ho, Yi Li, Matthew West and Matthew McDowell (Georgia Institute of Technology, USA)

11:10 Investigation of Temperature Variation on HSO Ferroelectric FDSOI NCFET

Rameez Raja Shaik (IIITDM Kancheepuram, India); Kumar Pradhan (Indian Institute of Information Technology Design and Manufacturing Kancheepuram, India); V Rajakumari (Indian Institute of Information Technology Design and Manufacturing, Kancheepuram, India)

11:30 Contact Modulation Using Pulsed Thermal Annealing in 2-Dimensional Semiconductors

Olaiyan Mohammed Alolaiyan (King Abdulaziz for Science and Technology, Saudi Arabia); Moh. Amer (KACST-UCLA, Saudi Arabia)

11:50 Characterization of Electrophoretically Deposited Zinc Oxide Nanoparticles on Silicon with Fabrication of a P-N Junction

Fawwaz Hazzazi, Theda Daniels-Race, Alex Young, Christopher OLoughlin and Orhan Kizilkaya (Louisiana State University, USA)

12:10 Gallium-Oxide Based HEMT with T-Gate for High-Power Nanoelectronics Applications

Rajan Singh and Trupti Ranjan Lenka (National Institute of Technology Silchar, India); Hieu Nguyen (New Jersey Institute of Technology Newark, USA)

TS3: Nanosensors and Nanoactuators II

Room: Salon E

Chair: Bonnie Gray (Simon Fraser University, Canada)

10:30 D-Shaped Photonic Crystal Fiber Based Surface Plasmon Resonance Sensor Using Dual Metal Oxide Combination for Healthcare Applications
Veerpal Kaur (Sant Longowal Institute of Engineering & tech. Longowal, India); Surinder Singh (Sant Longowal Institute of Engineering and Technology, India)

10:50 Graphenized Papertronic Devices Using Blue Laser Ablated Polyimide Resin
Pavar Sai Kumar and Sanket Goel (BITS Pilani, Hyderabad Campus, India); Gohel Khush (BITS PILANI, India)

11:10 A Sensitive Electrochemical Biosensors Based on Glassy Carbon Electrodes Integrated with Smartphone for Prostate Cancer Detection
Naresh Mandal (Indian Institute of Technology Goa, India); Chirasree RoyChaudhuri (Bengal Engineering and Science University, India); Bidhan Pramanick (Indian Institute of Technology Goa, India)

11:30 Energy-Efficient Flexible Ammonia Sensors Enabled by Polypyrrole-Graphene
Xiao Xu, Zhehan Wang, Ke Zhan, Chenxu Bao, Zhengrui Zhu, Bo Chang, Qichao Chen, Xu Jing and Li Tao (Southeast University, China)

Tuesday, December 14 14:00 - 15:30 (America/Vancouver)

PL 3: Plenary Session on Nanodielectric Phenomena

Room: Salon A

Chairs: Giovanni Mazzanti (University of Bologna, Italy), Markondeya Raj Pulugurtha (Florida International University, USA)

14:00 Giant Polarization in Nanodielectrics
Christopher Homes (Brookhaven National Laboratory, USA)

Abstract:
The static dielectric constant of a material $\varepsilon_0$ is a scaling factor for capacitors and the devices based upon them; the larger the dielectric constant, the greater the degree of miniaturization. A new strategy to achieve high dielectric permittivity with low loss involves using localized lattice defect states through ambipolar co-doping.

14:45 Piezoelectric Nanofibers for Smart Material Development
Davide Fabiani and Giacomo Selleri (University of Bologna, Italy)

Abstract:
This paper illustrates that multifunctional materials with piezoelectric properties can be used self-sensing structural material and for energy harvesting applications: PVdF nanofibers, in particular with core-shell configuration show the best features for sensing applications while PZT nanofibers can be used more effectively for energy harvesting devices.
Tuesday, December 14 15:30 - 16:30 (America/Vancouver)

TPS: Poster Session on Functional Dielectrics

CEIDP-NMDC

Room: Salon E

Chair: Jérôme Castellon (Université de Montpellier, France)

15:30 Qualitative Study of the Injection Mechanism in N, N’- Ditridecyl-3,4,9,10-Perylenetetracarboxylic Diimide (PTCDI-C13) Based Vertical Organic Field-Effect Transistors

