

# Curriculum Vitae

## Chad B. O'Neal, Ph.D., P.E.

Max Watson Sr. Endowed Professor of Mechanical Engineering  
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### Research and Teaching Goals

I am pursuing research in developing advanced silicon technologies for novel applications in emerging market segments where innovative engineering creates new product concepts. Examples include next generation ICs through novel materials, processing, and electromagnetic theory, "Energy ICs" that store energy utilizing MEMS devices from energy scavenging, replacing and/or improving batteries and other portable energy supplies. This is coupled with advanced packaging technologies such as wafer level packaging and bonding. Another important focus area is developing antitamper technologies to prevent reverse engineering of critical technologies. My previous work has been in the areas of micro and nano system (IC, optoelectronic, MEMS, nanotechnology) design, fabrication, and packaging at the University of Arkansas, Sandia National Laboratories, and SYSCONN Corporation. My teaching interests include solid mechanics, machine design and kinematic analysis, and micro/nanotechnology.

### Education

Ph.D., Microelectronics-Photonics, University of Arkansas, May 2004.  
Recognized as one of ten outstanding students at the University of Arkansas in Chancellor's State of the University Address, 2004.  
Certificate of Electronics Manufacturing, College of Engineering, University of Arkansas, February 2001.  
MSME, University of Arkansas, Fayetteville, December 2000.  
BSME, University of Arkansas, Fayetteville, August 1998.  
Chancellor's list and Dean's list, University of Arkansas, College of Engineering.

### Academic Experience

**Louisiana Tech University**, May 2004-Present, Associate Professor of Mechanical and Nanosystems Engineering and The Institute for Micromanufacturing, Assistant Professor (May 2004-Aug. 2010), Max Watson Sr. Endowed Professor of Mechanical Engineering (Sept. 2007-Present). Developing research programs on advanced microenergy devices, acoustic sensors, wafer level packaging/bonding, and graphene synthesis using silicon processes such as MEMS, micromachining, packaging, and integrated circuit process technologies. Teaching undergraduate courses in the area of engineering materials, mechanical systems design and analysis, and graduate courses in nanotechnology principles. **Co-inventor on six US patents currently issued or pending. Over 38 technical publications in professional journals and conference proceedings.**

**University of Arkansas**, Jan.-May 2003, Senior Teaching Assistant, Instructor for Mechanics of Materials, Mechanical Engineering Dept., Solo-taught class of 52 undergraduate students, developed class notes, homework, quizzes, and exams. Supervised graduate teaching assistant for the course. Design, fabrication, and testing of a MEMS-based nanodrill targeting

300 nm diameter vias in MBE grown III-V semiconductor films for interconnection of quantum optical nanosystems (2000-Present). A study of the effects of packaging induced stress on the reliability of MEMS devices using Sandia MEMS Microengine as a test vehicle (HiDEC 1998-2000). Parameter studies of friction stir welding of low-density, high lithium content aluminum plates for next generation aeronautical applications (1997-1998).

## Industrial Research Experience

**SYSCONN Corporation**, Dec. 1999-May 2004, President/CEO, Directed and participated in R&D of Microsystems design and packaging. Principal investigator for NSF Phase I SBIR award on laser bonding of silicon wafers, 2003 (\$99,999). Designed and fabricated MEMS based signal acquisition system for miniature satellite communications system, 2002 (\$75,000). Developed and prototyped wafer-level VCSEL package targeting 10GB/s data rate, 2002 (\$33,400)

**Sandia National Laboratories**, May-Aug. 1999, Engineering Intern, Reliability Physics Department, developed and performed tests crucial for determining the operational and non-operational reliability, as well as investigation of the key parameters affecting the reliability of packaged Sandia MEMS microengine actuators.

**CTS Corporation**, Summers 1996 and 1997, Engineering Intern: Development of touch sensitive variable resistors for control systems, design of new automated production equipment, CAD design of electromechanical components, operational testing of devices, and production engineering.

## Organizational Memberships

Registered Professional Engineer, Louisiana #33234.

Member Order of the Engineer, 2008-Present.

Member International Microelectronics and Packaging Society (IMAPS) 1998-Present.

Member American Society of Mechanical Engineering (ASME) 1994-Present.

Member Institute of Electrical and Electronic Engineers (IEEE)/CPMT, 2002-Present.

Member National Society of Professional Engineers, (NSPE), 1998-Present.

Faculty Advisor of Society of Automotive Engineers (SAE), 2005-Present.

