



**CANEUS**

2004

**CANEUS 2004 Conference**  
Held on November 1-5, Monterey, California

**Micro-and Nanotechnology Developers  
And Aerospace End Users**

**Launch Cooperation  
With Collaborative Pilot Projects  
At CANEUS 2004**

By  
***CANEUS Organization***  
Nov 26, 2004

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## Executive Summary

Program managers, policy makers, scientists and engineers from North America, Europe and Asia Pacific nations met at Monterey, California with a call for global cooperation to pool the available resources to transform revolutionary micro and nano-technologies concepts into plans for developing new MNT-based materials and Aerospace system prototypes within the next three years. These plans provide private and government investors with an offer that is too good to refuse.

In recent years nanotechnology has captured the public imagination with the exciting promise of new, mind-boggling products for the home, consumer electronics, transportation, and health care, based on unique phenomena that occur at a billionth-of-a-meter scale. However, given the hard lessons learned from past experience, many of these concepts are doomed to remain laboratory curiosities and never make it to the marketplace.

Due to the major effort of the CANEUS organization and representatives of the leading Aerospace and Defense agencies including NASA and DoD, from the United States, ESA from Europe, and JAXA of Japan, now an ambitious undertaking is about to change the status quo forever. The CANEUS Conference and Workshop has been determined to find rapid and cost-effective means to transition exciting new concepts to products that could revolutionize aerospace and other important markets, which will ensure that micro and nanotechnology (MNT) does not become a passing fad. CANEUS 2004 was based on the premise that several key skills and functions need to come together to make this important transition happen for the mutual benefit of inventors and customers.

"The next step is to produce over the next six months, real and meaningful "deliverables" in the form of well-rounded business plans, by incorporating the combined wisdom of the assembled community". The objective is to initiate pilot projects to transform revolutionary MNT concepts into high-performance aerospace systems.

More than 250 delegates from over dozen nations including the top five who are leading the MNT developments attended the conference.

With a strong support from NASA and North American, European, and Asian governments, the CANEUS network consists of researchers, technology developers, industry professionals and investors from around the world. The objective is to construct a coherent, end-to-end technology development strategy that has the blessing of MNT researchers, industry leaders, agency program directors, government and private investors, military executives and civilian buyers of aerospace products.

This first-of-its-kind initiative provided attendees with deep insights into all aspects of the technology development pipeline from the initial proof-of-principle through the manufacture of high-reliability products. Attendees also had unprecedented access to leading researchers from international institutions developing exciting MNT materials and devices, heads of companies that develop MNT-based systems, directors of agency programs that fund MNT research, government and private investors, and top executives from aerospace companies who are looking to the next generation of MNT-based systems.

The CANEUS 2004 "Monterey declaration" laid the roadmap to provide a total walk-through of all the stages necessary to move a concept from the research stage to the manufacturing process. The concepts will be nurtured to maturity over the next two years, working through the process for presentation at the CANEUS 2006 Conference to be hosted in Toulouse, France.

"The declaration also addressed the challenge of efficiently transitioning aerospace MNT development from a mostly low TRL (Technology Readiness Level) stage to system-level implementations and the creation of an Aerospace MNT development "pipeline".

Fourteen technology-working groups were commissioned from topics matter specialists who researched MNT areas and recommended the development of specific technologies, which are still at the conceptual level, into practical devices and systems.

The Concept Coordinators said that it is our hope that many of these Concept Papers could serve as blueprints for technology development pilot projects aimed at transitioning these proven MNT concepts to working aerospace systems, and furthermore should set common standards all over the world.

The CANEUS-sponsored R&D projects will give participants from the three regions privileged access to the first-round of research, funding and manufacturing opportunities as pilot project prototypes demonstrate their advantages over existing systems. This has attracted the participation of industry leaders including the Boeing Company, Lockheed Martin Corporation, GE Aircraft Engines, Airbus, BAE Systems Advanced Technology Centre, Hewlett Packard, EADS, Alcatel Space Industries, Goodrich Corporation, and Motorola, as well as high-profile investors and program managers from leading government agencies such as NASA, AFRL, US Navy, US Army, Dept. of Commerce, ATP, NSF and others. High-profile investors and manufacturers focused on non-aerospace sectors were also at CANEUS 2004, as it is expected that MNT technologies developed will quickly find application in other fields.

The declaration touched on the need to create and implement a framework for funding such international initiatives.

The declaration also noted a number of challenges such as ITAR and inter-governmental agreements, which remain and urged the policy-makers to address them.

The CANEUS Organization and the American Institute of Aeronautics and Astronautics (AIAA), in partnership with the NASA and the Centre for Large Space Structures and Systems (CLS3), hosted CANEUS 2004, a forum for discussions on MNT-based system development for aerospace applications, leading to a selection of few pilot projects aimed at such development.

