Curriculum Vitae

R. Sreekumar

Principle Investigator.
SERB-DST fast-track Project.
Department of Physics,
Cochin University of Science & Technology,
Kochi, Kerala, India.

Personal details
Date of birth : 10-09-1979
Nationality : Indian
Phone: +91 9446314275 (mobile)

E-mail: sreekumar.rajappan@uv.es
srii10@gmail.com

Objective

To be a part of basic research and development in the fast developing domain of cost effective photovoltaics and nano-structured metal oxide materials. My area of interests is in renewable energy, quantum dots, preparation and characterization of thin film photovoltaic material and transparent conducting zinc oxides.

Education

Ph. D in Materials Science, Cochin University of Science and Technology (CUSAT), *India.*
Ph.D Thesis title: "Effects and Modifications in In/Se and In/Sb Systems by Swift Heavy Ion Irradiation"
Ph.D Instructor – Prof. K. P. Vijayakumar.
Thesis submitted – October 2008, Award date - 13th August 2009
Master of Science (Physics), Mahatma Gandhi University.
2000 to 2002, Maharaja's college, Kochi, India.
Bachelor of Science (Physics), Mahatma Gandhi University.
1997 to 2000, Bharata Matha College, Kochi, India

Research experience

Principle investigator of the project entitles "Development of All –spray-coated large area thin film solar cells employing Spray Pyrolysis methodology". Research project funded by Science and Engineering Research Board (SERB), Department of Science and Technology (DST), under Fast-tracck scheme for young scientist. **Work place** - Department of Physics, CUSAT, Kochi, India.

Dr. D. S. Kothari Postdoctoral Fellow, Dept. of Pure and Applied Physics, Mahatma Gandhi University, Kottayam, Kerala, India. Development of Wide band-gap ternary metal oxides (CaZnO, MgCdO and CdAlN) for UV photonics application. October 2013 to June 2014.
Instructor: Prof. N. V. Unnikrishnan

Postdoctoral fellow at Department de Fisica aplicada, University of Valencia, Burjassot, **Spain**.
1st July 2010 to 31st June 2013, **ZnO, MgO, MgZnO, CdO and MgCdO** quantum dots using Chemical spray Pyrolysis.
Instructor: Prof. Vicente Munoz Sanjose.

Research Scientist at Centre of excellence in Nano-electronics, Electrical Engineering Department, Indian Institute of Technology, Bombay **India**.
November 2009 to May 2010, Ion beam irradiation studies on InAs/GaAs quantum dots.

Instructor: Prof. S Chakrabarti.

Post Doctoral fellow at Laboratory Processes Material Instrumentation (LPMI), Ecole Nationale Superieure d'Arts et Metiers (ENSAM), Angers, **France.**

March 2009 to August 2009, ***Development of ZnO thin films using CVD/chemical spray pyrolysis (CSP) technique for photovoltaic application (organic solar cells).***

Instructor: Prof. Anne Bouteville.

Research Associate at **Thin Film Photovoltaic Division, CUSAT, India.**

15th March 2008 to 2nd March 2009, ***Development of Large area ZnO thin films using CSP for photovoltaic application (a-Si solar cells).***

Instructor: Prof. K. P. Vijayakumar.

Senior Research Fellow at **Thin Film Photovoltaic Division, CUSAT, India.**

15th March 2007 to 14th March 2008, ***Development of ZnO thin films*** *using CSP for photovoltaic application.*

Junior Research Fellow at **Thin Film Photovoltaic Division, CUSAT, India.**

2003 to 2007, Prepared and characterized Indium selenide thin films and modification of optical and electrical properties of indium selenide thin films for solar cell application employing Swift heavy ion irradiation.

Name and address of employer	Post held & date of joining	Post held & date of leaving	Nature of employment/duties	Funding Agency
Dept of Physics, CUSAT	Principle investigator & 01-07-2014	Principle investigator & 04-10-2014 (Pursuing till date)	Full-time research	SERB-DST, Govt. of India
Prof. N. V. Unnikrishnan, School of Pure and Applied Physics, M G University, Krala	Postdoctoral fellow & 23-10-2013	Postdoctoral fellow & 30-06-2014	Full-time research	UGC-India
Prof. Vicente Munoz Sanjose, Dept. Fisica Aplicada, University of Valencia, Spain	Postdoctoral fellow & 1-07-2010	Postdoctoral fellow & 31-06-2013	Full time research	University of Valencia, Spain.
Dr. S. Chakrabarti, Electrical Engineering Dept., IIT Bombay	Research Scientist & 16-11-2009	Research Scientist & 14-05-2010	Full-time research	ISRO, Govt. of India

