

Kitty Kumar

EDUCATION

Harvard University

- **Postdoctoral Fellowship**

Jan 2014 – present

Advisors: Professors Don Ingber, Joanna Aizenberg and Katia Bertoldi

University of Toronto

- **Postdoctoral Fellowship**

Aug – Dec 2013

Advisors: Professors Jun Nogami, Nazir P. Kherani and Peter Herman

University of Toronto

- PhD, Materials Science and Engineering

Aug 2013

Advisors: Professors Jun Nogami, Nazir P. Kherani and Peter Herman

Memorial University of Newfoundland

- MSc, Dept. of Physics and Physical Oceanography

Dec 2008

Advisors: Professors Anand Yethiraj and Kris Poduska

Panjab University

- MSc (Honors in Optics and Electronics), Dept. of Physics

June 2006

Advisors: Professor S.K. Tripathi

Govt. College for Women, Punjab, India

- BSc, Engineering Science Stream

June 2004

TEACHING EXPERIENCE

Massachusetts College of Arts and Design

Sept 2014 – Present

Visiting Lecturer; Science courses: Biomimetics, and Bacteria Assassins (Molecular Biology)

University of Toronto

Course Instructor; Materials Physics

Spring 2013

Teaching Assistant; Introduction to Materials and Chemistry

Jan 2009 – Apr 2013

Teaching Assistant; Phase Transformations

Sept 2009 – Dec. 2012

Memorial University of Newfoundland

Jan 2007 – Dec 2008

Teaching Assistant; Introduction to Physics Laboratory

RESEARCH EXPERIENCE

Wyss Institute of Biologically Inspired Engineering

Cambridge, MA

Postdoctoral Researcher

Research Projects

- *Biologically Inspired Hybrid Gripper for Soft Robotics*
 - Design optimization and fabrication of individual components of the hybrid gripper via finite element analysis, mechanical testing, and assembly of robotic gripper.
- *Biologically Inspired Fast Response Creased Pneumatic Soft Actuators*
 - Design optimization of actuators to achieve a variety of motions in short time (milliseconds) with low actuation pressure using finite element analysis
 - Develop single-step fabrication method
 - Pneumatic actuation testing

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- *Biologically Inspired Micro-millifluidic Technology for Thermoregulation*
 - Fabrication of millifluidic network in plastics and elastomers
 - Experimental optimization of the network design for fastest feasible cooling rate by studying rate of heat transfer in a variety of network designs

University of Toronto

Toronto, Canada
Postdoctoral Fellow
Research Project

- *Fabrication of Optical and Lab-on-chip/film devices by Laser Quantum Etching*

University of Toronto

Toronto, Canada
Research Project

- *Inverted Pyramidal Laser Texturing of Silicon for High Efficiency Solar Cells*
 - Designed and developed a new resist-less laser writing method for patterning dielectric thin films (etch mask) for selective chemical etching of silicon for photovoltaics
 - Nano and micro- patterning of silicon with electron beam and photolithography
 - Random chemical texturing of silicon
 - Optical wave simulations to optimized texture parameters for high efficiency
 - Effect of growth temperature of amorphous silicon on the crystallinity of silicon by transmission electron microscopy

Memorial University of Newfoundland

Newfoundland and Labrador, Canada
Graduate Research Assistant
Research Projects

- *Patterned Cobalt for High Density Hard Drive by Electro-deposition Through Colloidal Templates*
 - Patterning Cobalt by electrodeposition through spin coated and dip coated colloidal templates
 - Designed a table-top laser diffraction system with rotating stage to study the structure of spin coated colloidal templates
 - Structure analysis of colloidal templates with AFM and SEM
 - Magnetic characterization of patterned cobalt using magnetic force microscopy

AWARDS AND HONORS

2010-2013	Hatch Scholarship in Sustainable Energy Research
2012	Research Excellence Award; Advanced Photovoltaic Devices (APD) Research Group
2012	Best Poster Award for First Author Paper at 38 th IEEE Photovoltaic (<i>International</i>) Conference
2012	Best Research Talk Award at Next Generation Solar (<i>National</i>) Conference
2012	McAllister Graduate Fellowship
2011	Research Mentorship Award; Advanced Photovoltaic Devices (APD) Research Group
2008	SGS Fellowship, Memorial University of Newfoundland
2004	Best Student in Physics Award, Government College for Women

PROPOSAL WRITING

- **ARPA-E DOE Grant** – Lead and written proposal with other group members
- **NSERC Funding Grant** – Written in collaboration with Prof. Herman