Marc Ternisien (LaPLaCE - Paul Sabatier University, France); David Buso (University Paul Sabatier LAPLACE, France); Marjorie Morvan (Laboratory on Plasma and Conversion Energy, France); Cedric Renaud (Laboratory on Plasma and Conversion Energy (LAPLACE), France); Houssein El Housseiny (Laboratory on Plasma and Conversion Energy, France); Georges Zissis (Paul Sabatier, France)

15:35 Injection Mechanism Characterization in N, N’-Ditridecyl-3,4,9,10-Perylenetetracarboxylic Diimide Based Vertical Organic Field-Effect Transistors

Marjorie Morvan (Laboratory on Plasma and Conversion Energy, France); David Buso (University Paul Sabatier LAPLACE, France); Marc Ternisien (LaPLaCE - Paul Sabatier University, France); Cedric Renaud (Laboratory on Plasma and Conversion Energy (LAPLACE), France); Houssein El Housseiny (Laboratory on Plasma and Conversion Energy, France); Georges Zissis (Paul Sabatier, France)

15:40 Development of Different Metal Insulin Nanoformulations for Wound Healing Activity

Pawandeep Kaur (TIET, India)

Tuesday, December 14 16:00 - 16:30 (America/Vancouver)

Refreshment Break

Room: Cordova Foyer

Tuesday, December 14 16:30 - 18:10 (America/Vancouver)

TS4: Special Session on Nanodielectric Phenomena

CEIDP-NMDC
Room: Salon A

Chairs: George Chen (University of Southampton, United Kingdom (Great Britain)), Kremena Makasheva (LAPLACE, CNRS, University of Toulouse, France)

16:30 Merging Nanotechnology & Synthetic Biology Toward Directed Evolution of Energy Materials
Elena A. Rozhkova (Argonne National Laboratory, USA)

17:00 Dilute Nanocomposites - A New Class of Polymer Nanocomposites That Exploit Nanointerface Effects in Enhancing Dielectric Performance
Qiming Zhang (Pennsylvania State University, USA)

17:30 Development, Testing, and Integration of Silicon and Glass Substrates for Advanced Ion Trap Design
Chuan Seng Tan (Nanyang Technological University, Singapore)

Tuesday, December 14 16:30 - 18:30 (America/Vancouver)

TS5: Nanophotonics, Plasmonics and Metamaterials II

Room: Salon E

Chair: Makhsud Saidaminov (University of Victoria, Canada)

16:30 Keynote Presentation: Nanoplasmonics: Quantum, Nonlinear, and Single Molecule Regimes
Reuven Gordon (University of Victoria, Canada)

17:10 Extraordinary Acoustic Raman Spectroscopy of PR65
Elham Babaei and Ghazal Haji salem (University of Victoria, Canada); Burak Kaynak and Pemra Doruker (University of Pittsburgh, USA); Mohsin Naqvi (University of Cambridge, United Kingdom (Great Britain)); Feng-Yu Wang, Jhii-Hong Cheng, Che-Min Wu and Shang-Hua Yang (National Tsing Hua University, Taiwan); Ivet Bahar (University of Pittsburgh, USA); Laura Itzhaki (University of Cambridge, United Kingdom (Great Britain)); Reuven Gordon and Shohei Iwamoto (University of Victoria, Canada)

17:30 Electrical Characteristics of Rectenna Integrated Au/HfO2/Pt and CNT Diodes
Lina Tizani, Ahmed Yassin and Baker Mohammad (Khalifa University, United Arab Emirates); Mohd Rezeq (Khalifa University of Science, Technology and Research, United Arab Emirates)
17:50 Metasurface-Based Antennas Integrated with Carbon Nanotubes for DNA Sensors Applications

Alina Cismaru and Martino Aldrigo (IMT Bucharest, Romania); Sergiu Iordanescu (IMT-Bucharest, Romania); Mircea Dragoman (National Institute for Research and Development in Microtechnology (IMT), Romania); Cosmin Obreja (National Institute for R&D in Microtechnologies, IMT-Bucharest, Romania); Catalin Parvulescu (IMT-Bucharest, Romania)

18:10 FEM Approach to the Robust Design of a Graphene-Based 3D Structure for THz Devices