CANEUS is a nonprofit organization that benefits the worldwide aerospace community by fostering coordinated international development of MNT (Micro-Nano-Technologies) for aerospace applications. As a "hands on" organization, CANEUS is focused on the practical aspects of transitioning MNT rapidly and efficiently into aerospace systems. This objective is achieved via a mechanism of initiating pilot projects followed by full-scale development and manufacturing of MNT-based systems.

## 1. Overview

Hosted and organized by the CANEUS Organization and the American Institute of Aeronautics and Astronautics (AIAA) together with NASA and the CLS3 (Centre for Large Space Structures and Systems) of Montreal, Canada, this historic meeting on Micro/Nano-Technologies (MNT) for Aerospace attracted 250 delegates from the USA, Canada, Europe, Japan, Korea and Taiwan.

The CANEUS 2004 conference built on the theme developed during the CANEUS 2002 workshop; namely, addressing the challenge of efficiently transitioning aerospace MNT development from a mostly low TRL (Technology Readiness Level) stage to system-level implementations.

The creation of an Aerospace MNT development "pipeline" requires the buy-in and active participation of those involved in low, mid and high TRL development as well as end-users and investors. Given the small size of the overall Aerospace MNT community, a key objective of the conference, consistent with the mission of CANEUS Organization, has been to foster international partnerships aimed at creating MNT-based aerospace products by bringing together complementary skills and technologies.

## 2. Conference objectives

The CANEUS 2004 Conference was designed with the following objectives:

1. Provide participants with a complete understanding of the process required to advance radically innovative MNT concepts through to Aerospace system implementations of great commercial importance.
2. Bring together Aerospace MNT communities from Canada, Europe, USA and Asia and, in the context of proposed system-level projects (point 3. below), identify synergies of great potential value that result from the combining of complementary skills, expertise, techniques, and basic technologies.
3. Select promising MNT concepts and develop plans for pilot programs to advance their maturity and bring them, perhaps in useful combination, to the system level.

### 3. Conference Structure

#### 3.1. Overall Structure

Leading micro- and nanotechnology (MNT) researchers from around the world worked with system developers, major aerospace buyers and government and private investors in creating CANEUS 2004. The goal has been to plan projects that will see the development of new MNT devices based on novel concepts that will, within three years, be incorporated into high-level systems that answer the most critical needs of the aerospace buyers.

Prior to the conference, a forty-person team representing all of the stakeholders did two years of preparatory work. Concept Papers were commissioned from subject matter specialists who researched the different MNT areas and recommended the development of specific technologies that are now still at the conceptual level into practical devices and systems. Those recommendations are the subject of discussion and analysis as system-level pilot projects were presented in the CANEUS 2004 workshops.

The conference and workshops spanned a period of five days from November 1st to 5th of November 2004. Over these five days, the CANEUS 2004 conference included 22 thematic conference sessions and 3 poster sessions, and relevant technical exhibits, 7 process workshops covering 14 concept studies that identify potential pilot projects.

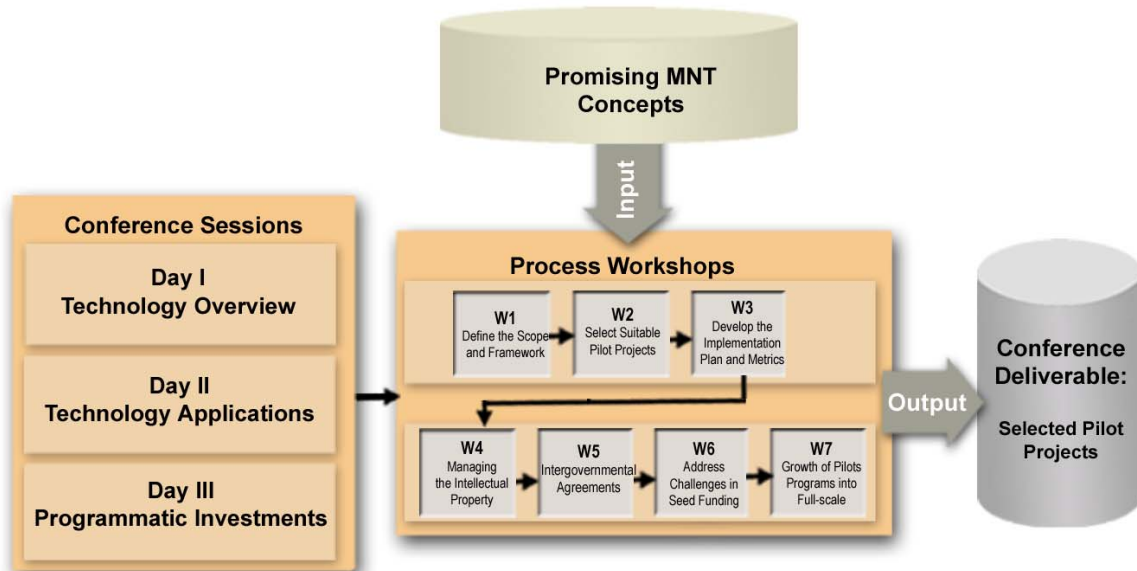


Figure 1- Overall CANEUS 2004 Structure

### 3.2. Topical Conference Sessions

Over 100 invited speakers representing the three regions, Canada and the USA, Europe and Asia Pacific, addressed the following topics at the conference and workshops:

