

**Prof. Soumitra Satapathi**

PhD, MRSC, MNASI

Assistant Professor ; Département of Physics, IIT Roorkee, Uttarakhand 247667, India

Associated Professor, Center of Nanotechnology, IIT Roorkee

BASE Fellow, Indo-US Science and Technology Forum

Visting Professor, University of Massachusetts Lowell, USA

Visting Professor, Max Planck Institute for Polymer Research, Mainz, Germany

Co-author : Organic Photovoltaic: A green solution for a gray problem

Co-Founder: LabX Scientific Pvt Ltd ([www.labx.co.in](http://www.labx.co.in))

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**Summary**

- Highly adaptable scientist with abilities in myriad of materials science and water remediation
  - Adept on various instrumental techniques on different platforms; able to adapt quickly to changing situations.
  - Extensive research experience internationally and nationally in the diverse areas of Materials Science and Water treatment
  - Strong leadership and networking skills.
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**EDUCATION**

**PhD, Physics and Applied Physics**

University of Massachusetts, Lowell, Massachusetts, USA (2012)

Thesis Title: Optical and optoelectronic properties of organic nanomaterials

**M.S., Physics and Applied Physics**

University of Massachusetts, Lowell, Massachusetts, USA (2010)

Thesis Title: Investigation of two-photon-induced-fluorescence from semiconducting polythiophenes

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**AWARDS**

- Member, Royal Society of Chemistry (MRSC) (2018)
- Member, National Academy of Science (MNASI) (2018)
- Young Scientist Delegate to BRICS meeting held in Hangzhou, China (2017) to represent India's energy Research
- Max Planck Institute Director's Award for Organic Electronics Research (2017)
- Board of Governor Member, Haiti Development Board, USA. (2017-Onwards)
- Bhaskara Advanced Solar Energy Research Award from Indo-US Science and Technology Forum and DST, Govt. of India. (2016)
- Research on "Jamun Solar Cells" is 2<sup>nd</sup> Highest Read Science Article in The Hindu.

- Young Scientist Award from DST, Govt. of India. (2015)
  - DST Nanomission Postdoctoral Research Award, Govt. of India (2013)
  - University of Massachusetts endowed scholarship, University of Massachusetts, Lowell, MA, USA (2012)
  - Sukant Tripathy Summer Fellowship, University of Massachusetts, Lowell, MA, USA (2012)
  - Graduate Research Scholar Award, University of Massachusetts, Lowell, MA, USA (2012)
  - Outstanding Graduate Student of the Physics Department award, UMASS, Lowell, MA, USA, (2012)
  - Outstanding Graduate Student of the Year award, University of Massachusetts Lowell, MA, USA, (2011)
  - Graduate Research Grants Awards, University of Massachusetts, Lowell, MA, USA, (2009)
  - Marquis Who's Who of America for 2011
  - National Talent Search Scholarship (1995-1996)
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### *Research Experience*

#### ■ **Assistant Professor, Physics Department, IIT Roorkee, Roorkee, Uttarakhand, India September 2014- Onwards**

- Development of low cost Arsenic and Fluoride detection system for domestic and community applications.
- Development of low cost waste water remediation technique
- Development of high efficiency and stable perovskite solar cells.
- Morphology optimization and photophysics study in perovskites solar cells.
- Fabrication of single crystal perovskite solar cells.
- Development of organic nanoparticles based high efficiency solar cells.
- Artificial Intelligence Inspired Nanofabrication
- Optical sensor for explosives detection and metal ion sensing.
- 3d printed microfluidics for rapid disease detection.
- Entrepreneurships, tech consultancy in clean energy, low cost biomedical devices and materials science

#### ■ **Postdoctoral Researcher, Biomedical Engineering Department, Tufts University, Medford, USA December 2013-August 2014**

- Optical diagnosis of engineered and diseased tissue; developed breast cancer model for nonlinear optical imaging and image analysis.
- 3dimensional Image analysis
- microrheology using optical tweezer.

#### ■ **DST Postdoctoral Researcher, Indian Association for the Cultivation of Science, Kolkata, India February, 2013 – November 2013**

- Studied time resolved spectroscopy of organic nanomaterials

- Developed a novel Muller Matrix approach for determining optical anisotropy.
- Studied phase separation in organic nanomaterials devices.

