

SYMPOSIUM J

Nano- and Microelectromechanical Systems
(NEMS and MEMS) and Molecular Machines

December 1 – 4, 2002

Chairs

Arturo A. Ayón Sony Semiconductor
Thomas E. Buchheit Sandia Natl Laboratories
David A. LaVan MIT
Marc J. Madou Nanogen

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♣ Also in conjunction with Symposium NN

TUTORIAL

**FT J: MEMS AND NEMS—FABRICATION,
NANOMETER-SCALE SENSING,
BIOMIMETICS AND OPTICAL MEMS**

Sunday, December 1, 2002

8:30 a.m. - 5:00 p.m.

Room 204 (Hynes)

The morning session of the tutorial will provide an overview of the technologies and processes available for creating MEMS and NEMS structures employing surface and bulk-micromachining. This session will also include an in-depth discussion of sensor technology and the issues and limitations related to making measurements in the nanometer scale.

The afternoon session will explore biomimetics in NEMS and MEMS. This topic is relevant because a tremendous potential is seen for merging of top-down and bottom-up manufacturing techniques in realizing future MEMS and NEMS devices. MEMS and NEMS examples inspired by natural engineering feats (biomimetics) will be culled from the fields of molecular diagnostics, responsive drug-delivery systems, protein, and DNA as structural elements and as sensors and actuators and from the areas of field-driven assembly of small components and molecular self assembly.

The afternoon session will also address the many devices which are driving the rapid growth in optical MEMS, with examples of commercial and near-term devices. Some materials-driven aspects of optical MEMS will be discussed, as well as actuation mechanisms.

Instructors:

Jonathan Bernstein, Corning - IntelliSense Corporation
Thomas Kenny, Stanford University
Marc Madou, Nanogen
Arturo A. Ayón, Sony Semiconductor

SESSION J1: MICRO AND NANO FLUIDICS

Chair: Lloyd J. Whitman

Monday Morning, December 2, 2002

Room 313 (Hynes)

8:30 AM *J1.1

THE FABRICATION, FORM AND FUNCTION OF MICRONEEDLES. Shawn P. Davis, Jung-Hwan Park, Wijaya Martanto, Mark R. Prausnitz, School of Chemical Engineering, Georgia Institute of Technology, Atlanta, GA; Mark G. Allen, School of Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta, GA.

9:00 AM J1.2

MESOSCALE THIN FILM ACTUATOR FOR PROMOTING FLUID MOTION IN MICROFLUIDIC AND NANOFUIDIC CHANNELS. Gauray Singh^a, Daniel J. Sadler^b, Ravi F. Saraf^a, and Frederic Zenhausern^b; ^aVirginia Tech, Department of Chemical Engineering, Blacksburg, VA; ^bMotorola Labs, Tempe, AZ.

9:15 AM J1.3

SYNTHESIS OF DISPERSIONS USING 'FLOW-FOCUSING' IN A MICROFLUIDIC DEVICE. Shelley L. Anna, Harvard University, Division of Engineering and Applied Sciences, Cambridge, MA; Nathalie Bontoux, École Polytechnique, Paris, FRANCE; Howard A. Stone, Harvard University, Division of Engineering and Applied Sciences, Cambridge, MA.

9:30 AM J1.4

DYNAMIC TUNING OF OPTICAL WAVEGUIDES WITH ELECTROWETTING PUMPS. P. Mach, T. Krupenkin, S. Yang, J. Hsieh, and J.A. Rogers, Bell Laboratories, Lucent Technologies, Murray Hill, NJ.

9:45 AM J1.5

ELECTROPHORETIC ASSEMBLY OF MICRON SCALE PARTICLES USING PATTERNED MICROELECTRODES. Ryan J. Kershner, Michael J. Cima, Massachusetts Institute of Technology, Department of Materials Science and Engineering, Cambridge, MA.

10:00 AM BREAK

SESSION J2: NANOTECHNOLOGY AND MOLECULAR MACHINES - I

Chair: Christoph Gerber

Monday Morning, December 2, 2002

Room 313 (Hynes)

10:30 AM *J2.1

EVOLVING BIOMOLECULAR CONTROL AND ASSEMBLY OF SEMICONDUCTOR AND MAGNETIC NANOSTRUCTURES. Angela M. Belcher, Christine Flynn, Seung-Wuk Lee, Chuanbin Mao, Brian Reiss, Brent Iverson, University of Texas at Austin, Department of Chemistry and Biochemistry, Austin, TX; George Georgiou, University of Texas at Austin, Department of Chemical Engineering, Austin, TX.

11:00 AM J2.2

NANOPATTERNED SURFACES FOR CONTROLLED GROWTH OF MOLECULAR NANOSTRUCTURES. Federico Rosei, Y. Naitoh, M. Schunack, E. Legsgaard, I. Stensgaard, and F. Besenbacher, Physics Department and I-NANO, University of Aarhus, DENMARK; P. Jiang, A. Gourdon, and C. Joachim CEMES-CNRS Toulouse, FRANCE. ♣

11:15 AM J2.3

CHARACTERISATION OF MEMS MECHANICAL PROPERTIES USING NANOSCALE TECHNIQUES. Nicholas Randall and Richard Soden, CSM Instruments SA, Peseux, SWITZERLAND.

11:30 AM J2.4

NANOCALORIMETRY OF THIN FILMS. J. Rodríguez-Viejo, M. Chacón, A.F. Lopeandía, M.T. Clavaguera-Mora, Universidad Autónoma de Barcelona, Physics Dep., Bellaterra, SPAIN; Leonel R. Arana, K.F. Jensen, Massachusetts Institute of Technology, Dept. of Chemical Engineering, Cambridge, MA.

11:45 AM J2.5

SENSING AND PHOTOCATALYSIS FOR A COMBINED NANO/MICROPOROUS ARRAY ENHANCED WITH NANOCRYSTALLINE SEMICONDUCTOR COATINGS. James Gole and Steven Lewis, School of Physics; and Peter Hesketh and Andrei Federov, School of Mechanical Engineering, Georgia Institute of Technology, Atlanta, GA.