#### 1. Technology Overview

- a. Low Mid and High TRL Materials
- b. Low Mid and High TRL Devices
- c. Sub-Systems
- d. Systems

#### 2. Technology Applications

- a. Manned Space Needs
- b. Unmanned Space Needs
- c. Aeronautics Needs
- d. Defense Needs
- e. Lessons Learned from Space
- f. Lessons Learned from Aeronautics
- g. Low Mid and High TRL Reliability

#### 3. Programmatic Investments

- a. Low Mid and High TRL Government Investment
- b. Low Mid and High TRL Private Investment
- c. Low Mid and High TRL International Collaborations

### 3.3. Concept papers discussed during the conference

The Conference Organizing Committee had selected 14 novel MNT concepts, which it believes could be transitioned to aerospace systems. Each concept paper was to provide the conference participants with the technical and programmatic background necessary to evaluate the current status in terms of technological maturity, key players in a particular technology arena, potential investors, aerospace end-applications and users, market potential, and the challenges involved in the development.

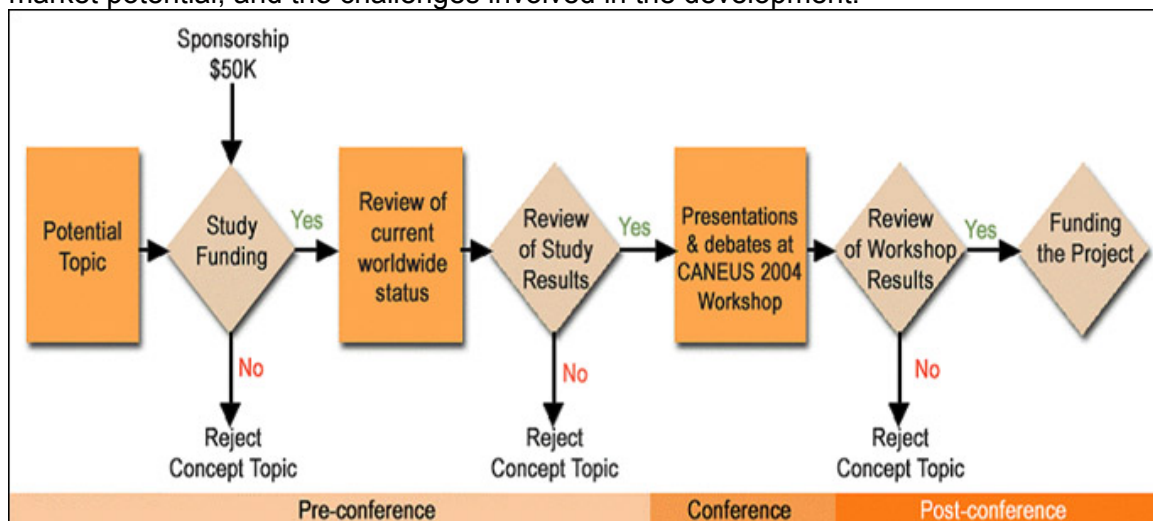


Figure 2 Pilot Project Development Process

### 3.4. Process workshops

Selected concept papers served as the basis for discussions during focused "process workshops" conducted during the later half of the CANEUS 2004 conference. These workshops addressed important aspects of the technology development cycle for aerospace systems. The Chairs and Panellists for each process workshop guided the discussion by highlighting the principal issues for a particular aspect of the technology development.