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## Key Journal Publications (partial list)

### Journal Publications (>40)

#### Book Chapter:

1. “Organic Photovoltaic: A green solution for a gray problem”, **Soumitra Satapathi**, Uttarakhand Science and Technology Department.
2. “Nanobiophotonics for Cancer Diagnostics”, **Soumitra Satapathi**, Manisha Chatterjee Satapathi, Anirban Mitra, Saugata Hazra, Anubhav Raghav, Manisha Sharma, Somesh Mahapatra, Manish Paul, Springer.

#### Publications:

30. Priya Srivastava, Anukul Prasad Parhi, R Ranjan, **Soumitra Satapathi**, Monojit Bag, “Temperature Assisted Nucleation and Growth to Optimize Perovskite Morphology at Liquid Interface: A Study by Electrochemical Impedance Spectroscopy”, DOI: 10.1021/acsaem.8b00818, **2018**, **ACS Applied Energy Materials**.
29. Payal Taya, Binoy Maiti, V Kumar, Priyodarshi De, **Soumitra Satapathi**, “Design of a novel FRET based fluorescent chemosensor and their application for highly sensitive detection of nitroaromatics”, 255, 3, 2628-2634, **2018**, **Sensors and Actuators B: Chemical**.
28. Jill Wenderott, Anubhav Raghav, Max Shtein, Peter Green, **Soumitra Satapathi**, “Local optoelectronic characterization of solvent annealed lead-free bismuth-based perovskite films”, 34, 26, 7647-7654, **2018**, **Langmuir**.
27. **Soumitra Satapathi**, Vishal Kumar, Mrinmoy Kumar Chini, Rajesh Bera, Krishna Kanta Halder, Amitava Patra, “Highly sensitive detection and removal of mercury ion using a multimodal nanosensor”, 16, 120-126, **2018**, **Nano-Structures & Nano-Objects**.
26. “Controllable Bulk Heterojunction Morphology by Self-Assembly of Oppositely Charged Nanoparticles”, Kulveer Singh, Prateek K. Jha, and **Soumitra Satapathi**, 121, 16045–16050, **2017**, **Journal of Physical Chemistry C**.
25. “Functionalized Nano-graphene Oxide as Multi-modal Clinic for Effective Drug Delivery”, Somesh Mohapatra, Rutusmita Mishra, Manisha Chatterjee, Partha Roy and **Soumitra Satapathi**, 10, 4, 3768-3771, **2017**, **International Journal of Pharmaceutical Sciences and Nanotechnology**.
24. “Controlling morphology of CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub> perovskite film by dual solvent elimination method”, Anubhav Raghav, Shivam Singh, Shailendra Kumar Sharma, Kabra Dinesh, Monojit Bag, **Soumitra Satapathi**, 12, 106–112, **2017**, **Nano-Structures & Nano-Objects**.
23. “Utilization of Naturally Occurring Dyes as Sensitizers in Dye Sensitized Solar Cells.” Nipun Sawhney, **Soumitra Satapathi\***, 7, 2, 539-544, **2017**, **IEEE Photovoltaics**. [Featured in Nature Asia, PTI, Quartz, BBC, Chemical Today]
22. “Effect of side groups on two-photon-absorption of soluble polythiophenes”, **Soumitra Satapathi**, Lian Li, Robinson Anandakathir, Lynne Samuleson, and Jayant Kumar, 50, 7, 375–380, **2017**, **Spectroscopy Letters**.