SESSION J3: MECHANICAL PROPERTIES AND
CHARACTERIZATION - I
Chair: Thomas E. Buchheit
Monday Afternoon, December 2, 2002
Room 313 (Hynes)

1:30 PM J3.1

MECHANICAL AND PHYSICAL PROPERTIES OF SILICON
NITRIDE THIN FILMS. Amit Kaushik, Hal Kahn, and
Arthur H. Heuer, Case Western Reserve University, Cleveland, OH.

1:45 PM J3.2

STOCHASTIC STRENGTH DISTRIBUTIONS IN POLYSILICON
MEMS. B.L. Boyce, T.E. Buchheit, C.R. Garcia, S.J. Glass, Sandia
National Labs, Materials and Process Sciences Center, Albuquerque,
NM; D.A. LaVan, Massachusetts Institute of Technology, Dept. of
Health Science and Technology, Cambridge, MA.

2:00 PM J3.3

DEVELOPMENT OF FATIGUE PRE-CRACKING METHOD INTO
MICRO-SIZED SPECIMENS FOR MEASURING FRACTURE
TOUGHNESS. Kazuki Takashima, Satoru Koyama, Katsuhisa Nakai,
Yakichi Higo, Tokyo Institute of Technology, P&I Laboratory,
Yokohama, JAPAN.

2:15 PM J3.4

FATIGUE IN POLYSILICON MEMS. Hal Kahn, R. Ballarini, J.J.
Bellante, Y. Wang, and A.H. Heuer, Case Western Reserve University,
Cleveland, OH.

2:30 PM J3.5

ENVIRONMENTAL AND INTERFACIAL EFFECTS ON THE
PREMATURE FAILURE OF POLYCRYSTALLINE SILICON
STRUCTURAL FILMS. Christopher L. Muhlstein, Materials Sciences
Division, Lawrence Berkeley National Laboratory, and Department of
Materials Science and Engineering, University of California, Berkeley,
CA; Eric A. Stach, National Center for Electron Microscopy,
Lawrence Berkeley National Laboratory, Berkeley, CA; Robert O.
Ritchie, Materials Sciences Division, Lawrence Berkeley National
Laboratory, and Department of Materials Science and Engineering,
University of California, Berkeley, CA.

2:45 PM J3.6

HIGH TEMPERATURE BEHAVIOR OF POLYSILICON.
Chung-Seog Oh, George Coles, William N. Sharpe, Johns Hopkins
Univ, Dept of Mechanical Engineering, Baltimore, MD.

3:00 PM BREAK

SESSION J4: ALTERNATIVE MICRO- AND
NANO-FABRICATION TECHNIQUES - I
Chair: Marc J. Madou
Monday Afternoon, December 2, 2002
Room 313 (Hynes)

3:30 PM *J4.1

UNCONVENTIONAL APPROACHES TO MICRO- AND
NANOFABRICATION. Younan Xia, Department of Chemistry,
University of Washington, Seattle, WA.

4:00 PM J4.2

PULSED LASER ANNEALING OF SILICON-GERMANIUM
FILMS. Sherif Sedky^a, Jeremy Schroeder^b, Timothy Sands^b, Roger
Howe^{a,c} and Tsu-Jae King^c; ^aBerkeley Sensor & Actuator Center,
University of California, Berkeley; ^bDepartment of Materials Science
& Engineering, University of California, Berkeley; ^cDepartment of
Electrical Engineering & Computer Sciences, University of California,
Berkeley, CA.

4:15 PM J4.3

GROWTH OF POLYCRYSTALLINE SILICON CARBIDE ON THIN
POLYSILICON SACRIFICIAL LAYERS FOR SURFACE
MICROMACHINING APPLICATIONS. R.F. Wiser, C.A. Zorman,
M. Mehregany, Case Western Reserve University, Dept of Electrical
Engineering and Computer Science, Cleveland, OH.

4:30 PM J4.4

FABRICATION OF MICRO-RELIEF STRUCTURES IN THICK
RESIST FOR ANTI-COUNTERFEITING APPLICATIONS.
Patrick W. Leech, Robert A. Lee, CSIRO Manufacturing Science and
Technology, Melbourne, AUSTRALIA; Henning Zeidler, Chemnitz
Technical University, Chemnitz, GERMANY.

4:45 PM J4.5

SELECTIVE TITANIUM OXIDE FORMATION USING ELECTRON

BEAM INDUCED CARBON DEPOSITION TECHNIQUE.
Thierry Djenizian, J. Macak, and Patrik Schmuki, Dept. of Material
Science, LKO, University of Erlangen-Nuremberg, Erlangen,
GERMANY.

SESSION J5: POSTER SESSION

Chairs: Arturo A. Ayón, Thomas E. Buchheit,
David A. LaVan and Marc J. Madou
Monday Evening, December 2, 2002
8:00 PM
Exhibition Hall D (Hynes)

J5.1

NOVEL METHODOLOGY FOR DEVELOPMENT OF MEMS.
Ryszard J. Pryputniewicz, Cosme Furlong, Worcester Polytechnic
Institute, Mechanical Engineering Department/CHSLT-NEST,
Worcester, MA; Thomas F. Marinis, Joseph W. Soucy, Draper
Laboratory, MEMS Packaging, Cambridge, MA.

J5.2

FABRICATION OF FLAT RF MEMS SWITCH MEMBRANE BY
MINIMIZING OF STRESS GRADIENTS IN THE Au MEMBRANE
STRUCTURE. Jong-Seok Kim, ME Center; Hoon Song, MEMS Lab.;
Jin-Woo Cho, CSE Center; Chan-Bong Jeon, ME Center, Samsung
Advanced Institute of Technology, Su-Won, KOREA.