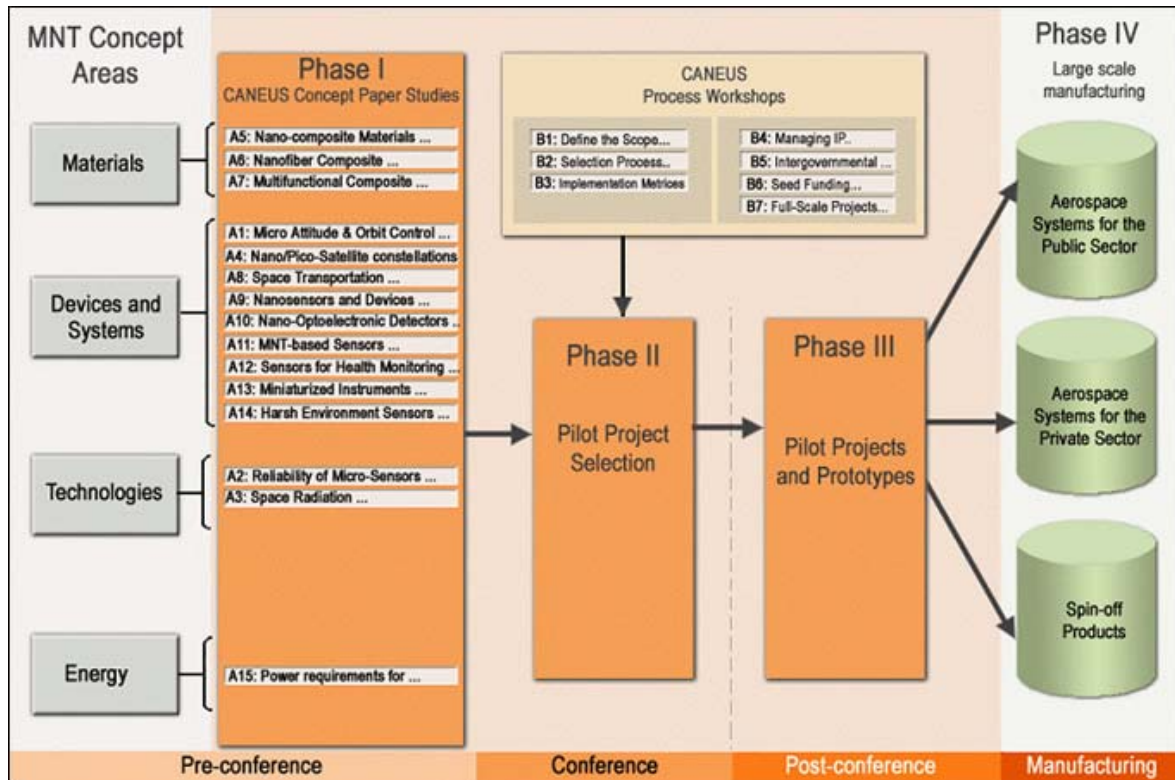


Figure 3: Workshop Structure



## 4. CANEUS 2004 Participants:

### 4.1. CANEUS 2004 Participants By Region:

More than 250 delegates from over twenty nations including the top five who are leading the MNT developments attended the conference.

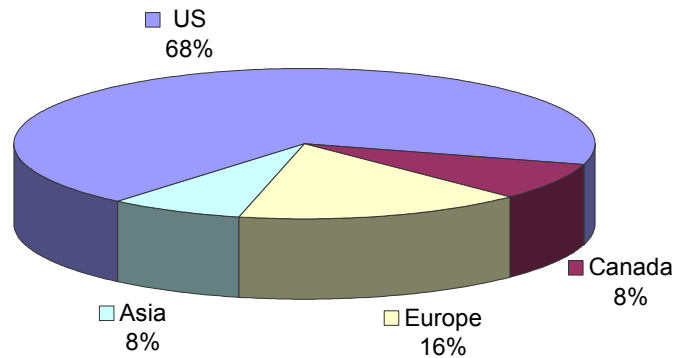


Figure 4-CANEUS 2004 participants by Region

### 4.2. CANEUS 2004 Participants By Sectors:

CANEUS is working in close collaboration with senior government officials to develop innovative funding means tailored to fit the needs of projects that cross international boundaries. CANEUS 2004 brought together key scientists, engineers, program managers, investors and policy-makers from America, Europe and Asia, representing both the MNT development community and aerospace end-users.

