

# SUDEEP MANDAL

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## EDUCATION:

**Postdoctoral Associate in Mechanical and Aerospace Engineering** Jan, 2010 – June, 2010  
CORNELL UNIVERSITY, College of Engineering, Ithaca, NY

**Ph.D. in Applied and Engineering Physics** Aug, 2005 – Dec, 2009  
CORNELL UNIVERSITY, College of Engineering, Ithaca, NY  
Thesis: “Photonic Crystals for Optofluidic Transport, Trapping and Biosensing”  
Advisor: Prof. David Erickson  
GPA: 4.03/4 (A+=4.3)

**M.S. in Applied and Engineering Physics** May, 2008  
CORNELL UNIVERSITY, College of Engineering, Ithaca, NY

**Bachelor of Technology in Engineering Physics** Aug, 2001 – May, 2005  
INDIAN INSTITUTE OF TECHNOLOGY (IIT) BOMBAY, Mumbai, India

## OTHER AFFILIATIONS:

UNIVERSITY OF REGENSBURG, Molecular Computing Group, Germany May, 2004 – July, 2004

## RESEARCH ACCOMPLISHMENTS:

- **Demonstrated optical transport in a liquid core waveguiding structure for the very first time.** Exploited the unique geometry of photonic crystal fibers to enable liquid core light guiding and demonstrated **optically induced particle transport over tens of centimeters.**
- Designed and patented a novel, evanescently coupled, resonant, one-dimensional photonic crystal architecture for **enabling massively multiplexed biomolecular sensing** with an estimated **mass sensitivity of 63 attograms.**
- Demonstrated **for the first time, the all optical trapping and handling** of dielectric nanoparticles using a planar silicon photonic platform integrated in a microfluidic architecture. These optical traps possess the **highest trapping stiffness demonstrated to date.**
- **100+ citations** with publications in Applied Physics Letters, Optics Express, Lab on a Chip, Nanoletters, Journal of Micro and Nanofluidics and Physical Review B.
- **9 Journal articles, 2 Patent applications, and 14 refereed conference publications** on highly inter-disciplinary research involving the development of silicon photonic based optical architectures for biomolecular sensing and optically induced transport, trapping and handling of nanoparticles.

## ACADEMIC HONORS:

- **Trevor R. Cuykendall Award** – Outstanding Teaching Assistant, 2005-2006.
- **Ranked among the top 0.2 % of a pool of 500,000 candidates** in the Joint Entrance Examination for the Indian Institute of Technology (IIT).

## RESEARCH EXPERIENCE:

### **Nanophotonic Devices for Direct Solar Conversion of CO<sub>2</sub> to Biofuel**

- Design and fabrication of silicon nitride nanophotonic devices for efficient optical excitation of cyanobacteria.
- Developing a microfluidic architecture to enable *in-situ* growth of cyanobacteria on optical waveguides.

### **Localized Heating in Optically Resonant Photonic Devices**

- Numerical modeling of resonant photonic structures to study the thermal effects of strongly localized electromagnetic fields in optically resonant devices with low mode volumes.

### Manipulation of Nanoparticles and Single Biomolecules in Optically Resonant Traps

- Demonstrated optical trapping of dielectric nanoparticles (50-500 nm) in nanoscale optical traps.
- Strongest optical trap demonstrated to date.

### Nanoscale Optical Sensor Arrays for Biomolecular Sensing

- Designed, modeled and fabricated multiplexed, one-dimensional photonic crystal resonators on a silicon microchip.
- Patented novel optical structure for applications in highly sensitive and multiplexable biosensing.
- Collaborated extensively and conducted interdisciplinary research combining nano-photonics, micro and nanofluidics, and bio-chemistry

### Optofluidic Transport in Liquid Core Waveguiding Structures

- Demonstrated optically induced particle transport in liquid-core waveguiding structures for the first time
- Patented the application of this architecture towards extremely size sensitive Optical Chromatography

### PROFESSIONAL SKILLS:

- Silicon nanophotonic device fabrication and testing, optical prototype development, fiber optics and sensitive optical detections
- Micro and Nano-fluidics. DNA, protein and antibody-antigen surface functionalization techniques
- Micro and Nanofabrication involving photolithography, electron-beam lithography, reactive-ion-etching and thin-film processing
- Electromagnetic Finite Difference Time Domain (FDTD) and Finite Element Method (FEM) simulations
- LABVIEW and data acquisition systems
- Programming Languages: C, MATLAB
- Engineering Software: COMSOL Multiphysics, Lumerical FDTD, Mathematica, L-Edit

### PATENTS:

1. Erickson, D., **Mandal, S.**, “Nanoscale Optofluidic Devices for Biomolecular Detection” Publication No: WO/2009/029957, Filed on September 2, 2008.
2. Erickson, D., **Mandal, S.**, “Optically driven separations in photonic crystal fibers” Application No: 12143952, Filed on June 23, 2008.