J5.3

DESIGN AND PERFORMANCE OF A MICROENGINE REALIZED
WITH ARRAYS OF ASYMMETRICAL ELECTROTHERMAL
POLYSILICON SURFACE MICROMACHINED MICRO-
ACTUATORS. Edward S. Kolesar, Matthew D. Ruff, William E.
Odom, Joseph A. Jayachadran, Justin B. McAllister, Simon Y. Ko,
Jeffery T. Howard, Peter B. Allen, Josh M. Wilken, Noah C.
Boydston, Jorge E. Bosch, Richard J. Wilks, Texas Christian
University, Department of Engineering, Fort Worth, TX.

J5.4

INVESTIGATION OF POLYMER MICRO-ACTUATORS BASED
ON ELECTROSTRICTIVE POLY(VINYLIDENE FLUORIDE-
TRIFLUOROETHYLENE) COPOLYMERS. Tian-bing Xu, Feng Xia,
Z.-Y. Cheng, and Q.M. Zhang, The Penn State Univ, Materials
Research Institute and Dept of Electrical Engineering, University
Park, PA.

J5.5

NONUNIFORMITY IN SELECTIVE ANODIZATION OF SILICON
AND ITS APPLICATION TO MICROSTRUCTURE
FABRICATION. S. Uehara, N. Negishi, and T. Matsubara, Seikei
University, Department of Electrical Engineering and Electronics,
Musashino-shi, Tokyo, JAPAN.

J5.6

MICROMACHINED PIEZORESISTIVE SILICON CANTILEVERS
FOR *IN SITU* STRESS MEASUREMENTS DURING THIN FILM
DEPOSITION. Steven C. Seel[†] and Carl V. Thompson, Dept of
Materials Science and Engineering, Massachusetts Institute of
Technology, Cambridge, MA. [†]Currently at Sandia National
Laboratories, Surface and Interface Sciences Dept, Albuquerque, NM.

J5.7

FABRICATION OF MICROMACHINED PIEZOELECTRIC
DIAPHRAGM PUMPS ACTUATED BY INTERDIGITATED
TRANSDUCER ELECTRODES. Eunki Hong, S. Trolier-McKinstry,
Materials Research Institute, Pennsylvania State University,
University Park, PA; S.V. Krishnaswamy, T.T. Braggins, C.B.
Freidhoff, Northrop Grumman Electronics, Sensors System Sector,
Baltimore, MD.

J5.8

Abstract Withdrawn

J5.9

STRESS ADJUSTMENT AND CHARACTERISTICS
IMPROVEMENT OF 1.9GHZ RANGE FILM BULK ACOUSTIC
WAVE RESONATOR BY USING MULTILAYER STRUCTURE OF
ZnO/Al₂O₃/SiO₂. Masaki Takeuchi, Hajime Yamada, Hideki
Kawamura, Yoshihiko Goto, Tadashi Nomura, Hiroyuki Fujino, Yukio
Yoshino, Takahiro Makino, Seiichi Arai, Murata Mfg. Co., Ltd.,
Nagaokakyoshi, Kyoto, JAPAN.

J5.10

JOULE HEAT EFFECTS ON RELIABILITY OF MICRO-
ELECTROMECHANICAL SWITCHES. Malgorzata S. Machate,
Cosme Furlong and Ryszard J. Pryputniewicz, Worcester Polytechnic

Institute, Mechanical Engineering Department/CHSLT-NEST, Worcester, MA.

J5.11

Abstract Withdrawn

J5.12

Abstract Withdrawn

J5.13

HYDROGEL MICROPUMP FOR MICROFLUIDIC DEVICES. Brian T. Good, Robert H. Davis, Christopher N. Bowman, University of Colorado, Department of Chemical Engineering, Boulder, CO.

J5.14

ENHANCEMENT OF MEMS DEVELOPMENT VIA DEFECT DETECTION BY OPTOELECTRONIC INTERFEROMETRIC TECHNIQUES. Kevin A. Bruff, Thomas F. Marinis^a, Joseph W. Soucy^a, Megan M. Owens^a, Cosme Furlong and Ryszard J. Pryputniewicz, Mechanical Engineering Department/CHSLT-NEST, Worcester Polytechnic Institute, Worcester, MA; ^aDraper Laboratory, Cambridge, MA.

J5.15

HYBRID INTEGRATION OF III-V VCSEL ARRAYS ON Si PLATFORM. Alex Katsnelson, Vadim Tokranov, Michael Yakimov, Matthew Lamberti, and Serge Oktyabrsky, School of Nanosciences and NanoEngineering, University at Albany-SUNY, Albany, NY.

J5.16

ANALYTICAL AND EXPERIMENTAL STUDY OF THE DYNAMICS OF A MEMS ACCELEROMETER. Patrick J. Saggal, Victoria Steward, Cosme Furlong, and Ryszard J. Pryputniewicz, Worcester Polytechnic Institute, ME/CHSLT-NEST, Worcester, MA.

J5.17

ANALYTICAL AND EXPERIMENTAL STUDY OF THERMOMECHANICAL CHARACTERISTICS OF A MEMS PRESSURE SENSOR. Houri Johari, Cosme Furlong, Ryszard J. Pryputniewicz, WPI, Mechanical Engineering Department/CHSLT-NEST, Worcester, MA.

J5.18

ALUMINUM NITRIDE CHIP CARRIER FOR MICRO-MECHANICAL SENSOR APPLICATIONS. Thomas Marinis and Joseph Soucy, Draper Laboratory, Cambridge, MA.

J5.19

POROUS SILICON-BASED ELECTRODES FOR LITHIUM BATTERIES. H.-C. Shin, Z. Shi, and M. Liu, School of Materials Science and Engineering, and L.T. Seals and J.L. Gole, School of Physics, Georgia Institute of Technology, Atlanta, GA.