21. "Effect of functional groups on sensitization of dye-sensitized solar cells (DSSCs) using free base Porphyrins", Nivedita Choudhary, Nipun Sahwney, Anubhav Raghav, M. Sankar, **Soumitra Satapathi**, 21, 222, 2017, **Journal of Porphyrins and Phthalocyanines**.
20. "Reusable graphene oxide nanofibers for enhanced photocatalytic activity: a detailed mechanistic study", Shailendra Kumar Sharma, Shivali Sokhi, Chandrajit Balomajumder, **Soumitra Satapathi**, 52, 9, 5390–5403, 2017, **Journal of Materials Science**.
19. "Systematic Investigation and in vitro Biocompatibility Studies on Implantable Magnetic Nanocomposites for Hyperthermia Treatment of Osteoarthritic Knee Joint", Somesh Mohapatra, Rutusmita Mishra, Partha Roy, K.L.Yadav, **Soumitra Satapathi**, 52, 9, 9262–9268, 2017, **Journal of Materials Science (JMISC)**.
18. "Graphene-Based 3D Xerogel as Adsorbent for Removal of Heavy Metal Ions from Industrial Wastewater", Purnendu, **Soumitra Satapathi**, 5, 2, 96-102, 2017, **Journal of Renewable Materials**.
17. "Functionalized Nano-graphene Oxide as Multi-modal Clinic for Effective Drug Delivery", Somesh Mohapatra, Rutusmita Mishra, Manisha Chatterjee, Partha Roy and **Soumitra Satapathi**, 10, 4, 3768-3771, 2017, **International Journal of Pharmaceutical Sciences and Nanotechnology**.
16. "Fluorescent Muller matrix analysis of highly scattering turbid media", **Soumitra Satapathi**,\* Jalpa Soni and Nirmalya Ghosh, 104, 131902, 2014, **Applied Physics Letters**.
15. "Synthesis of two-photon active cinnamoyl coumarins for high-contrast imaging of cancer cells and their photophysical characterization", Preeti Yadav, **Soumitra Satapathi**, Meena Kumari, Akanksha Chaturvedi, Lian Li, Lynne A Samuelson, Jayant Kumar, Sunil K Sharma, 280, 39-45, 2014, **Journal of Photochemistry and Photobiology A: Chemistry**.
14. "Two-photon active polymeric nanoparticles for high contrast in vitro imaging", **Soumitra Satapathi**, Anoop K. Pal, Lian Li, Lynne A. Samuelson, Dhimiter Bello and Jayant Kumar, 4, 1116, 2014, **RSC Advances**.
13. "Performance enhancement of dye sensitized solar cells by incorporating graphene nanosheets of various sizes", **Soumitra Satapathi**, Sriya Das, Lian Li, Lynne A Samuelson, Ravi Mosurkal, Micah Green and Jayant Kumar, 314, 638-641, 2014, **Applied Surface Science**.
12. "Photophysical Study of P3HT/NDI Based Hybrid Nanoparticles", **Soumitra Satapathi**, Mijanur Rahaman Molla, Santanu Bhattacharya, Suhrit Ghosh and Amitava Patra, 2014, 68:350, 2014, **European Journal of Physics D**.
11. "Synthesis of Nanoparticles of P3HT and PCBM for Optimizing Morphology in Polymeric Solar Cells", **Soumitra Satapathi**, Hardeep Singh Gill, Lian Li, Lynne Samuleson, Jayant Kumar,\* Ravi Mosurkal, 323, 3–18, 2014, **Applied Surface Science**.
10. "Enhanced sensory response of quaterthiophene bearing 1,2,3-triazole moiety to explosives", **Soumitra Satapathi**, Amarnath Bheemaraju, Dhandapani Venkataraman and Jayant Kumar, 14, 12, 4334 - 4339, 2014, **IEEE Sensors**.
9. "Sensitive detection of nitroaromatics with colloidal conjugated polymer nanoparticles", **Soumitra Satapathi**, Akshay Kokil, B. Harihara Venkataraman, Lian Li, Dhandapani Venkataraman, Jayant Kumar, 13, 2329, 2013, **IEEE Sensor**.
8. "Two-photon active Nile Red loaded fluorescent polystyrene nanoparticles", **Soumitra Satapathi**, Hardeep Singh Gill, Lian Li, Lynne Samuleson and Jayant Kumar, 1, 3, 2013, **Advanced Science Focus**.

