

Garrett D. Cole

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Objective To obtain a research position focusing on the design, fabrication, and characterization of advanced optical microsystems.

Citizenship United States

Graduate Education **University of California, Santa Barbara** Santa Barbara, CA
Ph.D., Materials Science and Engineering September 2001-October 2005
Specialization: Electronic and Photonic Materials

- Advisors: Profs. N.C. MacDonald and J.E. Bowers
- NSF IGERT Fellowship recipient
- GPA: 4.00

Thesis Topic **“MEMS-Tunable Vertical-Cavity Semiconductor Optical Amplifiers”**

- Developed and demonstrated the first widely tunable vertical-cavity SOA
- Designed and fabricated arrays of electrostatically tunable Fabry-Pérot interferometers in MBE grown AlGaAs
- Utilized III-V direct wafer bonding to combine the long-wavelength AlInGaAs/InP multi-quantum well active region with AlGaAs/GaAs DBRs
- Conducted fiber-optic testing of the MEMS tunable amplifier, including the signal gain, saturation, noise figure, and wavelength tuning response
- Characterized the mechanical properties of the MEMS actuator at atmosphere and in vacuum; including the mechanical damping, quality factor, step response, and linear and nonlinear frequency response
- Developed a comprehensive analytical model to describe the characteristics of the tunable VC SOA, using both a Fabry-Pérot and rate equation approach

Undergraduate Education **California Polytechnic State University** San Luis Obispo, CA
Bachelor of Science, Materials Engineering September 1997-June 2001

- Major GPA: 3.97

Undergraduate Thesis **“Design and Testing of a Thick Film Piezoelectric Strain Transducer”**

- Fabricated a thick film strain sensor based on a PZT/polymer composite
- Investigated effects of polymer matrix material on dynamic output of device

Technical Skills MEMS, III-V, and Si processing techniques

- Optical lithography to 10 mask levels
- Deposition techniques including thermal oxidation, thermal and e-beam evaporation, PECVD and ICPECVD
- AlInGaAs/GaAs wet and dry etching
- InGaAsP/InP wet and dry etching
- Ohmic contacts to III-Vs
- Si deep etching, SiO₂ etching
- Wet and dry release of MEMS
- Optical and Electron Microscopy
- Focused Ion Beam (FIB) milling
- X-Ray Diffraction

MEMS device testing

- Optical interferometry
- Laser Doppler vibrometry
- Micro/macro stress measurement

Optical and Electronic device testing

- Vertical cavity lasers and amplifiers
- I-V diode properties
- Fiber optic testing

Software Expertise:

- Mathematica
- Solidworks
- AutoCad
- L-edit and LinkCad
- Vertical – optical transmission matrix
- Coulomb electrostatic modeling
- HTML, Dreamweaver, Go Live!

Manufacturing Experience:

- CNC and manual mills and lathes
- Grinding, deburring and inspection
- MIG, TIG and stick welding
- Automotive repair

Experience **NASA Ames Research Center** Moffett Field, CA
Intern - Flight and Guidance Simulation Laboratory June 2000- September 2000

- Designed and tested components for hydraulic feedback system of VMS
- Implemented design software transition from AutoCad to Solidworks
- Designed a position adjustment mechanism for dynamic seat applications

**Experience
continued**

Design Machining

Campbell, CA

Machinist Assistant

June 1997- September 1997

- Operated manual and CNC vertical mills, interpreted engineering drawings
- Performed dimensional analysis of parts, deburring of final product
- Experience gained in drafting and programming