**PUBLICATIONS:** Manuscripts and References available at <http://www.sudeepmandal.com/publications>

### Articles published in refereed journals

1. Serey, X., **Mandal, S.**, Erickson, D., “Numerical Analysis of Silicon Photonic Crystal Resonator Nanotweezers” *Submitted* (2009)
2. **Mandal, S.**, Serey, X., Erickson, D., “Nanomanipulation using Silicon Photonic Crystal Resonators” *Nanoletters* **10**, 99-104 (2009). [[pdf](#)] (**Research Highlight in Lab on a Chip** [[pdf](#)])
3. **Mandal, S.**, Goddard, J, Erickson, D., “A Multiplexed Optofluidic Biomolecular Sensor for Low Mass Detection” *Lab on a Chip*, **9**, 2924-2932 (2009). [[pdf](#)]
4. Goddard, J., **Mandal, S.**, Nugen, S., Baemner, A., Erickson, D. “Biopatterning for label-free detection” *Colloids and Surfaces B* (Accepted 2009).
5. **Mandal, S.**, Erickson, D., “Nanoscale Optofluidic Sensor Arrays” *Optics Express*, **16**, 1623-1631 (2008). [[pdf](#)]
6. Erickson, D., **Mandal, S.**, Cordovez, B., Yang, A., “Nanobiosensors: Optofluidic, electrical and mechanical approaches to biomolecular detection at the nanoscale.” *Journal of Microfluidics and Nanofluidics*, **4**, 33-52 (2008). [[pdf](#)]
7. **Mandal, S.**, Erickson D., “Optofluidic Transport in Liquid Core Waveguiding Structures” *Applied Physics Letters*, **90**, 184103 (2007). [[pdf](#)]

8. Gutierrez, R., **Mandal, S.**, Cuniberti, G., “Dissipative effects in the electronic transport through DNA molecular wires” *Physical Review B*, 71, 235116 (2005). [\[pdf\]](#)
9. Gutierrez, R., **Mandal, S.**, Cuniberti, G., “Quantum transport through a DNA wire in a dissipative environment” *Nanoletters*, 5, 1093 (2005). [\[pdf\]](#)

#### Other refereed technical publications

10. **Mandal, S.**, Erickson, D., “Optofluidics: Applications” in Encyclopedia of Microfluidics and Nanofluidics. Springer (2006).
11. Goddard, J., **Mandal, S.**, Erickson, D., “Optically Resonant Nanophotonic Devices for Label-Free Biomolecular Detection” in Innovative Photonic Structures for Bio/Chemical Detection (X. Fan Ed.) Springer (2008)

#### Selected Conference Publications:

12. **Mandal, S.**, Goddard, J., Serey, X., Erickson, D., “Nanoscale Optofluidic Sensor Arrays for Multiplexed Label Free Biosensing and Biomolecular Trapping” *Micro-Total Analysis Systems* ( $\mu$ TAS), Korea, Nov. 2009.
13. **Mandal, S.**, Goddard, J., Erickson, D., “Optofluidic Sensor Arrays for Biomolecular Detections” *Conference on Lasers and Electro-Optics (CLEO) – Symposium on Optofluidics*, Baltimore, MD, May 2009.
14. **Mandal, S.**, Goddard, J., Erickson, D., “Nanoscale Optofluidic Sensor Arrays for Dengue Virus Detection” IEEE/LEOS Summer Topical on Optofluidics, Acapulco, Mexico, July 2008.
15. Goddard, J.M., **Mandal, S.**, Erickson, D., "Targeted Patterning of Nucleic Acid Probes on Optical Nanostructures" *Micro-Total Analysis Systems* ( $\mu$ TAS), San Diego, Oct. 2008.
16. **Mandal, S.**, Goddard, J., Erickson, D., “Nanoscale Optofluidic Sensor Arrays for Dengue Virus Detection” *Conference on Lasers and Electro-Optics (CLEO)*, San Jose, May 2008.
17. **Mandal, S.**, Goddard, J., Erickson, D., “Biomolecular Detection using Nanoscale Optofluidic Sensor Arrays” *IEEE MEMS*, Tucson, Jan. 2008.
18. Yang, A., **Mandal, S.**, Erickson, D., “Optofluidic Transport – Optical Waveguides as Microfluidic “Train Tracks”” *ASME International Mechanical Engineering Congress and Exposition*, Seattle, Nov. 2007.
19. **Mandal, S.**, Akhmechet, R., Chen, L., Nugen, S., Baeumner, A., Erickson, D. “Nanoscale optofluidic sensor arrays for Dengue virus detection” *SPIE Optics and Photonics*, Section on Optofluidics, San Diego, August 2007.
20. **Mandal, S.**, Erickson, D., “Optofluidic Transport in Liquid Core Photonic Crystal Fibers” *Conference on Lasers and Electro-Optics (CLEO)*, Baltimore, May 2007.
21. Yang, A., **Mandal, S.**, Erickson, D., “Micro and Nanofluidic Transport Using Advanced Photonic Devices.” *ASME International Mechanical Engineering Congress and Exposition*, Chicago, Nov. 2006.
22. Erickson, D., **Mandal, S.**, Yang, A., “Micro- and Nanofluid Dynamics in Optofluidic and Nanophotonic Devices” Optical Society of America, *Frontiers in Optics*, Rochester, NY, October 2006.
23. **Mandal, S.**, Erickson, D., "Optical Chromatography in Hollow Core Photonic Crystal Fibers" *Micro-Total Analysis Systems* ( $\mu$ TAS) Tokyo, Japan, Oct. 2006.
24. **Mandal, S.**, Yang, A.H.J., Erickson, D., “Optofluidically driven micro- and nanofluidic devices” *SPIE Optics and Photonics Conference*, August, 2006.
25. **Mandal, S.**, Erickson, D., “Particle Transport in Liquid Core Photonic Crystal Fibers” *IEEE/LEOS Summer Topical on Optofluidics*, Quebec City, July 2006.