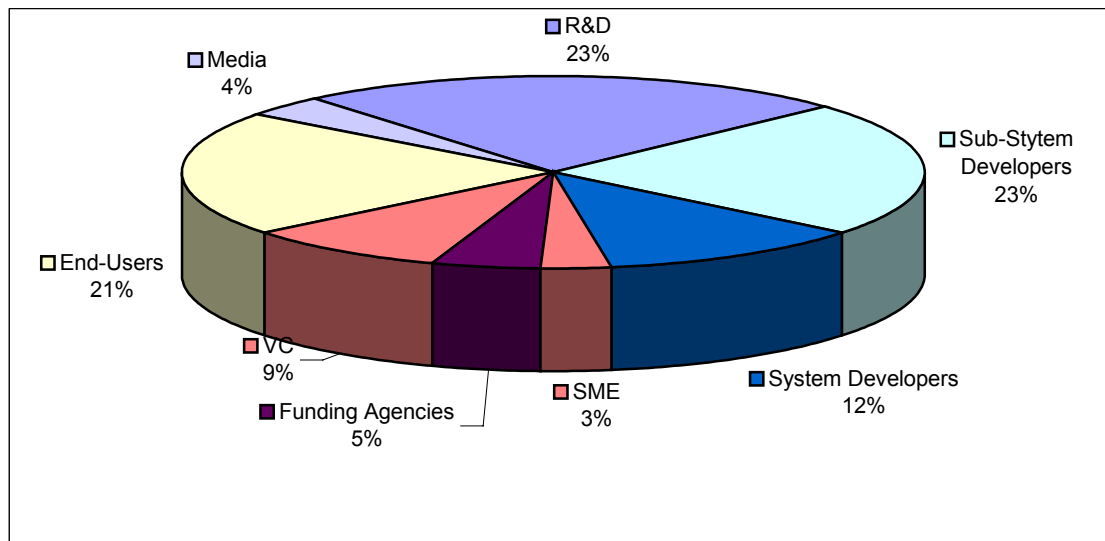


Figure 5-CANEUS 2004 participants by Sector

## 5. Recommendations

The CANEUS 2004 conference concluded with the recommendations to finalize the "blueprints" for a set of pilot projects aimed at practical Aerospace MNT development through to the level of a high-level system prototype. The pilot project document provides future investors, whether agency program managers or venture capitalists, with an authoritative and comprehensive plan for technology development. Promising concepts were presented in fourteen MNT topical areas (see appendix) spanning materials, devices and technologies.

The Concept Papers were discussed at the process workshops during the latter half of the conference. The pilot project "blueprints" will be developed using the step-by-step approach identified in the schematic below:

1. Intergovernmental agreements
2. Follow the GMI Model for CANEUS Organization
3. Recommendation for the concept papers
4. CANEUS memberships: individuals, Organizations, Countries
5. Creating Technology Development Pipeline Guidebook
6. Having one day topical workshops for each specific concept
7. Creating educational materials

## 6. Outcome:

The outcome of CANEUS 2004 included recommendations for future actions to be taken by the CANEUS Organization together with stakeholders and governmental policy makers from the participating CANEUS countries.

The CANEUS 2004 conference concluded with the development of "blueprints" for a set of Aerospace MNT development pilot projects that will lead to the production of system-level prototypes. These pilot projects will benefit from the coordinated efforts of the participating organizations that bring complementary skills and resources. CANEUS is working in close collaboration with senior government officials to develop innovative funding means tailored to fit the needs of projects that cross international boundaries

## Appendix I: Organizers and committee members

### Conference Chair

**Milind Pimprikar**  
CANEUS Organization, Canada

### Technical Co-Chair

**Thomas George**  
NASA-JPL, USA

### Technical Co-Chair

**Oudea Coumar**  
EADS-ST, Europe

### Conference Co-Chair

**Meyya Meyyappan**  
NASA Ames Research Center, USA

### Technical Co-Chair

**Deepak Srivastava**  
NASA Ames Research Center, USA

### Technical Co-Chair

**Jan Suski**  
MEMSfield and NEXUS, France

### Organized by:



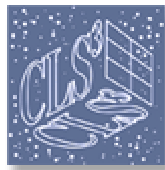
CANEUS Organization



AIAA - American Institute of Aeronautics and Astronautics\*



NASA - National Aeronautics and Space Administration



CLS3 - Centre for Large Space Structures and Systems, Canada

**Executive Committee**

- Noriko Abe, Canadian Embassy, Japan
- James Arnold, NASA Ames Research Center, USA
- William Atwell, The Boeing Company, USA
- Kitu Bindra, BurnsDoane, USA
- Raffaella Borzi, Interuniversity MicroElectronics Center (IMEC), USA/Europe
- Phillip Callen, NASA Johnson Space Center, USA
- Connie Chang, National Institute of Standards and Technology (NIST), USA
- Peter Eggleton, Telligence Group, Canada
- Carles Ferrer, CNM-CSIC, Spain
- Jeffrey Gray, Canadian Consulate General, USA
- Gary Hunter, NASA Glenn Research Center, USA
- David Lackner, NASA Ames Research Center, USA
- Jo-Won Lee, Institute of Science & Technology, Korea
- Les Lee, Air Force Office of Scientific Research, USA
- John Lekki, NASA Glenn Research Center, USA
- Mark Lorell, RAND Corporation, USA
- Pedro Medelius, NASA Kennedy Space Center, USA
- Gaetan Menozzi, NEXUS, EURIMUS and MEMSCap, France
- Walt Merrill, Glennan Microsystems Initiative, USA
- Jim Miller, NASA Marshall Space Flight Center, USA
- Michel Mirota, IRAP-NRC, Canada
- Rozita Naghshin, CLS3, Canada
- Harry Partridge, NASA Ames Research Center, USA
- Dan Powell, NASA Goddard Space Flight Center, USA
- Rajeshuni Ramesham, NASA Jet Propulsion Laboratory, USA
- Reza Sadri, Bombardier, Canada
- Jose Sinibaldi, Naval Post-Graduate School, USA
- Sharon Smith, Lockheed Martin Corporation, USA
- Mike Sullivan, Naval Air Warfare Center, USA
- Koji Takahashi, Kyushu University, Japan
- William Tang, University of California – Irvine, USA
- Merry Wardrop, American Institute of Aeronautics and Astronautics, USA
- Tammy Wisner, American Institute of Aeronautics and Astronautics, USA
- Mary Zeller, NASA Glenn Research Center, USA