Polina Kuzhir (Institute of Nuclear Problem at Belarusian State University, Belarus); Monica La Mura and Patrizia Lamberti (University of Salerno, Italy); Alesia Paddubskaya (Belarusian State University, Belarus); Vincenzo Tucci (University of Salerno, Italy); Viatcheslav Vanyukov (University of Eastern Finland, Finland)

**TS6: Neuromorphic/AI/VR/Energy NanoDevices**

Room: Salon B

Chair: James Spicer (The Johns Hopkins University, USA)

16:30 Invited Presentation: Unsupervised Learning & Reservoir Computing Leveraging Analog Spintronic Phenomena

Joseph S. Friedman (The University of Texas at Dallas, USA)

17:10 Invited Presentation: Quantized Domain-Wall Magnetic Tunnel Junction (DW-MTJ) Neural Networks Optimized for Rapid, Energy Efficient Edge Inference

Christopher H Bennett (Sandia National Labs, USA)

17:50 Energy Harvesting at Millimeter-Waves Exploiting Dielectric Resonator Antennas (DRA) on Silicon

Simone Trovarello and Diego Masotti (University of Bologna, Italy); Alessandra Costanzo (DEI, University of Bologna, Italy)

18:10 Formation of Nano-Tree and Nano-Ring Structures from Au-Si-Ge Eutectic Solids

Galih R. Suwito, Weizhen Wang and Nathaniel Quitoriano (McGill University, Canada)
Tuesday, December 14 18:30 - 19:00 (America/Vancouver)

AW: IEEE NTC Awards

Room: Salon A

Presentation of IEEE Fellow Recognition

- Deji Akinwande, University of Texas – Austin
- David Gracias, Professor, Department of Chemical and Biomolecular Engineering, Johns Hopkins University
- Paul S. Weiss, UC Presidential Chair and distinguished professor UCLA

Tuesday, December 14 19:00 - 21:00 (America/Vancouver)

NMDC-CEIDP 2021 Conference Banquet

Room: Vistas 360 (19th Level)
Wednesday, December 15

Wednesday, December 15 8:30 – 10:00 (America/Vancouver)

PL 4: Plenary Session on Biomaterials and Cell Manipulation

Room: Salon A

Chair: Xiaoning Jiang (North Carolina State University, USA)

8:30  **Annealed Hydrogel Microparticles as Scaffolds for Tissue Repair**

Tatiana Segura (Duke University, USA)

Abstract:
Injectable materials that can conform to the shape of a desired space are used in a variety of fields including medicine. The ability to fill a tissue defect with an injectable material can be used for example to deliver drugs, augment tissue volume, or promote repair of an injury. This talk will explore the development of injectable materials that are based on assembled particle building blocks, for tissue repair.

9:15  **Microrobotic Systems for Cell Manipulation**

Dong Sun (City University of Hong Kong, Hong Kong)

Abstract:
The application of robot technology to achieve early diagnosis and treatment of diseases at the cellular level represents a new frontier in the development of contemporary medical robots. Microrobotic system for cell therapy is an entirely new emerging theme that is enabled with specially designed automated micromanipulation tools to perform medical diagnosis and treatment on single cells at large scale.

Wednesday, December 15 10:00 - 10:30 (America/Vancouver)

Refreshment Break

Room: Cordova Foyer
**Wednesday, December 15 10:30 - 12:30 (America/Vancouver)**

**WS1: Theory and Modelling of Nanomaterials and Devices II**

Room: Salon A

Chair: Michael M. Adachi (Simon Fraser University, Canada)

10:30 Inaugural Fellows Presentation: Adventures with Atomic Materials: From Flexible/Wearable Electronics to Memory Devices
   Deji Akinwande (University of Texas at Austin, USA)

11:10 Quantum Transport in Conductive Bacterial Nanowires
   William L Livernois and Anant M. P. Anantram (University of Washington, USA)

11:30 Analysis of High Aspect Ratio Nanopores for Resistive Pulse Sensing Applications Through Numerical Simulations
   José Berkenbrock (University of Saskatchewan, Canada); Daniela Suzuki (Universidade Federal de Santa Catarina, Brazil); Garth Wells (Canadian Light Source, Canada); Matthias Mail and Torsten Scherer (Karlsruhe Institute of Technology, Germany); Sven Achenbach (University of Saskatchewan, Canada)

