Joseph C. Doll

Education

Ph.D. Mechanical Engineering, Stanford University (August 2012)

Dissertation: Advances in high bandwidth nanomechanical force sensors with integrated actuation

M.S. Mechanical Engineering, Stanford University (2009)

NSF Graduate Research Fellow

National Defense Science and Engineering Graduate Fellow

B.S. Mechanical Engineering, University of California at Berkeley (2006)

Honors Thesis: Biocompatible Nanoplasmonic Probes for the Detection of Single Biomolecules

Professional interests

Sub-micron micromachining and process development
Integrated mechanical, electrical and thermal design
Piezoresistive and piezoelectric sensor design
Numerical design optimization
AlN film and process development
Sensor fusion and integrated systems

Process experience and skills

Mask layout and 0.5 μm lithography process development including 3D align (ASML PAS 5500/60)
RIE, DRIE and wet etch recipe development for AlN, Al, Mo, Si, SiO_2 and Ti
PVD, CVD and ALD experience including AlN, Al, Mo, PSG, parylene, SiO_2, Ti and high-k dielectrics
Experience in wafer dicing and the release of delicate structures (HF vapor and CPD)
Expertise in ion implantation, predeposition, interconnects and contacts
Strong background in metrology including AES, AFM, FIB, SEM, SIMS, SRA, Raman, VASE, XPS, XRD
Skills include CAD, FEA, statistical analysis, DoE, numerical analysis, optimization, L-Edit, Java, Matlab and Python

Academic experience

Graduate researcher (2006 - present)

Developed numerical optimization techniques for piezoresistive and piezoelectric sensor design

Compared low-power piezoresistive sensors with piezoelectric sensors using numerical design optimization

Experimentally studied piezoresistor self-heating and developed temperature constrained design methods

Demonstrated a CMOS compatible process for high performance AlN on Ti (and subsequently AlN on Mo)

Developed a strong background in analog circuit design, component selection, testing and PCB layout

Combining these efforts, designed and fabricated sub-micron cantilevers with integrated piezoresistive sensing and piezoelectric actuation that are capable of pN force resolution and μs time resolution in water

Journal reviewer (2010 - present)

Journal of Micromechanics and Microengineering
Measurement Science and Technology
Nanotechnology
Smart Materials and Structures

Teaching assistant (2006 - 2010)

E341: Micro/Nano systems design and fabrication laboratory (2009)
Cleanroom TA for DRIE and LPCVD oxide fabrication steps

E240: Introduction to MEMS/NEMS (2006)
Co-taught discussion sections, developed assignments and tests, developed a hands-on microfluidics lab exercise

Publications

Books

Piezoresistor design and applications
J.C. Doll and B.L. Pruitt
In preparation. Estimated completion and publication in 2012

Book chapters

Force sensing optimization and applications
J.C. Doll, S.-J. Park, A.J. Rastegar, N. Harjee, J.R. Mallon Jr., G. Hill, A.A. Barlian and B.L. Pruitt
Advanced Materials and Technologies for Micro/Nano-Devices, Sensors and Actuators. Springer (2010)

Selected archival journal publications (14 total, 5 first-author)

Self-heating in piezoresistive cantilevers
J.C. Doll, E.A. Corbin, W.P. King, and B.L. Pruitt
Applied Physics Letters (2011)

Aluminum nitride on titanium for CMOS compatible piezoelectric transducers
J.C. Doll, B.C. Petzold, B. Ninan, R. Mullapudi, B.L. Pruitt
Journal of Micromechanics and Microengineering (2010)

Design of piezoresistive vs. piezoelectric contact mode scanning probes
J.C. Doll and B.L. Pruitt
Journal of Micromechanics and Microengineering (2010)

Piezoresistive cantilever performance, part II: optimization
S.-J. Park, **J.C. Doll**, A.J. Rastegar, and B.L. Pruitt
Journal of Microelectromechanical Systems (2010)

Role of surface roughness in hysteresis during adhesive elastic contact
H.K. Kesari, **J.C. Doll**, B.L. Pruitt, W. Cai, A.J. Lew
Philosophical Magazine Letters (2010)

Design optimization of piezoresistive cantilevers for force sensing in air and water
J.C. Doll, S.-J. Park, B.L. Pruitt
Journal of Applied Physics (2009)

Selected archival conference publications (13 total, 6 first-author)

Optimization with process limits and application requirements for force sensors
S.-J. Park, **J.C. Doll**, N. Harjee, B.L. Pruitt
IEEE Sensors Conference, Hawaii, USA (2010)

Piezoresistive cantilevers optimized for kilohertz force sensing in aqueous solutions
J.C. Doll, B.C. Petzold, M.B. Goodman, B.L. Pruitt
Nanomechanical Cantilever Workshop, Banff, Canada (2010)

Piezoresistive cantilever optimization and applications
J.C. Doll, S.-J. Park, N. Harjee, A.J. Rastegar, J.R. Mallon, B.C. Petzold, et al.
Materials Research Society Fall Meeting, Boston, USA (2009)

A high d_{33} CMOS compatible process for aluminum nitride on titanium
J.C. Doll, B.C. Petzold, B. Ninan, R. Mullapudi, B.L. Pruitt
Transducers Conference, Denver, USA (2009)

High frequency force sensing with piezoresistive cantilevers
J.C. Doll, B.C. Petzold, P. Ghale, M.B. Goodman, B.L. Pruitt
Transducers Conference, Denver, USA (2009)

Invited talks

"MEMS for the investigation of mechanotransduction", University of Neuchatel (2008)

"Integration challenges in MEMS smart sensor fabrication", Sensors in Design, Design West (2012)