## Appendix 2: Conference Speakers and Session Chairs

### Session Chairs

- James Arnold, NASA Ames Research Center, USA
- William Atwell, The Boeing Company, USA
- Michael Borrus, The Petkevich Group, LLC, USA
- Claudio Bruno, University of Rome La Sapienza, Italy
- Phillip Callen, NASA Johnson Space Center, USA
- Oudea Coumar, EADS-Space Transportation, France
- Bonnie Dunbar, NASA Johnson Space Center, USA
- Carles Ferrer, CNM-CSIC, Spain
- Ann Garrison Darrin, Johns Hopkins University, USA
- Roger Grace, Roger Grace Associates, USA
- James Heath, California Institute of Technology, USA
- Gary Hunter, NASA Glenn Research Center, USA
- Randall Kubena, HRL Laboratories, LLC, USA
- David Lackner, NASA Ames, USA
- Les Lee, Air Force Office of Scientific Research, USA
- John Lekki, NASA Glenn Research Center, USA
- Laurent Marchand, European Space Agency, The Netherlands
- Keith McIver, South Carolina Department of Commerce, USA
- Jim Miller, NASA Marshall Space Flight Center, USA
- Harry Partridge, NASA Ames Research Center, USA
- Prakash Patnaik, Institute for Aerospace Research, National Research Council Canada, Canada
- Gernot Pomrenke, Air Force Office of Scientific Research, USA
- Dan Powell, NASA Goddard Space Flight Center, USA
- Rajeshuni Ramesham, NASA Jet Propulsion Laboratory, USA
- Reza Sadri, Bombardier, Canada
- James Shoemaker, DARPA, USA
- Mark Shuart, NASA-Langley, USA
- Jose Sinibaldi, Naval Post-Graduate School, USA
- Sharon Smith, Lockheed Martin Corporation, USA
- Richard Snyder, Ardesta, USA
- Deepak Srivastava, NASA Ames Research Center, USA
- Victor Starkovich, The Boeing Company, USA
- Lars Stenmark, Uppsala University, Sweden
- Jan Suski, MEMSfield and NEXUS, France
- Tia Benson Tolle, Air Force Research Laboratory, USA
- Margaret Tuma, NASA Glenn, USA
- Chris Van Hoof, IMEC, Belgium
- Willard Webster, NAVAIR, USA
- David Williamson, Air Force Research Laboratory, USA
- Mary Zeller, NASA Glenn Research Center, USA

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## Keynote Speakers

- The Honorable Arthur Carty, Chief Science Advisor to the Prime Minister of Canada and President, National Research Council, Canada
- Minoo Dastoor, National Nanotechnology Initiative (NNI), NASA Headquarters, USA
- Scott Hubbard, Director, NASA Ames Research Center, USA
- Peter Hubbard, AAAS Science and Diplomacy Fellow, U.S. Department of State, USA
- The Honorable Gordon England, Secretary of the Navy, USA
- David Whelan, Vice President-General Manager and Deputy, Phantom Works, The Boeing Company, USA

## Lead Speakers:

- Mark Adler, NASA Jet Propulsion Laboratory, USA
- Forrest "Jack" Agee, Air Force Office of Scientific Research, USA
- Susanne Arney, Bell Laboratories, USA
- Susan Bales, Office of Naval Research, USA
- John Belk, Phantom Works, The Boeing Company, USA
- James Cutts, NASA Jet Propulsion Laboratory, USA
- Ray Garbos, BAE Systems, USA
- Jess Granone, Army Space and Missile Defense Command, USA
- Chin-Ming Ho, University of California, USA
- Neil Kacena, Lockheed Martin Corporation, USA
- Zach Lemnios, DARPA, USA (Invited)
- Noel MacDonald, University of California, Santa Barbara, USA
- Michael Meador, NASA Headquarters, USA
- Peter Lillehei, NASA Langley Research Center, USA
- Mark Radcliffe, Gray Cary Ware & Freidenrich, LLP, USA
- George Studor, NASA Johnson Space Center, USA
- Tao Yu Sun, Aerospace Industrial Corporation Development, Taiwan (Invited)
- Steven Wax, DARPA, USA
- Stan Williams, Hewlett-Packard, USA
- Stephen Winzer, Lockheed Martin Corporation, USA
- Leonard Yowell, NASA Johnson Space Center, USA