Activities

MEMS group Webmaster, UCSB

August 2001-Present

- <http://www.engr.ucsb.edu/~memsucs/>

IEEE Lasers and Electro-Optics Society

May 2005-Present

- Student Member

Optical Society of America

January 2004-Present

- Student Member

Tau Beta Pi

January 2000-Present

- Engineering Honor Society Member

Alpha Sigma Mu

September 2000-Present

- Materials Engineering Honor Society Member

Society of Automotive Engineers

September 1997-Present

- Formula Racing Team Participant Sep. '99-June '01

Price is Right Contestant

November 16, 1999

- Won a gun safe, bowling ball set, cappuccino machine, and washer/dryer

**Publications
and
Presentations**

Journal Papers

- "Widely tunable bottom-emitting vertical-cavity SOAs," **G.D. Cole**, E.S. Bjorlin, C.S. Wang, N.C. MacDonald, J.E. Bowers, accepted for publication in *IEEE Photonics Technology Letters*.
- "MEMS-tunable vertical-cavity SOAs," **G.D. Cole**, E.S. Bjorlin, Q. Chen, C.-Y. Chan, S. Wu, C.S. Wang, N.C. MacDonald, J.E. Bowers, *IEEE Journal of Quantum Electronics*, vol. 41, no. 3, March 2005, pp. 390-407.
- "First demonstration of a MEMS tunable vertical-cavity SOA," Q. Chen, **G.D. Cole**, E.S. Bjorlin, T. Kimura, S. Wu, C.S. Wang, N.C. MacDonald, J.E. Bowers, *IEEE Photonics Technology Letters*, vol. 16, no. 6, June 2004, pp. 1438-1440.

Conference Presentations

- "Tunable Vertical-Cavity SOAs: a unique combination of tunable filtering and optical gain," **G.D. Cole**, *SPIE Optics East, IT103 Optoelectronic Devices: Physics, Fabrication, and Application II*, Boston, MA, 23 - 26 Oct. 2005. (invited)
- "Dynamic characterization of MEMS-tunable vertical-cavity SOAs," **G.D. Cole**, J.E. Bowers, K.L. Turner, N.C. MacDonald, *IEEE/LEOS International Conference on Optical MEMS and Their Applications*, Oulu, Finland, 1 - 4 Aug. 2005.
- "Design and analysis of MEMS tunable vertical-cavity semiconductor optical amplifiers," **G.D. Cole**, E.S. Björlin, Q. Chen, C.-Y. Chan, S. Wu, C.S. Wang, J.E. Bowers, N.C. MacDonald, *Proceedings of the 17th International Conference on InP and Related Materials*, Glasgow, Scotland, UK, 8 - 12 May 2005, Paper TuB-1-4.
- "Wavelength selection in MEMS tunable vertical-cavity SOAs," **G.D. Cole**, Q. Chen, E.S. Björlin, T. Kimura, S. Wu, C.S. Wang, J.E. Bowers, and N.C. Macdonald, in *Proceedings of the 15th International Conference on Optical Amplifiers and their Applications*, OSA Topical Meeting and Exhibit, San Francisco, CA, July 2004.
- "1550-nm vertical-cavity SOAs for optically preamplified high bit rate receivers," T. Kimura, S. Bjorlin, **G.D. Cole**, H.F. Chou, J. Bowers, in *Proceedings of 30th European Conference on Optical Communications*, Stockholm, Sweden, 5-9 Sep. 2004, Paper We4.P.070.

**Publications
and
Presentations
continued**

- "Microelectromechanical tunable long-wavelength vertical-cavity semiconductor optical amplifiers," **G.D. Cole**, Q. Chen, E.S. Björlin, T. Kimura, S. Wu, C.S. Wang, J.E. Bowers, N.C. MacDonald, in *Proceedings of 16th International Conference on InP and Related Materials*, Kagoshima, Japan, 31 May - 4 June 2004, Paper FA2-4, pp. 708-711.

Recent Press

- "R&D Highlights: MEMS enhance SOA tuning range," by Tami Freeman, *FibreSystems Europe/LIGHTWAVE Europe*, December 2004, pp. 5.
- "Light Booster," by Larry Hardesty, *Technology Review*, September 2004, pp.19.
- "MEMS make SOAs tune farther and faster," by Tami Freeman, *FibreSystems Europe/LIGHTWAVE Europe*, August 2004, pp. 7.

Patents

Provisional filing, UC Case 2005-623, "Tunable Optical Amplifying Filter Array"