J5.20

DETECTION OF BACTERIAL CELLS USING MECHANICAL RESONANT FREQUENCY GRAVIMETRIC BIOSENSOR BASED ON A SURFACE MICRO-MACHINED THIN SILICON CANTILEVER BEAM. Amit Gupta, Demir Akin, Rashid Bashir, Purdue Univ, School of Electrical and Computer Engineering, West Lafayette, IN.

J5.21

CONTROLLING CASIMIR FORCES IN MEMS AND NEMS. F.J. López, R. Esquivel-Sirvent, C. Villarreal, Instituto de Física, UNAM, MEXICO, D.F.

J5.22

TAILORING OF STRESS DEVELOPMENT IN MEMS PACKAGING SYSTEMS. Satyajit Walwadkar, Junghyun Cho, SUNY Binghamton, Dept of Mechanical Engineering and Integrated Electronics Engineering Center, Binghamton, NY; P.W. Farrell, Lawrence E. Felton, Analog Devices, Micromachined Product Division, Cambridge, MA.

J5.23

PASSIVE BREAKUP: ENGINEERING EMULSION DISTRIBUTIONS WITH MICROFLUIDICS. Darren R. Link, Shelley L. Anna, Howard A. Stone, and David A. Weitz, Dept of Physics and DEAS, Harvard University, Cambridge, MA.

J5.24

NONINVASIVE CHARACTERIZATION OF PACKAGING FOR MEMS INERTIAL SENSORS. Adam R. Klempler, Cosme Furlong, Ryszard J. Pryputniewicz, Worcester Polytechnic Institute, Mechanical Engineering Department/CHSLT-NEST, Worcester, MA; Thomas F. Marinis, Joseph W. Soucy, Draper Laboratory, MEMS Packaging, Cambridge, MA.

J5.25

NOVEL METHODOLOGY FOR INVESTIGATION OF RESIDUAL STRESSES IN SURFACE MICROMACHINED Poly-Si AND ZnO MEMS COMPONENTS. Cosme Furlong, Ryszard J. Pryputniewicz, Worcester Polytechnic Institute, Mechanical Engineering Department/CHSLT-NEST, Worcester, MA; Antonio Martinez, Javier Wu-Li, Subhashish Majumder, Ram S. Katiyar, University of Puerto Rico, Physics Department, Rio Piedras, PR; Wilfredo Otano, University of Puerto Rico, Mathematics and Physics Department, Cayey, PR.

J5.26

DEFECT-INDUCED SHIFTS IN THE ELASTIC CONSTANTS OF SILICON. Clark L. Allred^{a,b,c}, Jeffrey T. Borenstein^a, Marc S. Weinberg^a, Xianglong Yuan^b, Martin Z. Bazant^b, Linn W. Hobbs^b; ^aThe Charles Stark Draper Laboratory, Inc., Cambridge, MA; ^bMassachusetts Institute of Technology, Cambridge, MA; ^cAir Force Institute of Technology, Wright-Patterson AFB, OH.

J5.27

SUPERCONFORMAL FILM GROWTH FOR NEMS AND MEMS FABRICATION. T.P. Moffat, D. Wheeler, B. Baker and D. Josell, NIST, Gaithersburg, MD.

J5.28

PECULIARITIES OF SCANNING PROBE NANOLITHOGRAPHY IN POLYMETHYLMETHACRYLATE. Sergei F. Lyuksyutov, Robert Ralich, Department of Physics, The University of Akron, Akron OH; Shane Juhl, Richard A. Vaia, Materials and Manufacturing Directorate, Air Force Research Laboratory, Wright-Patterson Air Force Base, OH.

J5.29

BUILDING OPTICAL MICROMACHINES OUT OF LIQUIDS. Peter Mach, Shu Yang, Tom Krupenkin, John Rogers, Bell Labs, Lucent Technologies, Murray Hill, NJ.

J5.30

MANUFACTURING OF 3-D MICROSTRUCTURES USING NOVEL UPSAMS PROCESS FOR MEMS APPLICATIONS. Andre Sharon, Axel Bilsing, Gordon Lewis, Xin Zhang, Boston University, Department of Manufacturing Engineering, and Fraunhofer USA Center for Manufacturing Innovation, Boston, MA.

J5.31

DEPOSITED METAL FILM AS NOBLE BACKSIDE BARRIER FOR ADVANCED Si WAFER THROUGH-ETCHING USING DEEP REACTIVE ION ETCHING. Hong-Seok Min, Sang-Soo Hwang, Young-Chang Joo, Seoul National University, School of Materials Science & Engineering, Seoul, KOREA; Kun-Joong Park, Se-Jun Kim, Seung-Jin Song and Kyoung-Doug Min, Seoul National University, School of Mechanical & Aerospace Engineering, Seoul, KOREA.

J5.32

NANOINDENTATION SIZE EFFECTS IN Ni THIN FILMS. J. Lou^a, Z. Zong^a, P. Shrotriya^a, T. Buchheit^b and W.O. Soboyejo^a; ^aPrinceton Materials Institute, and Department of Mechanical and Aerospace Engineering, Princeton University, Princeton, NJ; ^bMechanical Reliability and Modeling Dept., Sandia National Laboratories, Albuquerque, NM.

J5.33

A NOVEL IN-SITU TEM TECHNIQUE FOR DIRECT OBSERVATIONS OF FATIGUE DAMAGE ACCUMULATIONS IN CONSTRAINED METAL THIN FILMS. Xiaoli Tan, Tianbao Du, Jian-ku Shang, Department of Materials Science and Engineering, University of Illinois at Urbana-Champaign, Urbana, IL.

J5.34

GROWTH OF HIGHLY ORIENTED AlN AND ZnO FILMS ON Si (100) AND (111) BY PULSE LASER DEPOSITION FOR MEMS APPLICATIONS. S.S. Hullavarad, R.D. Vispute, J.D. Yuan, V.N. Kulkarni and T. Venkatesan CSR, Physics Department, University of Maryland, College Park, MD; A.E. Wickenden, Madan Dubey, Matt Ervin and K. Viehmann, United States Army Research Laboratory, Sensors and Electron Devices Directorate, Adelphi, MD.