## Technical Skills

MEMS and IC fabrication and packaging techniques, (photolithography, PECVD, sputtering, RIE, evaporation, wafer-scale packaging, laser and anodic bonding, etc.) Analytical tools (SEM, EDX, XRD, AFM, nanoindentation.) Experienced in MEMS design and layout using AutoCad, Sandia Summit MEMS design tools, etc. and in designing custom tooling and equipment. Finite element modeling using C++ and ANSYS. Software skills: AutoCAD, Microstation, SolidWorks, C++, Visual Basic, PLC, CNC, ANSYS, SAS, MathCAD, and data acquisition.

## Selected Publications

### Patents (4 issued, 2 pending)

US patent #7,612,329, *Apparatus and Method for Free Space Optical Communications Beam Steering without Gimbals*, C. H. Chalfant III, F.J. Orlando, J.T. Gregory, C.B. O'Neal.

US patent #7,612,317, *Beam Steering for Optical Target Identification and Tracking without Gimbals or Scanning Mirrors*, C. H. Chalfant III, F.J. Orlando, J.T. Gregory, C.B. O'Neal, T.L. Tidwell.

US Patent #7,224,508, *MEMS-Based Optical Communications Beam Steering Apparatus*, C. H. Chalfant III, F.J. Orlando, J.T. Gregory, C.B. O'Neal.

US Patent #7,049,175, *Method of Packaging RF MEMS*, L.W. Schaper, A.P. Malshe, C.B. O'Neal, PCT filed 11/06/2002.

*Apparatus & Method for Nanoscale and Microscale Mechanical Machining and Processing*, A.P. Malshe, C.B. O'Neal, US patent pending 01/03/2002, PCT filed 08/25/2003.

*Miniature Sealed Cavity Optical Package*, R.B. Foster, A.P. Malshe, C.B. O'Neal, US patent pending 01/24/2003.

### **Journal Publications**

J. Soman and C. B. O'Neal, "Investigation on the Effect of Storage Time on Bond Strength Between Plasma Activated Silicon Wafers", *IEEE Sensors*, submitted November 2009.

J. Soman and C. O'Neal, "Fabrication and testing of a PZT strain sensor for soil applications," *IEEE Sensors*, accepted March 2010.

C.B. O'Neal, A.P. Malshe, W.F. Schmidt, et al., "Understanding the effects of die attachment stress on the reliability of a packaged MEMS device", *Journal of Microelectronics and Electronic Packaging*, accepted for publication November 2009.

C.B. O'Neal, A.P. Malshe, "Towards a nanomechanical machining system-on-a-chip for drilling and related machining processes", *Journal of Micromechanics and Microengineering*, submitted August 2009.

C. Easter and C. B. O'Neal, "Characterization of high-pressure XeF<sub>2</sub> vapor-phase silicon etching for MEMS processing," *Journal of Microelectromechanical Systems*, vol. 18, no. 5, October, 2009, pp. 1054-1061.

D. K. Chambers, B. Raut, D. Qi, et al., "The effect of helium plasma etching on polymer-based optoelectronic devices", *Thin Solid Films*, vol. 517, no. 19, pp. 5743-5746, 2009.

A.P. Malshe, C.B. O'Neal, S.B. Singh, W.D. Brown, W.P. Eaton, W.M. Miller, "Challenges in the Packaging of MEMS, *International Journal of Microcircuits and Electronic Packaging*, vol. 22, no. 3, pp. 233-241, 1999.

### **Conferences Publications**

C. B. O'Neal, "The effects of plasma pre-treatment and storage time on silicon fusion bonding," in Reliability, Packaging, Testing, and Characterization of MEMS/MOEMS and Nanodevices IX" Conference, San Francisco, CA, January 23-28, 2010, pp. 7592-12, **(INVITED)**.

J. Soman and C. B. O'Neal, "Investigation on the Effect of Storage Time on Bond Strength Between Plasma Activated Silicon Wafers", in The International Mechanical Engineering Conference and Exposition, November, Orlando, FL, 2009.

C. Easter and C. B. O'Neal, "XeF<sub>2</sub> Etching of Silicon for the Release of Micro-cantilever Based Sensors ", in ASME International Mechanical Engineering Congress and Exposition, November, Boston, MA, 2008.

B. Butcher and C. B. O'Neal, "Fabrication and Characterization of 200nm Piezoelectric PZT Nanowires Via A Template Wetting Procedure", in ASME International Mechanical Engineering Congress and Exposition, November, Boston, MA, 2008.

A. M. Popat and C. B. O'Neal, "Process Optimization for Releasing of MEMS/NEMS Devices and Coating of Anti-stiction SAM," in International Mechanical Engineering Congress and Exposition. Seattle, WA: ASME, 2007.