Prof. Anne Bouteville, ENSAM, Angers, France	Postdoctoral fellow & 03-03-2009	Postdoctoral fellow 03-08-2009	Full-time research	ARTS CARNOT Institute, France
Prof. K. P. Vijayakumar, Dept. of Physics, CUSAT	Senior research fellow & 15-03-2007	Research associate 02-03-2009	Full-time research	Hind High Vacuum Co. Pvt. Ltd, Bangalore.
Prof. K. P. Vijayakumar, Dept. of Physics, CUSAT	Junior research fellow 20-08-2003	University Junior research fellow 14-03-2007	Full time research	IUAC New Delhi and CUSAT, Kochi

Awards

1. ***DST fast-track young scientist Award*** *for pursuing independent project entitled "*Development of All -spray Coated large area thin film solar cells employing Spray Pyrolysis methodology*"* ***worth 25.44 lakhs*** *December 2013*
2. ***Dr. D. S. Kothari Postdoctoral fellowship****, UGC, Govt. of India – September 2013*
3. *ICTP-TRIL Postdoctoral fellowship, CNR-IMM Parma, Italy (2012) – Not accepted*
4. *Post doctoral fellowship from* ***Arts Carnot Institute****, France (2009).*
5. ***CSIR*** *Senior Research Fellowship from Government of India for pursuing Ph.D (2007).*
6. *Junior Research Fellowship (UFUP-32305) from IUAC, New Delhi, India for pursuing Ph.D (2003).*

Expertise in preparation techniques, equipments & characterization tools

Preparation techniques:

1*. Infrared ray assisted spray chemical vapour deposition (****CVD****)- ZnO:Al transparent conductive oxide*

2*.* ***Chemical spray pyrolysis*** *(CSP) – (a) Large area (10 cm x 10 cm) ZnO:Al transparent conductive oxide*
(b)Nanoparticles/ quantum dots on substrates of ZnO, MgZnO

3. Hydrothermal technique *– ZnO nano and micro-crystals (200 microns)*

4. *Physical vapour deposition (Thermal evaporation, Electron beam evaporation),*

5. *Chemical bath deposition technique.*

6. *Synthesis using Ion beam irradiation.*

Equipments: Scanning electron microscope, Transmission electron microscope, *He-Cd laser, Ar-ion laser, Nd-YAG laser, detectors, monochromator.*

Characterization tools: ***X-ray diffractometer, Photoluminescence,*** *Hall measurement, Scanning tunneling Microscopy, Transmission electron microscopy (TEM), X-TEM sample preparation Energy dispersive X-ray spectroscopy, X-ray photo electron spectroscopy, atomic force*

microscopy, Uv-vis-nir spectrophotometer, swift heavy ion beam irradiation studies, Rutherford back scattering spectroscopy, SRIM, Thermally stimulated current measurements, cryostat, stylus thickness measurement.

I. List of Publications

(a) Refereed Journals

1. **Sreekumar Rajappan Achary**, Said Agouram, Juan F Sánchez-Royo, Carmen Martínez-Tomás and Vicente Muñoz-Sanjosé, *"Growth and characterization of self-assembled $Cd_{1-x}Mg_xO$ ($0 \leq x \leq 1$) nanoparticles on r-sapphire substrates"*, **CrystEngComm. 16** (2014) 8969-8976 **(Impact factor – 3.858)**

2. **Sreekumar Rajappan Achary,** Said Agouram, Juan F Sánchez-Royo, Carmen Martínez-Tomás and Vicente Muñoz-Sanjosé, "*One-step growth of isolated CdO nanoparticles on r-sapphire substrates by using the spray pyrolysis methodology",* **RSC Advances,** 4 (2014) 23137-23144. **(Impact factor – 3.708)**

3. **R. Sreekumar**, A. Mandal, S. Chakrabarti and S. K. Gupta, "*H^- ion implantation induced ten-fold increase of photoluminescence efficiency in single layer InAs/GaAs quantum dots"*, **Journal of Luminescence**, 153 (2014) 109-117 **(Impact factor – 2.367)**