11:50 Design of Optimal Layer Thickness in Electrochromic Devices
   Shaurya Verma (Indian Institute of Technology Palakkad, India); Tanushree H. Choudhury (Indian Institute of Technology Bombay, India); Revathy Padmanabhan (Indian Institute of Technology Palakkad, India)

**WS2: Nanoacoustics I**

Room: Salon B

Chair: Oluwaseyi Balogun (Northwestern University, USA)

   Feng Lin and Jiming Bao (University of Houston, USA); Zhiming Wang (University of Electronic Science and Technology of China, China)

11:10 Miniaturized Dual-Mode Intravascular Transducer for Sonothrombolysis
   Bohua Zhang, Huaiyu Wu and Xiaoning Jiang (North Carolina State University, USA)

11:30 Ultrasound and Magnetic Dual-Mode Stacked Transducer for High Frequency Magneto-Sonothrombolysis
Bohua Zhang, Huaiyu Wu and Xiaoning Jiang (North Carolina State University, USA)

11:50 Quasi-Monopole Ultrasound Pulse Transducer Based on Piezoelectric Ceramic Material
Yiqi Cai, Shuqi Song, Lijun Xu and Jianguo Ma (Beihang University, China)

12:10 Ultrasound Imaging-Guided Microbubble-Mediated Catheter-Directed Sonothrombolysis: An In-Vitro Study
Chang Peng, Bohua Zhang and Huaiyu Wu (North Carolina State University, USA); Paul Dayton (University of North Carolina at Chapel Hill, USA); Zhen Xu (University of Michigan, USA); Xiaoning Jiang (North Carolina State University, USA)

WS3: Nanomaterials for Energy Applications III

Room: Salon E

Chair: Susanna Thon (Johns Hopkins University, USA)

10:30 Elucidating Polymer Binder Effect in Processing All-Solid-State Lithium Batteries
Yan Yao (University of Houston, USA)

11:10 Revealing Li Dendrite Growth in All-Solid-State Lithium Batteries
Zheng Fan (University of Houston, USA)

11:30 Synthesis and Electrochemical Properties of Nitrogen-Rich Hollow Carbon Spheres
Gaoqi Ji, Xinyu Yan (NUC, China)

11:50 A Flexible and Wearable Single Electrode Triboelectric Nanogenerator
Gulnur Kalimuldina, Yerzhan Nurmakanov, Roman Kruchinin and Zhansaya Kurmanbayeva (Nazarbayev University, Kazakhstan)

12:10 Computational Investigation of Electronic and Transport Characteristics for Janus MoTeSe Monolayer
Shivani Saini (Indian Institute of Information Technology, Allahabad, India); Sanjai Singh (IIIT Allahabad, India)
**Wednesday, December 15 14:00 - 16:00 (America/Vancouver)**

**WS4: Nanoelectronics II**

Room: Salon A

Chair: Kremena Makasheva (LAPLACE, CNRS, University of Toulouse, France)

14:00 Inaugural Fellows Presentation: Atomically Precise Chemical, Physical, Electronic, and Spin Contacts and Interfaces
Paul Weiss (University of California, Los Angeles, USA)

14:40 Effect of Surface Charge Model in the Characterization of Two-Dimensional Hydrogenated Nanocrystalline-Diamond Metal Oxide Semiconductor Field Effect Transistor (MOSFET) with Device Simulation
Reem Mohammed Alhasani (Waseda University, and King Abdulaziz City for Science and Technology, Japan); Quang Ngoc Nguyen (Waseda University, Japan); Mohammed Alhasani (University of Umm Alqura, Saudi Arabia); Hiroshi Kawarada, Taichi Yabe and Yutaro Iyama (Waseda University, Japan)

15:00 Operation of Nanomaterials Based Electronic Devices in Low Temperature
Reza Nekovei (Texas A&M University - Kingsville, USA)

15:20 Analysis, Modelling and Applications of Ferroelectric Negative Capacitance-Incorporated 2D Semiconductor Field Effect Transistors
Guangchao Zhao (School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore); Xingli Wang (CNRS-NTU-THALES Research Alliances/UMI 3288, Singapore); Mingqiang Huang (Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, China); BK Tay (School of EEE Nanyang Technological University, Singapore)

15:40 Improved Electrical Performance of InGaZnO Thin-Film Transistor with Increasing Channel Thickness
Chao Zhang, Ding Li and Xiao Dong Huang (Southeast University, China)
WS5: Theory and Modelling of Nanomaterials and Devices III