7. “Strong two-photon-induced fluorescence from a highly soluble polythiophene”, **Soumitra Satapathi**, Lian Li, Abhishek Kumar, Haibin Huo, Robinson Anandakathir, Mengyan Shen, Lynne Samuelson, Jayant Kumar, 4, 3612, 2011, **Optics Communications**.
6. “Biocatalytic Synthesis of Two-Photon Active Resveratrol Oligomer”, **Soumitra Satapathi**, Sethumadhavan Ravichandran, Ravi Mosurkal, Subhalakshmi Nagarajan, Lian Li, Ramaswamy Nagarajan, Lynne A. Samuelson, Jayant Kumar, 48(12), 1061-1066, 2011, **Journal of Macromolecular Science, Part A: Pure and Applied Chemistry**.
5. “Conjugated Polymer:TiO<sub>2</sub> Nanocomposite Solar Cells Based on P3HT Nanoparticles,” B. Harihara Venkatraman, Akshay Kokil, **Soumitra Satapathi**, Jayant Kumar, Dhandapani Venkataraman, 2011, 1312, mrsf10-1312-ii09-06, **MRS Proceedings**.
4. “Sensory Response and Two-Photon-Fluorescence Study of Regioregular Polythiophene Nanoparticles”, **Soumitra Satapathi**, Lian Li, Robinson Anandakathir, Lynne A. Samuelson, Jayant Kumar, 48(12), 1049-1054, 2011, **Journal of Macromolecular Science, Part A: Pure and Applied Chemistry**.
3. “Oligothiophene nanoparticles for high contrast imaging of cancerous cells”, **Soumitra Satapathi**, Anoop Pal, Amarnath Bheemaraju, Dhandapani Venkataraman and Jayant Kumar,\* **ACS Fall 2012 preprint**.
2. “Synthesis and Characterization of a Thiophene Copolymer for Photovoltaic Application,” **Soumitra Satapathi**, Robinson Anandakathir, Jayant Kumar, 48(12), 1044-1048, 2011, **Journal of Macromolecular Science, Part A: Pure and Applied Chemistry**.
1. “Fabrication of Dye-sensitized Solar Cells and Fluorescence Quenching Study Using Thiophene Based Copolymers”, **Soumitra Satapathi**, Fa-Dong Yan, Robinson Anandakathir, Ke Yang, Lian Li, Ravi Mosurkal, Lynne A Samuelson, Jayant Kumar, 47(12), 1180-1183, 2010, **Journal of Macromolecular Science, Part A: Pure and Applied Chemistry**.

#### **Invited Talk (Significant talk): (>50)**

27. **Soumitra Satapathi**, “Low Cost Technology for Arsenic Removal”, **Invited Lecture, Newton Bhabha International Workshop, Kolkata, 2018**.
26. **Soumitra Satapathi**, “Smart Materials for Energy Harvesting, Optical Sensing and Water Remediation”, **AK-Palberg Seminar Lecture, Max Planck Institute for Polymer Research, Mainz, Germany, 2018**.
25. **Soumitra Satapathi**, “Smart Materials: Capabilities and Applications”, **Invited Lecture, KU Leuven, Belgium, 2018**.
24. **Soumitra Satapathi**, “Organic Nanoparticles for Energy Harvesting, Sensing and Bioimaging: Magic at Nanoscale”, **Invited Talk, International Conference on Nanomaterials and their Applications**, University of Mysore, **2018**.
23. **Soumitra Satapathi**, “Perovskite Revolution”, **Invited Lecture, Department of Physics Colloquium**, University of Hyderabad, Hyderabad, **2017**.
22. **Soumitra Satapathi**, “Nanomaterials for Solar Cells”, **Center of Nanotechnology Excellence Lecture**, Jawaharlal Nehru Technical University, Hyderabad, **2017**.