J5.35

STRAIN GRADIENT EFFECT IN CONE INDENTATION. Anthony DiCarlo, Henry T.Y. Yang, University of California, Santa Barbara, Department of Mechanical and Environmental Engineering, Santa Barbara, CA; Srinivasan Chandrasekar, School of Industrial Engineering, Purdue University, West Lafayette, IN.

J5.36

THE EFFECT OF SURFACE MORPHOLOGY ON NANO-

HARDNESS. Weihua Xu, Ming-Hao Zhao, and Tong-Yi Zhang, Hong Kong University of Science and Technology, Department of Mechanical Engineering, Kowloon, Hong Kong, CHINA.

J5.37

RESIDUAL STRESS CONTROL TO OPTIMIZE PZT MEMS PERFORMANCE. M.S. Kennedy, J.S. Skinner, D.F. Bahr, C.D. Richards, R.F. Richards, Dept of Mechanical and Materials Engineering, Washington State University, Pullman, WA.

J5.38

MICROSTRUCTURE OF THICK POLYCRYSTALLINE SILICON FILMS FOR MEMS APPLICATION. H.W. Zhou, P.I. Gouma, State University of New York at Stony Brook, Dept. of Materials Science and Engineering, NY; B.G. Kharas, Standard MEMS Inc., Hauppauge, NY.

J5.39

MEASURING THE FRACTURE PROPERTIES OF MEM DEVICES. A.C. Fischer-Cripps, A. Bendeli, P. Rusconi, CSIRO Division of Telecommunications and Industrial Physics, Lindfield, NSW AUSTRALIA; Yakichi Higo, Kazuki Takashima, P&I Laboratory, Tokyo Institute of Technology, Yokohama, JAPAN.

J5.40

BENDING STUDIES OF THE MECHANICAL DEFLECTION OF GOLD COATED POLYSILICON MICRO-CANTILEVERS USING NANOINDENTATION TECHNIQUE. Parshuram Zantye, Ashok Kumar, Center for Microelectronics Research, Department of Mechanical Engineering, University of South Florida, Tampa, FL; Arun Sikder, Center for Microelectronics Research, University of South Florida, Tampa, FL; Manjula Rao Katapally, Shekhar Bhansali, Center for Microelectronics Research, Department of Electrical Engineering, University of South Florida, Tampa, FL.

J5.41

MICROFABRICATED TESTING TOOLS FOR LOAD-DEFORMATION STUDIES ON NANOSTRUCTURES. Shaoning Lu, Junghoon Lee, Rod Ruoff, Northwestern University, Department of Mechanical Engineering, Evanston, IL.

J5.42

EFFECT OF STRAIN RATE ON THE PLASTIC DEFORMATION OF FREESTANDING SUBMICRON GOLD THIN FILMS. H.D. Espinosa and B.C. Prorok, Northwestern University, Department of Mechanical Engineering, Evanston, IL.

J5.43

PROCESS DEVELOPMENT AND INTEGRATION OF PIEZOELECTRIC ALUMINUM NITRIDE THIN-FILM FOR RF MEMS APPLICATION. Rajnish K. Sharma, Jiang Ning, Han Hua and R. Gopalakrishnan, Institute of Microelectronics, Singapore, SINGAPORE.

J5.44

FEMTOSECOND LASER BASED MICRO/NANO STRUCTURING OF POLYMERIC MATERIALS. Anant Chimmalgi, Taeyul Choi, Costas P. Grigoropoulos, University of California Berkeley, Dept of Mechanical Engineering, Berkeley, CA.

SESSION J6/NN3: JOINT POSTER SESSION

Monday Evening, December 2, 2002

8:00 PM

Exhibition Hall D (Hynes)

J6.1/NN3.1

LOW TEMPERATURE ELECTRONIC TRANSPORT AND LONG RANGE ELECTRON TRANSFER IN MACROMOLECULES. Natalya Zimboskaya, City College of CUNY, Physics Department, New York, NY.

J6.2/NN3.2

MOLECULAR DYNAMICS STUDY OF ENERGY TRANSPORT THROUGH POLYMERIC MEDIUM. Rajesh Raghavan, Craig Carter, Massachusetts Institute of Technology, Dept of Materials Science and Technology, Cambridge, MA.

J6.3/NN3.3

SIMULATION OF ONE ELECTRON TRANSISTORS BASED ON FULLERENE MOLECULES. J.R. Soto, A. Calles, J. Austrich, and M.L. Marquina, Faculty of Sciences, National University of Mexico, MEXICO.

J6.4/NN3.4

A PROCEDURE FOR MODELING A ROTAXANE-BASED MOLECULAR DEVICE. XiangE Zheng and Karl Sohlberg, Drexel University, Chemistry Department, Philadelphia, PA.

SESSION J7/NN4: JOINT SESSION MOLECULAR ELECTRONICS

Chair: David A. LaVan

Tuesday Morning, December 3, 2002

Room 313 (Hynes)

8:30 AM *J7.1/NN4.1

REMOTE ELECTRONIC CONTROL OF DNA AND PROTEIN MOLECULAR MACHINES. Joseph Jacobson, Kimberly Hamad-Schifferli, John Schwartz, The MIT Media Lab Center for Bits and Atoms; J.P. Shi, and Shuguang Zhang, The Center for Biomedical Engineering, Massachusetts Institute of Technology, Cambridge, MA.

9:00 AM J7.2/NN4.2

SELF-ALIGNED SPLIT GATE ELECTRODES ON SUSPENDED CARBON NANOTUBES. Seung-Beck Lee, L.A.W. Robinson, D.G. Hasko, H. Ahmed, Univ of Cambridge, Cavendish Laboratory, Cambridge, UNITED KINGDOM; K.B.K. Teo, M. Chhowalla, G.A.J. Amaratunga, W.I. Milne, Univ of Cambridge, Dept of Engineering, Cambridge, UNITED KINGDOM.