C. Easter and C. B. O'Neal, "Annealing Procedures and Their Effects on PZT/Nanoparticle Thin Film via a Modified Sol-gel Process," in International Mechanical Engineering Congress and Exposition. Seattle, WA: ASME, 2007.

J. T. Brown, A. M. Popat, C. B. O'Neal, and Y. Xie, "Intermetallic Effects of Electroplated Lead-free Solder Bumps Using a Novel Single Chamber Electroplating Process for Large Diameter

Wafers", in InterPack 2007, July, Vancouver BC, 2007.

B. Raut, D. K. Chambers, C. B. O'Neal, and S. Selmic, "Reactive Ion Etching of Light Emitting MEH-PPV and Conducting PEDOT:PSS Polymer Materials", in ASME International Mechanical Engineering Congress and Exposition (IMECE), November, Chicago, IL, 2006.

V. Patil and C. B. O'Neal, "Adhesive Strength Characterization of CYTOP™: Low Temperature Wafer-Level Packaging", in ASME International Mechanical Engineering Congress and Exposition (IMECE), November, Chicago, IL, 2006.

C. B. O'Neal, A. P. Malshe, and A. Popat, "Fabrication and Testing of Nano Mechanical Machining System on a Chip", in 4th International Symposium on Nanomanufacturing, November, Boston, MA, 2006.

R. Mukherjee and C. B. O'Neal, "Dynamic Modeling and Prototyping for Low Frequency Piezoelectric MEMS Vibration Energy Scavenging: VibES", in ASME International Mechanical Engineering Congress and Exposition (IMECE), November, Chicago, IL, 2006.

C. Easter and C. B. O'Neal, "Design, Actuation, and Control of a Piezo-MEMS Articulating Arm", in ASME International Mechanical Engineering Congress and Exposition (IMECE), November, Chicago, IL, 2006.

W. Jordan, H. Cardenas, and C. B. O'Neal, "Using a materials concept inventory to assess an introductory materials class: Potential and problems", in, Portland, OR, United States, 2005, pp. 15095-15101.

P.V. Bonta, C.B. O'Neal, S. Muthusami, "Micro Fuel Cell Technologies, Advancements, and Challenges", *The 3rd International Conference on Fuel Cell Science, Engineering and Technology*, May 2005.

A. Mohan, C.B. O' Neal, R.B. Foster, A.P. Malshe, "A Wafer-Level Packaging approach for MEMS & Related Microsystems using Selective Laser-Assisted Bonding", *Proceedings of ECTC 2005*.

D. Spencer, A.P. Malshe, R.B. Foster, C.B. O'Neal, "Novel Method for Wafer-Scale Packaging of Opto-electronic Devices:", *IMAPS 2003*, Boston, November 2003.

C.B. O'Neal, N. Joshi, A.P. Malshe, et al, "Geometric Error Assessment and Related Fabrication of a Nanomechanical Drill, "New Developments in Thermal Aspects of Material Removal Processes, Oklahoma State University, June 10-12, 2003, pp. 85-91.

C.B. O'Neal, A.P. Malshe, K. Virwani, W.F. Schmidt, "Design Consideration, Process and Mechanical Modeling, and Tolerance Analysis of a MEMS-based Mechanical Machining System-on-a-Chip (SOAC) for NanoManufacturing", *Proceedings of IMECE 2002: ASME International Mechanical Engineering Congress and Exposition November 17-22, 2002 New Orleans, LA*.

A.P. Malshe and C.B. O'Neal, "Wafer-level and Chip-scale Packaging of MEMS and Related Microsystems", MEMS and Related Microsystems Advanced Technology Workshop, sponsored by IMAPS, Scotts Valley, CA (November 2001).

A.P. Malshe, Y. Tao, C.B. O'Neal, W.D. Brown, S. Singh and M.H. Gordon, "Systematic Development and Testing for Reliable Electronic Packaging of Surface Micromachined MEMS (sm-MEMS) Devices", EPDT-NSF Conference, Fayetteville, AR (September 2001).

A.P. Malshe, C.B. O'Neal, S. Singh, Y. Tao, R. Cragan, and W. D. Brown, "Packaging and integration of MEMS and related microsystems for system-on-a-package (SOP)", *Proceedings of the SPIE 2000 Symposium on Smart Materials and MEMS*, Vol. 4235, pp. 198-208, 2001. (INVITED)

C.B. O'Neal, A.P. Malshe, W.F. Schmidt, M.H. Gordon, R.R. Reynolds, W.D. Brown, W.P. Eaton,

W.M. Miller, "A Study of the Effects of Packaging Induced Stress on the Reliability of the Sandia MEMS Microengine", *InterPack 2001*, July 2001, #15668, Kauai, Hawaii.