21. **Soumitra Satapathi**, “Photophysics, Sensing and Bioimaging Study in Polymeric Nanoparticles System”, **Invited Lecture, Newton Bhabha International Workshop, Kolkata, 2017.**
20. **Soumitra Satapathi**, “Photophysical, Sensing and Bioimaging Study in Polymeric Nanoparticle System”, **Invited Lecture, Center for Soft and Nano Research Institute, Bangalore, 2017.**
19. **Soumitra Satapathi**, “Smart Nanomaterials for Drug Delivery”, Nanobioteck, **AIIMS, New Delhi, 2016.**
18. **Soumitra Satapathi**, “Implantable Magnetic Nanocomposite for Hyperthermia Treatment of Osteoarthritic Knee Joint”, **ICBET, Singapore, 2016.**
17. **Soumitra Satapathi**, “Perovskite Solar Cells: Morphology Optimization”, **Invited Lecture, SERIUS, IIT Bombay, 2016.**
16. **Soumitra Satapathi**, “Organic Solar Cells: A Green Solution to a Grey Problem”, **QIP Talk, IIT Roorkee, 2015.**
15. **Soumitra Satapathi**, “Photophysical Study of P3HT/NDI Based Hybrid Nanoparticles International Symposium on Polymer Science and Technology”, **MACRO, Kolkata, 2015.**
14. **Soumitra Satapathi**, ‘Strong Two-Photon-Fluorescence from Semiconducting Polymer Nanoparticles for High Contrast Imaging of Cancerous Cells”, **American Physical Society Fall Meeting, Boston, USA, 2012.**
13. **Soumitra Satapathi**, “Oligothiophene Nanoparticles for High Contrast Imaging of Cancerous Cells”, American Chemical Socety Fall Meeting Philadelphia, USA, 2012.
12. **Soumitra Satapathi**, “Enhancement of Efficiency in Dye Sensitized Solar Cells by Incorporation of Graphene”, **Materials Research Society Fall, Boston, USA, 2011.**
11. **Soumitra Satapathi**, “Enhancement of Efficiency in Dye Sensitized Solar Cells by Incorporation of Graphene”, **Sukant Tripathy Annual Symposium, Lowell, USA, 2011.**
10. **Soumitra Satapathi**, “Enhanced efficiency in dye sensitized solar cells using reduced graphene oxide-TiO<sub>2</sub> nanocomposites”, **American Physical Society Spring Meeting, UMASS Lowell, USA, 2011.**
9. **Soumitra Satapathi**, “Sensitive detection of nitro aromatic explosives using novel polythiophene nanoparticles”, **American Physical Society Fall meeting Texas, USA, 2011.**
8. **Soumitra Satapathi**, “Two-photon-induced Fluorescence Study from Soluble Polythiophenes”, **Material Research Society Fall Meeting, USA, 2010.**
7. **Soumitra Satapathi**, “Thiophene based polymer for organic solar cells, International Conference and Exhibition on Device Packaging”, **Massachusetts, USA, 2010.**
6. **Soumitra Satapathi**, “Detection of Nitro Aromatic Explosives using Pegylated Polythiophene Copolymer”, **Sukant Tripathy Annual Symposium, Lowell, USA, 2010.**
5. **Soumitra Satapathi**, “Detection of Nitro Aromatic Explosives Using Novel Polythiophene Nnaoparticles”, **Sukant Tripathy Annual Symposium, Lowell, USA, 2010.**

4. **Soumitra Satapathi**, “Detection of Nitro-Containing Explosive Materials with Silicon Nanostructures: an Application of Surface Enhanced Raman Scattering”, **American Physical Society New England Meeting**, University of Massachusetts Amherst, USA, **2011**.
3. **Soumitra Satapathi**, “Enhanced Efficiency in Dye Sensitized Solar Cells by Incorporation of Graphene”, **Invited Talk, Canadian American Mexican Meeting, Washington D.C. ,USA, 2011**.
2. **Soumitra Satapathi**, “Biocatalytic Synthesis of Two-Photon Active Resveratrol Oligomer”, **Sukant Tripathy Annual Symposium, Lowell, USA, 2009**.
1. **Soumitra Satapathi**, “Sensory Response and Two-Photon-Fluorescence Study of Regioregular Polythiophene Nanoparticles”, **Sukant Tripathy Annual Symposium, Lowell, USA, 2010**.

#### **Patent:**

1. Provisional patent filed “DEVICE AND METHOD FOR REAL TIME THICKNESS CONTROLLED SPIN COATING”, Application#: 201611039173 and Date of Filing: November 17, 2016.
2. Patent filed “Peristaltic Pump with Automated Gear Assembly Fabrication and its Method”, Application #: 201811031020, Date of Filing: 20.08.2018

#### **Technology Transfer:**

**Founder and Director:** LabX Scientific Pvt Ltd ([www.labx.co.in](http://www.labx.co.in))

**Objective:** LabX is a startup founded by Prof Soumitra Satapathi and a highly skilled team of Physics and Engineering students from IIT Roorkee with an expertise in electronics, instrumentation, design and 3D Printing. We have developed smart Spin Coater in the TIDES Business Incubation Center, IIT Roorkee. We have an aim to achieve a totally personalized fabrication of devices and bring about an IOT revolution in the field of Laboratory Instrumentation.