9:15 AM J7.3/NN4.3

ENERGY TRANSFER AND CONVERSION IN NANOCANNEL COMPOUNDS CONTAINING CONJUGATED CHROMOPHORES. R. Tubino, Dip. Scienza dei Materiali and INFM, Univ. of Milano-Bicocca, Milano, ITALY; G. Bongiovanni, A. Mura, Dip. Fisica and INFM, Univ. of Cagliari, Cagliari, ITALY; C. Botta, ISMAC-CNR, Milano, ITALY; G. Di Silvestro, Universita' di Milano, Milano, ITALY.

9:30 AM J7.4/NN4.4

SEMIEMPIRICAL STUDY OF A PH-SWITCHABLE [2]ROTAXANE. Laura Frankfort, Karl Sohlberg, Department of Chemistry, Drexel University, Philadelphia, PA.

9:45 AM J7.5/NN4.5

A STUDY ON DNA ELECTRONICS USING NANOGAP JUNCTIONS. Joon Sung Lee, Yang-kyu Choi, Oh Seaback, and Luke P. Lee, Berkeley Sensor and Actuator Center, Department of Bioengineering, University of California at Berkeley.

10:00 AM BREAK

SESSION J8/NN5: JOINT SESSION NANOTECHNOLOGY AND MOLECULAR MACHINES - II

Chair: Joseph M. Jacobson

Tuesday Morning, December 3, 2002

Room 313 (Hynes)

10:30 AM *J8.1/NN5.1

CHEMICAL ANALYSES AND MOLECULAR RECOGNITION WITH NANOMECHANICAL CANTILEVER ARRAYS. Christoph Gerber, NCCR National Center of Competence for Nanoscience, Inst. of Physics, Univ. Basel, Nanoscale Science Group, IBM Research Lab, Rueschlikon, SWITZERLAND.

11:00 AM J8.2/NN5.2

FABRICATION AND CHARACTERIZATION OF A CARBON NANOTUBE TORSIONAL OSCILLATOR. P.A. Williams, A.M. Patel, S.J. Papadakis, M.R. Falvo, S. Washburn, R. Superfine, Dept. of Physics and Astronomy and Curriculum of Applied and Materials Science, University of North Carolina, Chapel Hill, NC.

11:15 AM J8.3/NN5.3

CHEMICAL CONTROL OF ENERGY DISSIPATION IN NANOMECHANICAL, MHz-RANGE SILICON RESONATORS. Yu Wang, Joshua A. Henry, Melissa A. Hines, Cornell Univ, Dept of Chemistry, Ithaca, NY.

11:30 AM J8.4/NN5.4

FOCUSED ION BEAM NANO-MACHINED STRUCTURES FOR STRAIN ANALYSIS BY A MOIRE TECHNIQUE. Biao Li, Albany NanoTech, Albany, NY; Xin Zhang, Department of Manufacturing Engineering, Boston University, Boston, MA; Huimin Xie, Dept of Eng. Mechanics, Tsinghua University, CHINA.

11:45 AM J8.5/NN5.5

PROCESSING TECHNIQUES FOR SINGLE WALLED CARBON NANOTUBES FOR ELECTRONICS APPLICATIONS. Paul Jaynes, Tom Tiano, Charlie Carey, Margaret Roylance, Foster-Miller, Inc., Waltham, MA; Ken McElrath, CNI, Houston, TX.

SESSION J9: MECHANICAL PROPERTIES AND CHARACTERIZATION - II

Chair: Harold Kahn
Tuesday Afternoon, December 3, 2002
Room 313 (Hynes)

1:30 PM J9.1

SIZE DEPENDENT ELASTICITY IN NANOCRYSTALLINE GOLD FILMS. Aman Haque, Taher Saif, Dept. of Mechanical & Industrial Engineering, University of Illinois at Urbana Champaign, Urbana, IL.

1:45 PM J9.2

MICRO-SCALE MEASUREMENTS OF THE MECHANICAL PROPERTIES OF THIN FILM ULTRANANOCRYSTALLINE DIAMOND. H.D. Espinosa, B.C. Prorok, K.-H. Kim, and B. Peng, Department of Mechanical Engineering, Northwestern University, Evanston, IL; O. Auciello, J.A. Carlisle, D.M. Gruen, N. Moldovan, and D.C. Mancini, Materials Science and Experimental Facilities Divisions, Argonne National Laboratory, Argonne, IL.

2:00 PM J9.3

IN SITU NANOINDENTATION OF ULTRANANOCRYSTALLINE DIAMOND AND AMORPHOUS DIAMOND THIN FILM COATINGS. A.M. Minor, Lawrence Berkeley National Laboratory, Materials Science Division, and University of California, Berkeley, Dept of Materials Science, Berkeley, CA; E.A. Stach, Lawrence Berkeley National Laboratory, National Center for Electron Microscopy, Berkeley, CA; J.W. Morris Jr., Lawrence Berkeley National Laboratory, Materials Science Division, and University of California, Berkeley, Dept of Materials Science, Berkeley, CA; T.A. Friedmann, Sandia National Laboratory, Dept of Nanostructure and Semiconductor Physics, Albuquerque, NM; X. Xiao, O.H. Auciello, J.A. Carlisle, Materials Science and Chemistry Division, Argonne National Laboratory, Argonne, IL.

2:15 PM J9.4

INTERNAL DISSIPATION IN AMORPHOUS DIAMOND MEMS OSCILLATORS. J.P. Sullivan, T.A. Friedmann, R.V. Ellis, and T.M. Schofield, Sandia National Laboratories, Albuquerque, NM.