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OUTREACH ACTIVITIES

2009-present	Mentored three graduate and seven undergraduate students
2015	Clubes De Mexico - Workshop on Biomimicry, Guanajuato, Mexico
2013	Conference Assistant; 25th International Conference on Amorphous and Nano-crystalline Semiconductors, Toronto
2012-2013	Lead Organizer of Lecture Series for PV Innovation Network, Canada
2013	Completed Prospective Professor Training Program, University of Toronto
2012	PV Innovation Network Representative, 27 th European Photovoltaic Specialist Conference, Paris, France
2012	Conference Graduate Assistant; 38 th IEEE Photovoltaic Specialists Conference organization committee, Tampa, Florida
2011	Completed Teaching Assistantship Training Program, University of Toronto

SOCIETY AFFILIATIONS

- PV Innovation Network, Canada; Member
- Materials Research Society; Member

MANUSCRIPTS IN REVIEW OR IN PREPARATION

10. "Biologically Inspired Functionally Graded 3D printed Hybrid Robotic Grippers". Kumar, K.; Liu, J.; Ali, M.; Tolley, M. T.; Weaver, J.; Aizenberg, J.; Ingber, E. D.; Bertoldi; K.
9. "Inverted Pyramidal Gratings for High Efficiency Ultra-Thin Silicon Photovoltaics". Kumar, K.; Khalatpour, A; Nogami, J; Kherani, N. P.
8. "Corrugated Design for Fast Response and Low Input Pneumatic Actuators". Kumar, K.; Boatti, E.; Dorancy, J. F.; Aizenberg, J.; Ingber, E. D.; Bertoldi; K.
7. "Biologically inspired Millifluidic Design for Uniform Cooling on Large-area Windows and Photovoltaics". Kumar, K.; Hancock, M.; Doherty, T.; Aizenberg, J.; Ingber, E. D.; Bertoldi; K.

PUBLISHED JOURNAL ARTICLES

6. "Interferometric Femtosecond Laser Processing for Nanostructuring Inside Thin Film". Ho, S.; Kumar, K.; Lee, K. K.; Li, J.; & Herman, P. R. (2014). *Advanced Optical Technologies*, 3(5-6), 499-513. DOI: [10.1515/aot-2014-0047](https://doi.org/10.1515/aot-2014-0047)
5. "Quantized structuring of transparent films with femtosecond laser interference". Kumar, K.; Lee, K. K.; Li, J.; Nogami, J.; Kherani, N. P., & Herman, P. R. (2014). *Light: Science & Applications*, 3(3), e157. DOI:[10.1038/lsa.2014.38](https://doi.org/10.1038/lsa.2014.38)
4. "Ultrafast laser direct hard-mask writing for high efficiency c-Si texture designs". Kumar, K.; Lee, K. K.; Nogami, J.; Herman, P. R.; & Kherani, N. P. (2013). *EPJ Photovoltaics*, 4, 45101. DOI: <http://dx.doi.org/10.1051/epjpv/2013015>
3. "Femtosecond laser direct hard mask writing for selective facile micron-scale inverted-pyramid patterning of silicon". Kumar, K.; Lee, K. K. C.; Herman, P. R.; Nogami, J.; & Kherani, N. P. (2012). *Applied Physics Letters*, 101(22), 222106. DOI: <http://dx.doi.org/10.1063/1.4768689>
2. "Ultrafast laser direct hard-mask writing for high performance inverted-pyramidal texturing of silicon". Kumar, K.; Lee, K. C.; Nogami, J.; Herman, P. R.; & Kherani, N. P. (2012, June). In *2012 38th IEEE*

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Photovoltaic Specialists Conference (PVSC), (pp. 002182-002185). IEEE. DOI: [10.1109/PVSC.2012.6318029](http://dx.doi.org/10.1109/PVSC.2012.6318029)

1. “Orientationally correlated colloidal polycrystals without long-range positional order”. Arcos, C.; Kumar, K.; González-Viñas, W., Sirera, R.; Poduska, K. M., & Yethiraj, A. (2008). *Physical Review E*, 77(5), 050402. DOI: <http://dx.doi.org/10.1103/PhysRevE.77.050402>

PROVISIONAL PATENTS (Full Applications in Process)

2. “3D Printed Hybrid Robot”. Kumar, K.; Tolley, M.; Aizenberg, J.; Ingber, E. D.; Bertoldi, K.; Weaver, J.; Barlett, N.; Wood, R.

1. “Interferometric Laser Processing”. Kumar, K.; Lee, K. K.; Li, J.; Nogami, J. & Herman, P. R.