#### ***Impact of Research by Dr. Soumitra Satapathi***

Dr. Soumitra Satapathi is actively involved in Materials Science and Water Remediation Research in IIT Roorkee where his main focus is water remediation, low cost solar cells based water treatment, Optical Sensing and Drug Delivery. Recently, he and his research group have developed a new class of solar cells called Dye Sensitized Solar Cells (DSSCs) using naturally occurring polyphenolic dye anthocyanine from Indian summer fruit Jamun. As Jamun is easily available in a large amount during summer, therefore the dye extraction and purification process is also cost effective using this source of anthocyanine. These dye sensitized, low cost solar cells would be very useful in addressing next generation energy challenges. **This research was featured in all leading national and international print and electronic media including Nature Asia, PTI, BBC, Quartz, USA Today, Times of India to name a few. The National Renewable Energy Laboratory (NREL), USA, the apex body of energy research in the world has proposed to call the natural dye based solar cells as “Satapathi Cells” from 2018. His research on Jamun Solar Cells was also identified as “top ten technological breakthrough” under 40 for 2017 by times group.** Tata power is developing the Jamun based solar cells module along with Satapathi’s research group.

Apart from DSSCs, Dr. Satapathi is closely involved in research in other organic electronics devices like perovskite solar cells, organic solar cells, nanoparticles based solar cells development etc. In water remediation, he is developing ultra-low cost sensor for domestic and industrial effluents removal. In sensor work, he is developing a field based sensor for rapid detection of explosives. In support of his research excellence in next

generation solar cells, **he received the prestigious Bhaskara Advanced Solar Energy (BASE) Award, 2016 from Govt. of India and Indo-US Science & Technology Forum.** As a part of this award, he was invited to Materials Science Dept, University of Michigan, Ann Arbor in summer, 2016 and developed kirigami based flexible solar tracking system integrated on perovskite solar cells. His work on nanoparticles based solar cells was recognized by DST and DAAD, Germany as **he received prestigious DST DAAD PPP fellowship, 2016 to jointly work with University of Bayeruth, Germany on nanoparticles based solar cells.** **He has been nominated for prestigious Max Planck Institute Director Award for young scientist, 2017 from India.** **Dr. Satapathi has received more than 1.50 crore extramural grant in support of his research program and published many high impact journals papers and also filed patents from IITR.** He has delivered more than 20 invited lectures after joining IIT Roorkee. **In accreditation of his research contribution to the energy field, Govt. of India has selected him as young scientist delegate to represent the energy policy and research ecology in Hangzhou, China in BRICS meeting, 2017.** **Based on his translation research output, he has founded a start-up “Lab X”, pre-incubated by TIDES, IITR.** Apart from mentoring undergraduates and graduate students, he is also actively involved in popularizing science in various forums.

### **Media Link of Research:**

### **English News Coverage:**

1. <http://www.natureasia.com/en/nindia/article/10.1038/nindia.2017.47>
2. [http://www.ptinews.com/news/8645027\\_Jamun-used-to-make-low-cost-solar-cells.html](http://www.ptinews.com/news/8645027_Jamun-used-to-make-low-cost-solar-cells.html)
3. <http://www.deccanchronicle.com/technology/in-other-news/300417/iit-scientists-create-low-cost-solar-cells-using-jamun.html>
4. <http://www.thehindu.com/sci-tech/science/iit-scientists-create-low-cost-solar-cells-using-jamun/article18333363.ece?homepage=true>
5. <http://www.dnaindia.com/scitech/report-iit-scientists-create-low-cost-solar-cells-using-jamun-2422964>
6. <http://indianexpress.com/article/technology/science/iit-scientists-create-low-cost-solar-cells-using-jamun-4634601/>
7. <http://indiatoday.intoday.in/story/iit-scientists-create-low-cost-solar-cells-using-jamun/1/942005.html>
8. <https://qz.com/969989/iit-an-indian-berry-contains-a-crucial-ingredient-for-creating-cheap-solar-cells/>
9. <http://www.livemint.com/Science/ymfe3m9bx7FMzeGSJhFYMK/Jamuns-can-be-used-to-make-lowcost-solar-cells-say-IIT-Roo.html>
10. <http://www.news18.com/news/tech/iit-scientists-create-low-cost-solar-cells-using-jamun-1384249.html>
11. <https://www.nationalheraldindia.com/news/2017/04/26/eat-drink-and-make-solar-cells-from-jamun-iit-roorkee-inexpensive-photosensitiser>
12. <http://www.tribuneindia.com/mobi/news/science-technology/jamun-used-to-make-low-cost-solar-cells/397981.html>
13. <http://www.thebetterindia.com/98164/jamun-iit-roorkee-solar-energy/>