Room: Salon B

Chair: William L Livernois (University of Washington, USA)

14:00 Invited Presentation: Atomic-Scale Modeling of 2D Material Based Contacts and Transistors for Nanoscale Electronics

Soren Smidstrup (Synopsys QuantumATK, Denmark); Vihar Georgiev (University of Glasgow, United Kingdom (Great Britain)); Vaida Arcisauskaite (Synopsys QuantumATK, Denmark); Anders Blom (Synopsys QuantumATK, USA); Line Jelver (University of Southern Denmark, Denmark); Karsten Wedel Jacobsen and Emeritus Ole Hansen (Technical University of Denmark, Denmark)

14:40 COMSOL Modeling of a MoS2-Based Ferroelectric-Metal Field Effect Transistor (FeM-FET) for Memristor Applications

Nicola Pelagalli (Marche Polytechnic University, Italy)

15:00 First Principle Investigations of Optoelectronic Behavior for Janus ReSeTe: For Potential Applications in Optical Sensors

Anup Shrivastava (Indian Institute of Information Technology, Allahabad, India); Sanjai Singh (IIIT Allahabad, India)

WS6: Plasma Processes for Nanomaterial Synthesis

Room: Salon E

Chairs: Ahmad Hamdan (Université de Montréal, Canada), Flavien Valensi (University Paul Sabatier, France)

14:00 Influence of Electrodes Nature on the Electrical Characteristics of Spark Discharges in Water

Audren Dorval and Naomi Bourbeau (Université de Montréal, Canada); Korentin Géraud (Université de Toulouse III-Paul Sabatier, France); Flavien Valensi (University Paul Sabatier, France); Ahmad Hamdan (Université de Montréal, Canada)

14:20 Pulsed Spark Discharge in Deionized Water for Nanoparticle Synthesis: Electrical Measurement and Cavitation Bubble Study

Audren Dorval (Université de Montréal, Canada); Korentin Géraud (Université de Toulouse III-Paul Sabatier, France); Ahmad Hamdan (Université de Montréal, Canada); Flavien Valensi (University Paul Sabatier, France)
14:40 Spectroscopic Analysis of Pulsed Underwater Spark for Nanoparticles Synthesis Using Cu and Mo Electrodes

Tetiana Tmenova and Flavien Valensi (University Paul Sabatier, France); Anatoly Veklich (Taras Shevchenko National University of Kyiv, Ukraine); Viacheslav Boretstkij (Taras Shevchenko National University of Kyiv, France); Yann Cressault (Paul Sabatier Toulouse University & LAPLACE Laboratory, France)

15:00 Laser Generation in Liquids of Doped Nanomaterials

David Amans (Univ. Lyon, Univ. Claude Bernard Lyon 1, CNRS, Institut Lumière Matière, F-69622 Villeurbanne, France); Arsène Chemin (Univ Lyon, UCBL1, CNRS, Institut Lumière Matière, France); Julien Lam (CNRS, Université de Toulouse, CEMES, France); Gaetan Laurens, Tristan Albaret, Vincent Motto-Ros, Gilles Ledoux and Christophe Dujardin (Univ Lyon, UCBL1, CNRS, Institut Lumière Matière, France)

15:20 Pulsed Nanosecond Discharge in Heptane in Contact with Ag Solution: Feasibility of Nanoparticles Synthesis

Kyana Mohammadi and Ahmad Hamdan (Université de Montréal, Canada)

Wednesday, December 15 16:00 - 16:30 (America/Vancouver)

Refreshment Break

Room: Cordova Foyer

Wednesday, December 15 16:30 - 18:10 (America/Vancouver)

WS7: Biomedical Applications, Drug Delivery, Tissue Engineering

Chair: Alfred A Zinn (Kuprion Inc., USA)

16:30 Invited Presentation: Bioelectronic System Scaling Solutions with Nanopackaging

Markondeya Raj Pulugurtha (Florida International University, USA)

17:10 Protein Interaction with SiO2 and AgNPs: From Adsorption on Solid Surfaces to Organization and Conformational Changes