4. **Sreekumar Rajappan Achary**, Said Agouram, Juan F Sánchez-Royo, Manuel Lopez-Ponce, J. M. Ulloa, E. Muñoz, A. Hierro and Vicente Muñoz-Sanjosé, "*Self-assembled $Mg_xZn_{1-x}O$ quantum dots ($0 \leq x \leq 1$) on different substrates using spray pyrolysis methodology*" **CrystEngComm. 15** (2013) 182-191, **(Impact factor – 3.858)**

5. **R. Sreekumar *Rajappan-Achary***, Said Agouram, Candid Reig, Juan F. Sánchez-Royo, Carmen Martínez-Tomás and Vicente Muñoz-Sanjosé, "*Self assembled **Zinc oxide** quantum dots using spray pyrolysis methodology", **Crystal growth and Design,*** 11 (2011) 3790–3801. **(Impact factor – 4.558)**

6. **R. Sreekumar**, R. Jayakrishnan, C. Sudha Kartha, K.P. Vijayakumar, Y. Kashibawa and T. Abe**.** "*Different phases of indium selenide prepared by annealing In/Se bilayer at various temperatures: Characterisation studies", **Sol. Energy Mater. Sol. Cells,*** 90 (2006) 2908. **(Impact factor – 5.030)**

7. R. Vinod, M. Junaid Bushiri, **Sreekumar Rajappan Achary** and Vicente Muñoz-Sanjosé**, "***Quenching and blue shift of UV emission intensity of hydrothermally grown ZnO:Mn nanorods",* Mater. Sci. Eng. B, 191 (2014) 1-6 **(Impact factor – 2.122)**

8. R. Vinod, M. Junaid Bushiri, P. Sajan, **Sreekumar Rajappan Achary** and Vicente Muñoz-Sanjosé**,** The Mn^{2+} induced room temperature ferromagnetism and spin glass behavior in hydrothermally grown Mn doped ZnO nanorods, Physics Status Solidi (a) **211** (2014) 1155-1161. **(Impact factor – 1.525)**

9. R Vinod, P Sajan, **Sreekumar Rajappan Achary**, Carmen Martinez Tomas, Vicente Muñoz-Sanjosé[2] and M Junaid Bushiri, "*Enhanced UV emission from **ZnO** nanoflowers synthesized by the hydrothermal process*" J. Phys. D: Appl. Phys. **45** (2012) 425103 **(Impact factor - 2.521)**

10. R. Jayakrishnan, K. Mohanachandran, **R. Sreekumar**, C. Sudha Kartha, K. P. Vijayakumar, '***ZnO thin Films** with blue emission grown using chemical spray pyrolysis',* Materials Science in Semiconductor Processing **16** (2013) 326-331. **(Impact factor – 1.761)**

11. Jérôme Garnier, **Rajappan Achary Sreekumar** and Anne Bouteville, "*Influence of the Heating Mode and the Spray Introduction on Chemically Vapour Deposited Aluminium Doped **Zinc Oxide Thin Films**",* ECS Transactions **25 (8)** (2009) 1259-1265

12. **R. Sreekumar**, T. H. Sajeesh, T. Abe, Y. Kashiwaba, C. Sudha Kartha, and K. P. Vijayakumar, "*Influence of indium concentration and growth emperature on the structural and optoelectronic properties of indium selenide thin films*", Phys. Status Solidi B, **250**, 95-102 (2013) **(Impact factor – 1.605)**

13. R. Sreekumar, Arjun Mandal, S. K. Gupta and S. Chakrabarti, "*Effect of high energy proton irradiation on InAs/GaAs quantum dots: Enhancement of photoluminescence efficiency (upto ~7 times) with minimum spectral signature shift*", Material Research Bulletin *46 (2011) 1786–1793*. **(Impact factor – 1.968)**

14. R. Sreekumar, A. Mandal, S. Chakrabarti and S. K. Gupta, "*Effect of heavy ion implantation on self assembled single layer InAs/GaAs quantum dots"*, *J. Phys D: Applied Phys.**43** (2010) 505302* **(Impact factor - 2.521)**

15. R. Sreekumar, R. Jayakrishnan, C. Sudha Kartha, K.P. Vijayakumar, S. A. Khan, D. K. Avasthi, "*Enhancement of band gap and photoconductivity in gamma indium selenide due to SHI irradiation", J. Appl. Phys. **103** (2008) 023709.* **(Impact factor - 2.185)**