14. <https://www.topnewstoday.in/news/112187/iit-scientists-create-low-cost-solar-cells-using-jamun>
15. [http://wap.business-standard.com/article/pti-stories/jamun-used-to-make-low-cost-solar-cells-117042600376\\_1.html](http://wap.business-standard.com/article/pti-stories/jamun-used-to-make-low-cost-solar-cells-117042600376_1.html)
16. <https://www.brainbuxa.com/education-news/iit-scientist-are-using-jamuns-to-create-solar-cells-in-india-6350>
17. <http://www.techsourceint.com/scientists-create-low-cost-solar-cells-using-indian-fruit-jamun/>
18. <http://currentaffairs.gktoday.in/scientists-iit-create-cost-solar-cells-jamun-05201744265.html>
19. <http://www.techsourceint.com/scientists-create-low-cost-solar-cells-using-indian-fruit-jamun/>
20. <http://www.jagranjosh.com/current-affairs/iit-researchers-used-jamun-to-create-inexpensive-solar-cells-1493706525-1>
21. <https://www.crazyengineers.com/news/iit-roorkee-engineers-are-working-on-developing-solar-cells-using-jamun.95839/>
22. <https://energyinfrapost.com/iit-scientists-create-low-cost-solar-cells-using-jamun/>
23. <http://www.ummid.com/news/2017/April/30.04.2017/iit-roorkee-scientists-create-low-cost-solar-cell.html>
24. <http://www.newsnation.in/science-news/scientists-at-iit-roorkee-use-jamun-to-create-low-cost-solar-cells-article-169984.html>
25. <http://www.ecowatch.com/india-berry-solar-cell-2389135918.html>
26. <http://www.iasabhiyan.com/iit-scientists-create-low-cost-solar-cells-using-jamun/>
27. <http://www.competitive-exam.in/post/scientists-at-iit-create-low-cost-solar-cells-using-jamun>
28. <https://www.inshorts.com/news/jamuns-can-be-used-to-make-lowcost-solar-cells-iitr-study-1493280251055>
29. <https://www.sufiyandroiddevelopers.com/iit-scientists-create-low-cost-solar-cells-using-jamun-fruit/>
30. <http://www.kodson.com/finance/2017/04/30/iit-scientists-create-low-cost-solar-cells-using-jamun/>
31. <http://www.examlover.com/currentaffairs/IIT-scientists-create-low-cost-solar-cells-using-jamun>
32. <https://steelguru.com/power/iit-scientists-create-low-cost-more-efficient-solar-cells-using-jamun/479663>
33. <http://hungarytoday.hu/~newsinfo/latest/iit-scientists-create-lowcost-solar-cells-using-jamun>
34. <http://giveandgain.shop/news/iit-scientists-create-low-cost-solar-cells-using-jamuns/>
35. <http://www.indiaeveryday.com/news-iit-scientists-create-low-cost-solar-cells-using-jamun-1005-3473792.htm>

36. <http://renewablesnaps.com/are-iit-scientists-really-using-jamuns-to-create-solar-cells-in-india/>
37. [https://article.wn.com/view/2017/04/26/Jamun\\_used\\_to\\_make\\_lowcost\\_solar\\_cells/](https://article.wn.com/view/2017/04/26/Jamun_used_to_make_lowcost_solar_cells/)
38. <http://menafn.com/1095425830/IIT-Roorkee-scientists-use-Jamuns-to-make-solar-cells>
39. [http://energy.einnews.com/article\\_detail/378606976-iit-scientists-create-low-cost-solar-cells-using-jamun?vcode=XIbw](http://energy.einnews.com/article_detail/378606976-iit-scientists-create-low-cost-solar-cells-using-jamun?vcode=XIbw)
40. <https://www.optimistdaily.com/2017/05/creating-cheap-solar-cells-with-an-ingredient-from-a-delicious-indian-berry/>
41. <http://www.scienceworldreport.com/articles/59099/20170503/component-indian-berry-absorbs-much-sunlight-lead-production-solar-panels.htm>
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