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**Session Speakers:**

- Kris Ahlers, Air Force Research Laboratory, Air Vehicles Directorate, USA
- Enrique Barrera, Rice University, USA
- Stefano Bellucci, INFN - Laboratori Nazionali di Frascati, Italy
- Michael Borrus, The Petkevich Group, LLC, USA
- Sylvain Charbonneau, Institute for Microstructural Sciences, Canada
- Dorian Challoner, The Boeing Company, USA (Invited)
- Wonbong Choi, Florida International University, College of Engineering, USA
- Patrick Ciganer, NASA Headquarters, USA
- Paul Coleman, Girvan Institute, USA
- Jean-Pierre Daniel, Airbus, France
- Alok Das, Air Force Research Laboratory, USA
- Bonnie Dunbar, NASA Johnson Space Center, USA
- Massayoshi Esashi, Tohoku University, Japan
- Denis Flandre, Université Catholique de Louvain (UCL), Belgium
- Paddy French, Delft University of Technology, The Netherlands
- Heico Frima, European Commission, Belgium
- Bishnu Gogoi, Motorola, USA
- Yuji Hanawa, New Energy and Industrial Technology Development Organization (NEDO), Japan
- Henry Helvajian, The Aerospace Corporation, USA
- S. Ejaz Huq, Rutherford Appleton Laboratory, United Kingdom
- George James, NASA Johnson Space Center, USA
- Norimitsu Kamimori, Japanese Aerospace Exploration Agency (JAXA), Japan
- Eui Kwan Koh, Nano-Defect Research Team, Korea (Invited)
- Jae Jin Lee, Teletron, Korea
- Darby Makel, Makel Engineering Inc., USA
- Yunosuke Makita, Director, Kankyo Semiconductors Co., Ltd, Japan
- Laurent Marchand, European Space Agency, The Netherlands
- Gabriel Marquette, Schlumberger, France
- Gaetan Menozzi, NEXUS, EURIMUS and MEMSCap, France
- Sung Moon, Korea Institute of Science and Technology, Korea
- David Morgan, The Boeing Company, USA
- Gerhard Müller, EADS, Germany
- Wilfried Noell, Institute of Microtechnology, University of Neuchâtel, Switzerland
- Prakash Patnaik, National Research Council, Canada
- Olivier Paul, IMTEK, University of Freiburg, Germany
- Brett Pokines, Air Force Office of Scientific Research, Asian Office of Aerospace Research and Development, Japan
- Francis Presseccq, Centre National d'Etudes Spatiales (CNES), France
- Alan Pritchard, BAE Systems Advanced Technology Centre, UK
- Louis Ross, The Global Emerging Technology Institute, Ltd. (GETI), USA
- Robert Schafrik, GE Aircraft Engines, USA
- Herbert Shea, Swiss Federal Institute of Technology Lausanne (EPFL), Switzerland
- Stephanie Shipp, National Institute of Standards and Technology, USA
- Fred Sexton, Sandia National Laboratory, USA
- Klaus Schadow, Chair - NATO Working Group on MEMS for Aerospace, Europe
- Stephanie Shipp, National Institute of Standards and Technology, USA
- Louis Shu, Weise Labs, Taiwan
- Mark Stuart, NASA-Langley Branch Head, USA

- 
- Richard Siegel, Rensselaer Polytechnic Institute (RPI), USA
  - James Siekkinen, Goodrich Corporation, USA
  - Sharon Smith, Lockheed Martin Corporation, USA
  - Lars Stenmark, Uppsala University, Sweden
  - Viktor Stolc, NASA Ames Research Center
  - Sang-Hee Suh, Institute of Science and Technology, Korea
  - Koji Takahashi, Kyushu University, Japan
  - Toshiyuki Tsuchiya, Department of Mechanical Engineering, Kyoto University, Japan
  - Chris Van Hoof, Interuniversity Micro Electronics Center (IMEC), Belgium
  - Olivier Vendier, Alcatel Space Industries, France
  - Gerhard Wachutka, Munich University, Germany
  - Miwako Waga, The Global Emerging Technology Institute Ltd., Japan
  - Dean Wiberg, NASA Jet Propulsion Laboratory, USA



## Appendix 3: Process Workshop coordinators and Panellists

### Process Workshop Coordinators

- George Abbey, Rice University, USA (*International Policy Pannel*)
- Claudio Bruno, University of Rome La Sapienza, Italy
- Peter Eggleton, Telligence Group, Canada
- Phillip.S Callen,NASA-JSC, USA
- Oudea Coumar, EADS-ST, France
- Thomas George, NASA-JPL, USA
- Neil Gordon, Canadian NanoBusiness Alliance, Canada
- Les Lee, Air Force Office of Scientific Research, USA
- Pedro Medelius, NASA-KSC, USA
- Walt Merrill, Glennan Microsystems Initiative, USA
- Meyya Meyyappan, NASA Ames Center for Nanotechnology, USA
- Michel D. Mirota, IRAP-NRCC, Canada
- Gaetan Menozzi, NEXUS, EURIMUS and MEMSCap, France
- Harry Partridge, NASA-Ames, USA
- Rajeshuni Ramesham, NASA JPL, USA
- Deepak Srivastava, NASA Ames Research Center, USA
- Jan Suski, MEMSfield, France
- Margaret Tuma, NASA Glenn, USA
- Mary.V Zeller, NASA-GRC, USA