16. R. Sreekumar, R. Jayakrishnan, C. Sudha Kartha and K.P. Vijayakumar, "*Anomalous photoconductivity in gamma In_2Se_3*", *J. Appl. Phys. 100 (2006) 033707.* **(Impact factor - 2.185)**

17. **R. Sreekumar**, P.M. Ratheesh Kumar, C. Sudha Kartha, K.P. Vijayakumar, D. Kabiraj, S.A. Khan, D. K. Avasthi, Y. Kashibawa and T. Abe**,** "*Swift heavy ion induced interface mixing in In/Sb", Semicond. Sci. Technol.* ***21*** *(2006) 382.* **(Impact factor – 2.206)**

18. **R. Sreekumar**, P.M. Ratheesh Kumar, C. Sudha Kartha, K.P. Vijayakumar, D. Kabiraj, S.A. Khan and D. K. Avasthi, "*SHI induced single-phase InSe formation at lower annealing temperature"*, *Nucl. Instr. and Meth. B* ***244*** *(2006) 190.* **(Impact factor – 1.266)**

(c) Full Papers in National Conference Proceedings:

19. **R. Sreekumar**, C. Sudha Kartha, K.P. Vijayakumar, D. Kabiraj, S.A. Khan and D. K. Avasthi, "*Enhanced interlayer mixing in In/Se bilayer system due to SHI irradiation"**,** DAE Solid State Physics Symposium 2004, Amritsar, India*

(c) Presented at International Conferences

1. **Sreekumar Rajappan-Achary**, Lluis Manel Guia Martin, Said Agouram, Juan F. Sanchez-Royo, M. Carmen Martinez Tomas and Vicente Muñoz-Sanjosé *"Growth, morphological and structural characterization of* $Mg_xCd_{1-x}O$ *using* ***Spray Pyrolysis*** *methodology"*, European Material Research Society **(E-MRS 2013)** Spring meeting, May 27-31, 2013, Strasbourg, France

2. **Sreekumar Rajappan-Achary**, Said Agouram, Juan F. Sanchez-Royo, M. Carmen Martinez Tomas and Vicente Muñoz-Sanjosé "*Growth of* $Mg_xZn_{1-x}O$ *quantum dots using* ***spray pyrolysis*** *methodology*", International workshop on ZnO and related materials (**IWZnO 2012**), CNRS – Sophia Antipolis, Nice, France, September 11-14, 2012.

3. **Sreekumar Rajappan-Achary**, Said Agouram, Vicente Muñoz-Sanjosé and Anne Bouteville, "*Self-textured Zinc Oxide Thin Films Using* ***Spray Pyrolysis*** *without any post growth treatment*", European Material Research Society **(E-MRS 2012)** Spring meeting, May 14-18, 2012, Strasbourg, France

4. **Sreekumar Rajappan-Achary**, Said Agouram, Juan F. Sanchez-Royo, Tomas and Vicente Muñoz-Sanjosé "***Spray pyrolysis****: A simple technique for the direct growth of self-assembled metal oxide quantum dots on substrates",* European Material Research Society **(E-MRS 2012)** Spring meeting, May 14-18, 2012, Strasbourg, France.

5. **R. Sreekumar**, N. Montenegro, S. Agouram, V. Sallet, C. Martinez-Tomas and V. Muñoz-Sanjose, *"New paths for the growth of ZnO-based low dimensional nanostructures"*, Presented (Invited) in Workshop on Frontier photonic and electronic materials and devices, March 16-18, 2011, San Anton-Granada, Spain.

6. **R. Sreekumar,** Sudipta Das, S. Sengupta, S. Chakrabarti and S. K. Gupta, *"Effect of low energy proton irradiation on single layer InAs/GaAs quantum dot heterostructure"*. Presented (oral) in Material Research Society Fall meeting 2010 **(MRS -2010)**, November 29 – December 3, 2010, Boston, MA, USA.

7. **R. Sreekumar,** S. Sengupta, S. Chakrabarti, and S. K. Gupta. "*Enhancement of luminescence efficiency in InAs/GaAs quantum dots by proton irradiation*", Presented (oral) in Electronic Materials Conference 2010 **(EMC 2010)**, June 23-25, 2010, Notre Dame, Indiana, USA.