2:30 PM J9.5

RAMAN SPECTROSCOPY OF A SILICON FLEXURE: STRESS MEASUREMENT AND MODEL VERIFICATION. V.T. Srikar, Massachusetts Institute of Technology, Dept of Aeronautics and Astronautics, Cambridge, MA; A.K. Swan, M.S. Ünli, Boston Univ, Electrical and Computer Engineering Dept, Boston, MA; B.B. Goldberg, Boston Univ, Electrical and Computer Engineering Dept and Physics Dept, Boston, MA; S.M. Spearing, Massachusetts Institute of Technology, Dept of Aeronautics and Astronautics, Cambridge, MA.

2:45 PM J9.6

OXIDE DISPERSION STRENGTHENED NICKEL (ODS-Ni) AS A LIGA STRUCTURAL MATERIAL. T.E. Buchheit, R.P. Janek, S.H. Goods, P.T. Kotula, D.T. Schmale, and J.R. Michael, Sandia National Laboratories, Albuquerque, NM and Livermore, CA.

3:00 PM BREAK

SESSION J10: ALTERNATIVE MICRO- AND NANO-FABRICATION TECHNIQUES - II

Chair: Somuri V. Prasad
Tuesday Afternoon, December 3, 2002
Room 313 (Hynes)

3:30 PM *J10.1

MATERIALS ASPECTS OF LIGA BASED MICROSTRUCTURES. Josef Hormes, Jost Göttert, Kun Lian, Challa Kumar, Center for Advanced Microstructures and Devices, Louisiana State University, Baton Rouge, LA.

4:00 PM J10.2

THE DEVELOPMENT OF ALTERNATIVE MOLDS FOR MICROMOLDING. Terry Garino, Joseph Cesarano, Brad Boyce, Sandia National Laboratories, Ceramic Materials Dept, Albuquerque,

NM; Alfredo Morales, Sandia National Laboratories, Microsystems Processing Dept, Livermore, CA.

4:15 PM J10.3

FERROELECTRIC $\text{Pb}(\text{Zr}_{0.52}\text{Ti}_{0.48})\text{O}_3$ THIN FILMS PATTERNED BY MICROCHANNEL MOLDING. Christopher R. Martin and Ihan A. Aksay, Princeton University, Department of Chemical Engineering, Princeton, NJ.

4:30 PM J10.4

THE IMPROVEMENT OF TEMPERATURE COEFFICIENT OF FREQUENCY IN THIN FILM BULK ACOUSTIC WAVE RESONATOR USING SECONDARY HARMONICS. Yukio Yoshino, Masaki Takeuchi, Hajime Yamada, Yoshihiko Goto, Tadashi Nomura, Takahiro Makino, Seiichi Arai, Murata Mfg. Co., Ltd., Kyoto, JAPAN.

4:45 PM J10.5

MICROMOLDING OF METALS WITH LIGA FABRICATED MOLD INSERTS. D.M. Cao, W.J. Meng, Mechanical Engineering Department, Louisiana State University, Baton Rouge, LA; D. Guidry, K.W. Kelly, Mezzo Systems Inc., Baton Rouge, LA.

SESSION J11: BIOTECHNOLOGY AND BIOCOMPATIBILITY

Chair: Angela M. Belcher
Wednesday Morning, December 4, 2002
Room 313 (Hynes)

8:30 AM *J11.1

DETECTING BIOMOLECULAR RECOGNITION WITH MAGNETIC MICROARRAY SENSORS. L.J. Whitman, Naval Research Laboratory, Washington, DC.

9:00 AM J11.2

A CHEMICAL SENSOR USING NEURONS AND A 3-D MICRO-FLUIDIC CHIP. H.A. McNally^a, H. Kuffuoglu^a, D. Akin^a, J. Grimmer^b, J. Walker^b, R. Shi^b, R. Borgens^b, R. Bashir^{a,c}; ^aSchool of Electrical and Computer Engineering, ^bSchool of Veterinary Medicine, ^cDepartment of Biomedical Engineering, Purdue University, W. Lafayette, IN.

9:15 AM J11.3

AN INVESTIGATION OF Ti COATING AND SURFACE TEXTURE ON CELL/SURFACE INTERACTIONS IN BioMEMS STRUCTURES. S. Mwenifumbo, E. Kung, S. Allameh and W.O. Soboyejo, Princeton Materials Institute, and Department of Mechanical and Aerospace Engineering, Princeton University, Princeton, NJ.

9:30 AM J11.4

IN VIVO BIOCOPATIBILITY OF MATERIALS AND OPERATION OF A MEMS DRUG DELIVERY DEVICE. Gabriela Voskerician, Case Western Reserve University, Dept of Biomedical Engineering, Cleveland, OH; Rebecca S. Shawgo, Michael J. Cima, Massachusetts Institute of Technology, Dept of Materials Science and Engineering, Cambridge, MA; James M. Anderson, Case Western Reserve University, Dept of Biomedical Engineering, Cleveland, OH; Robert Langer, Massachusetts Institute of Technology, Dept of Chemical Engineering, Cambridge, MA.

9:45 AM J11.5

ELECTROCHEMICAL DISINTEGRATION OF GOLD MEMBRANES ON A MEMS DEVICE FOR DRUG DELIVERY. Yawen Li, Rebecca S. Shawgo, Massachusetts Institute of Technology, Dept of Materials Science and Engineering, Cambridge, MA; Robert Langer, Massachusetts Institute of Technology, Dept of Chemical Engineering, Cambridge, MA; Michael J. Cima, Massachusetts Institute of Technology, Dept of Materials Science and Engineering, Cambridge, MA.

10:00 AM BREAK

SESSION J12: APPLIED MICRO- AND NANO-TECHNOLOGY

Chair: Arturo A. Ayón
Wednesday Morning, December 4, 2002
Room 313 (Hynes)

10:30 AM *J12.1

VIBRATING RF MEMS FOR LOW POWER COMMUNICATIONS. Clark T.-C. Nguyen, Center for Wireless Integrated Microsystems, Dept. of Electrical Engineering and Computer Science, University of Michigan, Ann Arbor, MI.