### Workshop Pannelist and Lead Speakers

- Mark Adler, NASA-JPL, USA
- Bretton Alexander, OSTP, USA
- Barry Alexia, Strategy & Business Development Advanced Concepts & Technology
- James Arnold, NASA-ARC, USA
- William Atwell, Boeing, USA
- Edmond Baroth, NASA-JPL, USA
- Raj Bawa, awa Biotechnology Consulting and RPI, USA
- Legislative Staffer to Senator Wyden
- Kitu Bindra, BurnsDoane, USA
- Bobby Brar, Rockwell Scientific Company, USA
- Dorian Challoner, Boeing Space Systems, USA
- Jean-Pierre Daniel, Airbus, France
- John Dransfield, Industrial Technology Advisor, Canada
- Carles Ferrer, CNM-CSIC, Spain
- Heico Frima, European Commission, Belgium
- Hubert Galinat, Ministry of Industry, France
- Ray Garbos, BAE Systems, USA
- Gary Hunter, NASA-GRC, USA
- Wes Jamroz, MPB Communications, Canada
- Sylvia Johnson, NASA Ames Research Center, USA
- Alan Johnston, JPL-NASA, USA

- 
- Randall Kubena, HRL, USA
  - Stephen Maebius, Foley and Lardner, USA
  - Laurent Marchand, ESA, Netherlands
  - Gabriel Marquette, Schlumberger Limited - European Affairs, France
  - Allan Martel, IMS, Canada
  - Keith McIver, Boeing Phantom Works, USA
  - Jim Miller, NASA-MSFC, USA
  - John Mimikakis, Government of USA
  - Nick Ortyl, Blue Road Research, USA
  - Prakash Patnaik, IAR-NRC, Canada
  - Uri Sagman, C Sixty, USA
  - Benoit Simard, NRC-SIMS, Canada
  - Koji Takahashi, Kyushu University, Japan
  - Shuji Tanaka, Tohoku University, Japan
  - William Tang, University of California, Irvine, USA
  - Bob Twigg, Stanford University, USA
  - Eric Werwa, Office of Congressman Michael Honda 15th District California, USA
  - Charles Wieland, Burns Doanne for Workshop IP Panelist
  - Tetsuo Yasaka, Kyushu University, Japan

## Appendix 4: Concept Paper Committee Members

### Concept Paper Coordinators:

- James Arnold, NASA-ARC, USA
- William Atwell, Boeing, USA
- Julie Chen, NSF, USA
- Oudea Coumar, EADS-ST, France
- Mark Field, Rockwell Scientific, USA
- Thomas George, NASA-JPL, USA
- Les Lee, Air Force Office of Scientific Research, USA
- Milind Pimprikar, CLS3, Canada
- Gernot Pomrenke, AFOSR, USA
- Dan Powell, NASA-Goddard Space Flight Center, USA
- Rajeshuni Ramesham, NASA JPL, USA
- Deepak Srivastava, NASA Ames Research Center, USA
- Jan Suski, MEMSfield, France
- Margaret Tuma, NASA Glenn, USA
- Richard S Williams, NASA-HQ

### Concept Paper Committee Members

- Kyle T. Alfriend, Texas A&M University, USA
- James Arnold, NASA-ARC, USA
- Phaedon Avouris, IBM Research Division, USA
- Farrokh Ayazi, Georgia Institute of Technology, USA
- Yoseph Bar-Cohen, NASA-JPL, USA
- Edmond Baroth, NASA-JPL, USA
- Michael R Barratt, NASA-JSC, USA
- Olivier Ben, SEA, UK
- Alain Benoit, European Space Agency, Netherlands
- Colombo R. Bolognesi, (CSDL, Canada
- Lee Nor Braten, NASA-JSC, USA
- Simon Brown, University of Canterbury, New Zealand
- Claudio Bruno, University of Rome La Sapienza, Italy
- Phillip.S Callen, NASA-JSC, USA
- Philip Calvel, Alcatel Space Industries, France
- Preston Carter, Hyfly, DARPA, USA
- Dorian Challoner, Boeing Space Systems, USA
- Sylvain Charbonneau, IMS, NRCC, Canada
- Oudea Coumar, EADS-ST, France
- Ingrid de Wolf, IMEC, Belgium
- Gilles Delapierre, LETI/CEA, France
- Patrick Delaux, EADS-ST, Europe
- Jeffrey F DeNatale, Rockwell Scientific, USA
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- Robert Ecoffet, CNES, France
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