A.P. Malshe, S.S. Singh, K. Hankins, J.J. Young, B.S. Park, S.N. Yedave, W.D. Brown, "Effects of Packaging Process Steps on the Functionality of MEMS Devices: Investigation of Electrical Interconnection on Lubricated MEMS", *2000 International Symposium on Microelectronics*, 2000.

C.B. O'Neal, A.P. Malshe, W.F. Schmidt, R.R. Reynolds, M.H. Gordon, and W.D. Brown, Investigation of Effects of Die Attachment on MEMS Functionality: Lessons Learned, *IMAPS Advanced Technology Workshop on Packaging and Integration of MEMS & Related Microsystems*, Orlando, Florida, November 10-12, 2000.

C.B. O'Neal, A.P. Malshe, W.P. Eaton, "Effect of Storage Life and Drive Signals on the Reliability of the Sandia Microengine", MEMS Reliability for Critical Applications, *SPIE Proceedings*, Santa Clara, CA, September 18-20, 2000, Vol.4180 , pp.123-132.

C.B. O'Neal, A.P. Malshe, MEMS Packaging at the University of Arkansas, TEX\_MEMS '99, College Station, TX , August 24, 1999.

C.B. O'Neal, Sandia Microengine Reliability Study, *Sandia Student Symposium*, August 5, 1999.

C.B. O'Neal, A.P. Malshe, S.B. Singh, W.D. Brown, W.P.Eaton, Challenges in the Packaging of MEMS, *Proceedings of the 1999 International Symposium on Advanced Packaging Materials*, Braselton, GA, March 14-17, pp.41-47.

### **Research Grants: (Cumulative Awarded Grand Total >\$4M)**

06/09-06/10, Internal Combustion Engine Research and Development Laboratory Enhancement, LA BOR, \$18,073.

04/09-03/10, Focused Ion Beam Resistant System enhancement, AFRL, \$1,000,000.

06/09-5/11, Volume Protection Using Anti-Tamper Technology Phase II, DOD/MDA, \$1,000,000.

09/09-08/10, Advanced Energy Recovery using Novel micro and Nano Fabrication Processes, DOE/COES, \$96,832.

10/08-09/09, A piezoelectric photovoltaic micropower generation (PPVMG) chip, DOE/COES, \$79,739.

12/08-05/09, Energy Harvester for AT Applications, Army, \$100,000.

08/2009-07/2009, Fabrication of a Probe tip Changer, PI, University of Florida, \$5,547.

03/2008-9/2008, Volume Protection Using Anti-Tamper Technology Phase I, DOD/MDA, \$100,000.

06/2007-06/2008, Enhancement of Microsystems Engineering Labs with a XeF<sub>2</sub> Release Etch Station, PI, LA Board of Regents, \$67,000.

06/2007-06/2008, Enhancement of Micro/Nanotechnology Education with Hands-on Scanning Electron Microscopy, co-PI, LA Board of Regents, \$60,630.

05/2007-04/2008, Wafer Bonder for Device Packaging Applications, PI, DOD DURIP, Army, \$160,825.

04/2007-08/2009, Low-profile Multimode Sensors, PI, SBIR Phase II with Radiance Technologies, Inc., AFRL Sensors Directorate, FA8650-07-C-8102, \$750,000.

04/2006-09/2006, Low-profile Multimode Sensors, PI, SBIR Phase I with Radiance Technologies, Inc., AFRL Sensors Directorate, \$100,000.

03/2006-07/2006, Reflow Study of Solder Bumps for Wafer-level Packaging of 200 mm+ Wafers, PI, Surfact Technologies, Inc, \$3,500.

02/2006-06/2006, Evaluation of Electroactive Polymers as Strain-gauges for Small Displacements, Army Corps of Engineers, Waterways Experiment Station, \$25,994.

03/2006-05/2007, Fabrication of a Semi-automatic MEMS Release Station, PI, Space Photonics, Inc. \$4,270.

08/2005-07/2008, Acquisition of a Field Emission Scanning Electron Microscope for Nanotechnology Research, Training, and Education, co-PI, NSF MRI- #0520863, \$524,875.

02/2005-05/2006, Nanotechnology in Microscale Fuel Cells (IfM Internal Grant), Phase I and II and Development of Encapsulated Organic Optoelectronic Technology (IfM Internal Grant), Phase I and II, DARPA and NAVY SPAWAR SC, N66001-05-1-8903, \$105,722.

06/2003-03/2004, Laser-Assisted Bonding for Wafer-level Packaging of MEMS and Related Microsystems, Phase I, NSF-DMII-0320326, \$99,999.

### **Graduated Students**

One PhD and four MS students to date, three PhD and four MS students pending in the future.