11:00 AM J12.2

ON A ROAD TO "SOFT" OPTICAL MEMS. Tom Krupenkin, Peter Mach, Shu Yang, Bell Labs, Lucent Technologies, Murray Hill, NJ.

11:15 AM J12.3

MODELING COMBINED THERMAL, ELECTRICAL, OPTICAL AND MECHANICAL RESPONSE FOR MEMS SPECTROSCOPIC GAS SENSOR BASED ON PHOTONIC CRYSTALS. Anton C. Greenwald, Martin U. Pralle, Mark P. McNeal, Nicholas Moelders, Irina Puscasu, James T. Daly, Edward A. Johnson, Ion Optics, Inc., Waltham, MA.

11:30 AM J12.4

PIEZOELECTRIC MICROMACHINED TRANSDUCERS BASED ON PZT FILMS. Paul Murali, Jacek Baborowski, Nicolas Ledermann, Swiss Federal Institute of Technology EPFL, Ceramics Laboratory, Lausanne, SWITZERLAND.

11:45 AM J12.5

THERMAL IMAGING USING NANOSTRUCTURED MICROCANTILEVERS. Panos G. Datskos, Slo Rajic, Lawrence R. Senesac, James L. Corbeil, Nickolay V. Lavrik, Oak Ridge National Laboratory, Engineering Science and Technology Division, Oak Ridge, TN.

4:30 PM J13.8/Y7.8

POLYMER-SILSESQUOXANE COMPOSITES AS A ROUTE TO HIGH SURFACE AREA MATERIALS FOR MEMS SENSOR APPLICATIONS. Douglas C. Meier, Steve Semancik, The National Institute of Standards and Technology, Chemical Science and Technology Laboratory, Process Measurements Division, Gaithersburg, MD; Michael J. Fasolka, The National Institute of Standards and Technology, Material Science and Engineering Laboratory, Polymers Division, Gaithersburg, MD.

4:45 PM J13.9/Y7.9

PLANAR EXTRINSIC BIASING OF THIN FILM SHAPE-MEMORY MEMS ACTUATORS FOR PHOTOLITHOGRAPHIC COMPATIBILITY. D.S. Grummon, Michigan State University, Dept. of Chemical Engineering and Materials Science, E. Lansing, MI; R. Gotthardt and T. LaGrange, Ecole Polytechnique, Lausanne, SWITZERLAND.

SESSION J13/Y7: JOINT SESSION
SURFACE ENGINEERING ISSUES IN MEMS
STRUCTURES AND DEVICES

Chairs: Thomas E. Buchheit and Orlando Auciello
Wednesday Afternoon, December 4, 2002
Constitution B (Sheraton)

1:30 PM *J13.1/Y7.1

ULTRANANOCRYSTALLINE DIAMOND FOR TRIBOMECHANICAL COATINGS AND MICROELECTROMECHANICAL SYSTEMS. Orlando Auciello, J.A. Carlisle, J. Birrell, A. Erdemir, D.M. Gruen, D.C. Mancini, N.A. Moldovan, Argonne National Laboratory, Argonne, IL; M.T. Dugger, Sandia National Laboratories, Albuquerque, NM; E.A. Stach, Lawrence Berkeley National Laboratory, Berkeley, CA.

2:00 PM J13.2/Y7.2

A COMPARATIVE MICROTRIBOLOGICAL INVESTIGATION OF STATE-OF-THE-ART DIAMOND-LIKE CARBON FILMS FOR MEMS APPLICATIONS. I. Ahmed, G. Bregliozzi and H. Haefke, CSEM Swiss Center for Electronics and Microtechnology Inc., Neuchatel, SWITZERLAND.

2:15 PM J13.3/Y7.3

ENVIRONMENT-INDUCED EFFECTS ON DIAMOND FRICTION AND WEAR. Joakim Andersson, Staffan Jacobson, Tribomaterials Group, Ångström Laboratory, Uppsala University, SWEDEN.

2:30 PM *J13.4/Y7.4

TETRAHEDRAL AMORPHOUS-CARBON (ta-C): MATERIALS PROPERTIES AND MEMS. T.A. Friedmann, J.P. Sullivan, R.V. Ellis, T.M. Alam, T.E. Buchheit, M.P. de Boer, Sandia Nat. Laboratories, Albuquerque, NM; E.A. Stach, Lawrence Berkeley National Laboratory, Natl Ctr Electron Microscopy, Berkeley, CA.

3:00 PM BREAK**3:30 PM *J13.5/Y7.5**

TRIBOLOGY OF LIGA NICKEL ALLOYS: MICROSTRUCTURAL EVOLUTION AT THE WORN SURFACES. S.V. Prasad, J.R. Michael, P.G. Kotula, T.E. Buchheit, T.R. Christenson, Sandia National Laboratories, Albuquerque, NM; J.J. Kelly, Sandia National Laboratories, Livermore, CA.

4:00 PM J13.6/Y7.6

DESIGNING SHAPE OF 3-D NANOSTRUCTURES: CONTROL THROUGH LITHOGRAPHY AND INTERFACIAL STRESS. H. Deniz, S.J. Papadakis, O. Sul, M.R. Falvo, S. Washburn, R. Superfine, Dept. of Physics and Astronomy and Curriculum of Applied and Materials Science, University of North Carolina, Chapel Hill, NC.

4:15 PM J13.7/Y7.7

INTERPLAY OF SURFACE ROUGHNESS AND RELATIVE HUMIDITY ON MEMS STICKTION. Richard A. Plass, Maarten P. de Boer, Radiation and Reliability Physics Dept., Sandia National Laboratories, Albuquerque, NM; Erin E. Flater, Robert W. Carpick, Engineering Physics Dept., University of Wisconsin at Madison, Madison, WI.