PRESENTATIONS

- “Bioinspired 3D-Printed Hybrid Grippers”. Kumar, K.; Liu, J.; Christianson, C.; Ali, M.; Tolley T. M.; Aizenberg, J.; Ingber, D.; Weaver, J.; Bertoldi, K. *Oral Presentation at MRS Spring Meeting, Phoenix, March 2016.*
- “High efficiency inverted pyramidal texture on silicon using ultrafast laser direct hard-mask writing”. Kumar, K.; Lee, K. K.; Nogami, J.; Kherani, N. P., & Herman, P. R. *Oral Presentation at Photonics North (National), Montreal, June 2012.*
- “Ultrafast laser direct hard-mask writing for high performance inverted-pyramidal texturing of silicon”. Kumar, K.; Lee, K. K.; Nogami, J.; Kherani, N. P., & Herman, P. R. *Poster Presentation at 38th IEEE Photovoltaics Specialist Conference (International), Austin, June 2012.*
- “Ultrafast laser direct hard-mask writing for high efficiency texture designs”. Kumar, K.; Lee, K. K.; Nogami, J.; Kherani, N. P., & Herman, P. R. *Poster Presentation at Photovoltaic Technical conference (International), France, June 2012.*
- “Laser mask writing for high performance inverted-pyramidal texturing of silicon”. Kumar, K.; Lee, K. K.; Nogami, J.; Kherani, N. P., & Herman, P. R. *Oral Presentation at Next Generation Solar Conference (National), Montreal, May 2012.*
- “Anti-reflection monocrystalline silicon using a laser written mask and chemical etching”. Kumar, K.; Lee, K. K.; Nogami, J.; Kherani, N. P., & Herman, P. R. *Poster Presentation at 2nd International Conference on Crystalline Silicon Photovoltaics, Belgium, April 2012.*
- “High efficiency texturing by ultrafast direct hard-mask writing”. Kumar, K.; Lee, K. K.; Nogami, J.; Kherani, N. P., & Herman, P. R. *UT2 Sustainable Energy Workshop, University of Tokyo, 2012.*
- “Antireflective texturing of c-Si with femtosecond laser and KOH etching”. Kumar, K.; Lee, K. K.; Nogami, J.; Kherani, N. P., & Herman, P. R. *UT2 Sustainable Energy Workshop, University of Toronto, 2011.*
- “Patterning the future”. Kumar, K.; Poduska, K. M., & Yethiraj, A. *Oral Presentation, Graduate Student Research Colloquia Series, Memorial University of Newfoundland, March 2008.*

INVITED PRESENTATIONS

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- “Ultrafast laser direct mask writing for high efficiency crystalline solar cells”. *Electromagnetics-Photonics Seminars at University of Toronto, 2012*
- “Facile high performance inverted-pyramidal texturing of silicon”. *An Afternoon of Engineering Innovation organized by University of Toronto Engineering Alumni Office, September, 2012.*

LAB SKILLS

<u>Fabrication Techniques</u>	<u>Characterization Techniques</u>
<ul style="list-style-type: none">• Femtosecond Laser Processing• Elastomer Processing (Molding and Casting)• Stereolithography and 3-D printing• Laser Cutting• Cleanroom micro and nano-Photolithography• Electron Beam Lithography (EBPG 5000+)• Chemical Vapor Deposition• Chemical bath deposition• Spincoating• Electrodeposition• Plasma-enhanced Chemical Vapor Deposition• Reactive Ion Etching• Ultra-sonication, Centrifugation, Synthesis of silica colloids, Chemical washing, Chromatography, Chemical analysis, Metallography	<ul style="list-style-type: none">• Mechanical Testing (Instron, Micro-indenter)• X- Ray and laser diffraction• Scanning electron microscopy• Transmission electron microscopy• Confocal microscopy and optical microscopy• Atomic and magnetic force microscopy• Carrier Lifetime Measurements• Thin Film Thickness Measurements• Electrical conductivity measurements• UV-VIS, IR Spectrometry• Infrared Imaging

OTHER SKILLS

- **Drawing and Image Processing** - ImageJ, Solidworks, Photoshop, Illustrator, 3D MAX.
- **Data Processing** - Matlab, IDL, Origin, Igor Pro

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REFERENCES

Prof. Donald E. Ingber

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Boston, MA 02115, USA
Email: ingber@seas.harvard.edu
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Prof. Joanna Aizenberg

John A. Paulson School of Engineering and Applied Sciences, Harvard University
229 Pierce Hall, 29 Oxford Street
Cambridge, MA 02138, USA
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Prof. Jun Nogami

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Prof. Peter Herman

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