8. **R. Sreekumar,** S. Sengupta, S. Chakrabarti, and S. K. Gupta. "*Investigation of degradation of photoluminescence efficiency in InAs/GaAs quantum dots on heavy ion bombardment". Presented (oral)* in **E-MRS 2010** Spring meeting, June 7-11, 2010, Strasbourg, France.

9. **R. Sreekumar**, Anita R. Warrier, C. Sudha Kartha, K. P. Vijayakumar, S. A. Khan, D. K. Avasthi. "*Use of SHI irradiation in gamma In_2Se_3 thin films for PV devices in outer space application", 2nd* ***European Optical Society Tropical Meet:*** *Optical Microsystems '07, 30th September to 3rd October 2007, Capri, Italy.*

10. **R. Sreekumar**, P.M. Ratheesh Kumar, C. Sudha Kartha, K.P. Vijayakumar, D. Kabiraj, S.A. Khan and D. K. Avasthi, "*SHI induced single-phase InSe formation at lower annealing temperature"*, Indo-German workshop: "Synthesis and Modification of Nano Structured Materials by Energetic Ion Beams" – February 20-24, 2005 at Nuclear Science Centre, New Delhi, India.
11. **R. Sreekumar**, R. Jayakrishnan, C. Sudha Kartha and K. P. Vijayakumar, "*Effect of Indium concentration on the electrical properties of γ-In_2Se_3*", *International conference on Optoelectronic Materials and Thin films for Advanced Technology, October 2005, Kochi, India.*

(d) Presented at National Conferences.

12. **Sreekumar Rajappan-Achary**, Said Agouram, Juan F. Sanchez-Royo, M. Carmen Martinez Tomas and Vicente Muñoz-Sanjosé , Self-assembled MgxZn1-xO quantum dots ($0 \leq x \leq 1$) on different substrates using spray pyrolysis methodology, *1st Workshop NANOMAT12,* Programa Prometeu de la Generalitat Valenciana, Denia, Spain, *6-7 March 2012*
13. **R. Sreekumar**, C. Sudha Kartha and K. P. Vijayakumar, "*Effect of indium concentration and annealing temperature on the c-axis growth of γ-In_2Se_3" The 17th AGM of the Material Research Society of India, February 2006, Lucknow, India*

Post-graduate research

I have enrolled my Ph.D registration in 2003 with Cochin University and Science and Technology, Kochi, India, as I secured a **Junior Research Fellowship** from Inter University Accelerator Centre (IUAC), New

Delhi, India. My Ph.D research problem was to prepare single phased indium selenide thin films, which is used in photovoltaic application and to study the effect of ion beam irradiation. Swift heavy ions (SHI) of 80 MeV Ni, 100 MeV Au, 100 MeV Ag, 40 MeV S from 15UD Pelletron accelerator facility at IUAC were used for modifying the optoelectronic properties of InSe thin films. Different characterization tools such as PL, XRD, SEM, AFM, RBS, TEM, XPS and Optical absorption analysis were used to characterize the thin films. Ion beam facility at IOP, Bhubaneswar and BARC, Mumbai were also used for implantation and characterization studies such as RBS. The study proved that using SHI irradiation one could achieve single phase indium selenide at relatively lower annealing temperatures. One of the main achievements during the Ph.D research work was that, we were able to integrate InSb system with Si matrix, using SHI beam irradiation. This can lead to miniaturization of InSb sensor devices, which are now using discrete Si circuitry physically separated from InSb sensor arrays.

In year 2007, I received **Senior Research Fellowship** for pursuing Ph.D from Council for Scientific and Industrial Research (CSIR). During this period we published five research papers in International Journals. Out of which two papers are accepted for publication without any revision. I have presented my research work in 9 national and international conferences, in which four of my work has been chosen for ***oral presentation*** in different international conferences. **CSIR and Department of Science and Technology (DST),** Government of India, provided financial support in the form of ***travel grant*** to attend and present my work in *2nd European Optical Society Tropical Meet: Optical Microsystems '07*, held at Capri, Italy in 2007.