Marvine Soumbo and Christina Villeneuve-Faure (LAPLACE, University of Toulouse, France); Caroline Bonafos (CEMES-CNRS, France); Christine Roques (LGC, University of Toulouse, France); Kremena Makasheva (LAPLACE, CNRS, University of Toulouse, France)
17:30 Making Ultra-Active Antimicrobial Copper Possible Through Surface Area Enhancement
Rachel Brody, Alfred A Zinn, Mina Izadjoo, Randall Stoltenberg and Rob Roth (Kuprion Inc., USA)

17:50 A High Yield, High Purity Microfluidic Device for Potential Application of Blood Plasma Generation
Hesam Abouali (University of Waterloo, Canada); Seiedali Hosseini (Imam Khomeini International University, Iran); Sanjana Srikant and Mahla Poudineh (University of Waterloo, Canada)

WS8: Nanomaterials, Nanoelectronics, Nanooptics and Nanoprocessing

Room: Salon E

Chair: Chelsey Currie (Simon Fraser University, Canada)

16:30 A Theoretical Study on Porous-Silicon Based Synapse Design for Neural Hardware
Orthi Sikder (Indiana University-Purdue University Indianapolis, USA); Peter J Schubert (Indiana University-Purdue University Indianapolis & Green Fortress Engineering, USA)

16:50 Morphology Control and Optimization of Nano-MgO-Mg(OH)2 Composite via Vapor Steaming for Effective CO2 Capture
Ping Wu and Hasanthi L. Senevirathna (Singapore University of Technology and Design, Singapore)

17:10 Implication of WFV in FinFET Due to Square and Right Angle Triangle Grain: A Comparative Study
Rajesh Saha (MNIT Jaipur, India); Rupam Goswami (Tezpur University, India); Brinda Bhowmick and Srimanta Baishya (NIT Silchar, India)

WS9: Nanoacoustics II

Room: Salon B

Chair: Xiaoning Jiang (North Carolina State University, USA)

16:30 Keynote Presentation: Thermal Conductivity of Encapsulated Semiconducting Crystals with Intrinsic Magnetism
Oluwaseyi Balogun (Northwestern University, USA)
17:10 Observation of Domain Morphology of Pb(Mg1/3Nb2/3)O3-xPbTiO3 Single Crystals
  Haotian Wan (North Carolina State University & NCSU, USA); Yohachi Yamashita and
  Xiaoning Jiang (North Carolina State University, USA)

17:30 High-Resolution Imaging of Ultrasound in Dielectric Materials Using Near-Field Scanning
  Optical Microscopy
  James Spicer (The Johns Hopkins University, USA)

**Wednesday, December 15 18:30 - 19:00 (America/Vancouver)**

Closing Remarks, NMDC Awards
  and Announcement IEEE NMDC 2022

  Room: Salon A
Plenary Speakers (tentative)

Huiming Cheng, TBSI, CAS Academician
Ming Lu, Fudan U, CAS Academician
Ning Gu, Southeast U, CAS Academician
Jin-Woo Kim, U Arkansas, IEEE fellow
Zhihong Chen, Purdue, IEEE fellow
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Xiaoning Jiang, NC State U., USA
Fabrizio Lombardi, Northeastern U, USA
Peng Zhou, Fudan U, China
Manish Chhowalla, Cambridge, UK
Tianhong Cui, UMN, USA

Technical Topics (include but are not limited to)

Van der Waals Nanomaterials
Micro/Nano Memory/Memristors
Wearable & Printed Electronics
Quantum and Beyond Devices
MEMS/NEMS and Nanomechanics
Nano Energy Materials & Devices
Neuromorphic/AI/VR NanoDevices
Nano-Biomedicine & Healthcare
Nano Fabrication and Integration
Intelligent Manufacturing
Nano-Packaging & Passivation
Nano Information Technology

Call for contributions

Papers: Prospective authors are invited to submit high-quality papers reporting original results on above topics. Accepted papers will be published in IEEE Xplore, and selected papers will be invited to submit their extended version to IEEE Transactions on Nanotechnology and/or IEEE Nanotechnology Magazine.

Best Conference Papers and Best Student Papers will be awarded.

Tutorials & Workshops related to the conference theme are welcome.

Exhibits: IEEE NMDC 2022 offers on-site and online space with an excellent opportunity for companies with links to nanotechnology to showcase their products and services.

Important Deadlines

Abstract Submission: April 30, 2022
Full Paper Submission: May 30, 2022
Notification of Acceptance: July 15, 2022