From March 2007, I moved into an ***industrial consultancy project*** for the development of transparent conductive oxides ***(TCO) for photovoltaic applications***. During this period we have designed and developed an automated chemical spray pyrolysis machine, for depositing large area (10 cm x 10 cm in dimension) TCO/semiconducting thin films. This machine is now commercially marketed by a private company named **Hallmarc slides and controls** Pvt Ltd, Kochi. We succeeded in depositing Zinc oxide (ZnO) thin films of ***resistivity 2.5 x10^{-3} ohm cm*** with transmittance > 80% in the visible region of electromagnetic spectrum on ordinary glass substrates in an area of ***10cm x 10cm***. This work has been carried out in collaboration with an industry based at Bangalore (Hind High Vacuum Co. Pvt Ltd.), India.

From March 2009, I pursued research by joining ENSAM, Angers, France as a post doctoral researcher acquiring a ***fellowship from Arts Carnot institute***, France. At ENSAM, our aim was to deposit low resistive ZnO using IR assisted CVD and Spray Pyrolysis technique and to study the difference of these two techniques. We used a custom made CVD machine supplied by **Anneal-Sys** in which an atomizer 'Altokit' (make: KEMSTREAM) was used to generate atomized precursor. We succeeded in depositing ZnO thin films with resistivity of the order of ~ 8 x10^{-4} ohm cm with ***inherent haze***, using Spray Pyrolysis technique, which can be used for a-Si/ thin film solar cells. Whereas, smooth and haze-less ZnO

thin films with resistivity of the order of 2.9 x 10^{-3} ohm cm and figure of merit of 1.7 10^{-3} Ω^{-1} were deposited using IR assisted CVD, which can be used for organic solar cell fabrication.

In November 2009, I joined Electrical engineering department**, IIT Bombay** as a Research Scientist in **an ISRO project**, which was on the development of InAs/GaAs quantum dot (QD) based IR cameras and lasers for outer-space application. In this project I did the ion beam irradiation studies on InAs/GaAs QDs (grown using MBE) to study the irradiation effects on these materials in collaboration with BARC, Mumbai. Ion beams of Protons, Sulfur and Chromium in the energy range from 30 keV to 5 MeV were used for implantation studies. Various effects, such as sulfur ion induced degradation and proton ion induced enhancement in photoluminescence from InAs/GaAs QDs were observed using this study. The results were presented in conferences (EMRS 2010, EMC 2010 and MRS 2010) and papers are published in ***J. Phys. D: Applied Phys***. and ***Material Research Bulletin*** and one manuscript is accepted for publication in **Journal of Luminescence**.

Then in July 2010, I moved to Department of Fisica Aplicada (Physics), University of Valencia, Spain as I secured a fellowship for persuing my post doctoral work on metal oxide quantum dots (ZnO, MgO, MgZnO, MgCdO and CdZnO) using Chemical Spray Pyrolysis technique. Currently we were able to deposit ZnO quantum dots of 5 nm and MgZnO of 6-8 nm on glass substrate using spray Pyrolysis technique. One thing to be noted is that, till date nobody demonstrated metal oxide QD deposition using Spray pyrolysis. We have published two papers on ZnO and $Mg_xZn_{1-x}O$ quantum dots and currently working on the development of CdO and $Mg_xCd_{1-x}O$ quantum dots (which is a novel material).

References

Prof. K. P. Vijayakumar. (Ph.D Advisor)
Dept. of Physics, CUSAT, India.
E-mail: kpv@cusat.ac.in
Phone: +919847322577

Prof. Vicente Munoz Sanjose. (Post doc Advisor)
Dept. of Applied Physics and Electromagnetism,
University of Valencia, Spain.
E-mail : Vicente.Munoz@uv.es
Phone: +34 620840197

Prof. M. K. Jayaraj.
Dept. of Physics,
CUSAT, India.
E-mail: **mkj@cusat.ac.in**
Phone: +91 9447972704

Prof. Anne Bouteville. (Post doc Advisor)
LPMI, ENSAM, Arts et Métiers ParisTech,
Angers, France.
E-mail: anne.bouteville@angers.ensam.fr
Phone: +33 241207329

Prof. N. V. Unnikrishnan. (Post doc Advisor)

School of Pure and Applied Physics,

Mahatma Gandhi University, Kottayam, Kerala, India.

E-mail: nvu100@yahoo.com

Phone: +91 9745047850

Prof. S. Chakrabarti. (Post doc Advisor)

Electrical Engineering Department,

IIT Bombay, Mumbai.

E-mail: subho@ee.iitb.ac.in

Phone: +91 9619685279