

# Curriculum vita

## ABHIJIT SARKAR

Work: Michigan Molecular Institute, Home: 5101 Natalie Court  
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### Major Field of Interest :

1. Design and Synthesis of conjugated monomers involving acetylenic and olefinic bonds as well as heteroaryl moieties such as thiophene, quinoline etc. and their polymerization to get materials having electrical, optical, chromic properties.
2. Synthesis of conjugated monomers and polymers for optical and nonlinear optical properties.
3. Synthesis and properties of Dehydrobenzoannulenes. Synthesis of poly -aromatic hydrocarbons.
4. Dendrimers, functionalized dendrimers for optoelectronics. Sensors and Biosensors.

### Laboratory Experience :

1. Conducting laboratory course.
2. Using different types of instruments(including maintenance) as listed below :
  - (a) 300 and 400 Mhz NMR spectrometer.
  - (b) Solid state NMR spectrometer
  - (c) Powder X-ray diffractometer
  - (d) Single crystal X-ray diffractometer
  - (e) DSC/DTA/TGA instrument
  - (f) GC and HPLC
  - (g) FTIR, UV-spectroscope and the common spectroscopes used for characterisation processes.
  - (h) various microscopes including Scanning electron microscope.
  - (i) Laser systems for second-order and third-order nonlinear optical property measurements.
  - (j) Macintosh, MS-DOS system and workstations(unix system) for various computational works such as energy calculations, molecular dynamics.  
Hand on experience with many common softwares.

### Academic qualifications :

1. Doctoral(**Ph.D.**) : [Organic Chemistry(Polymers)] December 1993  
Indian Institute of Technology, Powai, Bombay 400 076, INDIA.  
Thesis on "*Synthesis and Polymerisation of Heteroaryl Functional Diacetylenes.*"
2. Postgraduation(**M.Sc.**) (Organic Chemistry)1986  
Ranchi University, Ranchi 834 008, Bihar, INDIA.(First Division).
3. Graduation(**B.Sc.**) (Physics, Chemistry, Mathematics) 1983  
St. Xavier's College, (Ranchi University) Ranchi 834 001, Bihar, INDIA.(First Division).

## Present appointment :

“Associate Scientist” at Michigan Molecular Institute (MMI), Midland, Michigan.  
2002 till date

At MMI, I am involved with a variety of research projects. Some of the major projects are the following. Dendrimer based colorimetric biosensors using polydiacetylene as the chromophore, is being successfully carried out with promising results and prototype sensor devices. This project has been expanded to variety of morphologies of the sensor, including solid state sensor and soluble sensor. We are collaborating with industries towards commercialization of the sensor. Water purification is another area of research where we are using a variety of polymers for detecting contaminants as well as removing them from water. The other focus of my research is design and preparation of optoelectronic materials. We have used dendrimer as the template material and exploited the vast surface functionality to tailor it so that it can show high optical nonlinearity. The target devices are holographic material as well as electro-optical material. In collaboration with an industrial partner, we are pursuing our goal to make a commercial holographic device. The third area of my research concerns with Quantum dots and nanoparticles for optical sensors and for other optical applications.

## Previous appointments :

- (a) “Senior Research Associate” at Michigan Molecular Institute,  
Midland, Michigan, USA  
*Project on Biosensor design and preparation.*  
2001 to 2002
- (b) "Postdoctoral Research Associate" at the Department of Chemistry,  
University of Oregon, Eugene, USA.  
*Design and Synthesis of Dehydrobenzoannulenes and other analogues.*  
1999 to 2001.
- (c) "Research Assistant Professor" at the Institute for Chemical Reaction  
Science, Tohoku University, 2-1-1 Katahira, Aoba-ku, Sendai 980-8577.  
1997 to 1999.
- (d) "JSPS Post Doctoral Fellow" at the Institute for Chemical Reaction  
Science, Tohoku University, Japan  
Research Area : *Preparation of functional Polymers for Non-linear  
Optical(NLO) materials.*  
1995 to 1997.
- (e) "NSTB Post Doctoral Fellow in the project "*Synthesis, characterisation  
and application of novel functional polymers*" in the Department of  
Chemistry, National University of Singapore, Singapore.  
1994 to 1995.
- (f) "Research Officer" in R&D Group (Polymer Division),  
Polyolefins Industries Limited(PIL/NOCIL), Thane, India.  
1993 to 1994.
- (g) “Graduate Teaching Assistant” in Polymer, Organic and General Chemistry,  
Indian Institute of Technology, India  
1989 to 1991.

## Research experience :

### (a) PhD research experience :

The research work was carried out under the supervision of Prof. S. S. Talwar, Professor, Department of Chemistry, Indian Institute of Technology, Bombay, India. The broad aim of this study was to understand the influence of various side groups on the polymer backbone and its manifestations in various properties like, electronic, optical, solution and mechanical properties.

Synthesis of some diacetylenes were carried out. Mostly, heteroaryl groups were used and a good exposure to normal synthesis and characterization of organic compounds were gained in this process. Polymerization of the diacetylenes were carried out in solid state. Also, the polymerization kinetics were obtained. Different properties of the monomers as well as the polymers were studied. Thermal properties of many diacetylenes showed some interesting observations. They became liquid crystalline after melting. This aspect was investigated in detail. Crystal structures of diacetylenes were obtained from single crystal X-ray diffractometer.

Electrochemical polymerization of few diacetylene monomers were also carried out. This work was novel in the sense that diacetylenes had not been polymerised electrochemically previously. The results obtained were interesting and helped in explaining some aspects of this kind of polymerization. Also, in order to compare, we carried out chemical polymerization of the above diacetylenes using catalysts.

### (b) Post doctoral research experience :

(i) As a NSTB postdoctoral research fellow at National University of Singapore, I worked with Prof. H.S.O. Chan in the Department of Chemistry. The project involved design and synthesis of functionalized conjugated monomers with an aim to prepare electroactive polymers. In order to achieve this, I have used a broad array of synthetic procedures. During my stay in Prof. Chan's laboratory, I have added on to my synthetic capabilities gained during PhD work at Bombay. I have also gained experience in various analytical techniques needed for characterization of new materials. Besides these, I have supervised Honours and Masters level students in the laboratory related to design, synthesis and polymerization of various monomers. Our aim was to use molecular engineering in the monomer precursors so as to control or induce the required properties in the final polymers. Polymerization had been accomplished using chemical as well as electrochemical methods. Monomers and Polymers were characterized fully using spectroscopic methods and elemental analysis. Significantly, I was successful in making a new class of conjugated monomers whose polymerization resulted into conjugated polymers exhibiting solubility as well as conductivity.

(ii) As a JSPS postdoctoral fellow at Sendai, I worked with Prof. Hachiro Nakanishi. Here, I was involved in preparation of monomers and polymers for non linear optical properties. I concentrated on polydiacetylenic type of polymers functionalized with heteroaryl groups. Basically, my work involved designing and execution of schemes to synthesize such monomers and then polymerize them. The polymers were being used to make films or crystals in order to study their NLO properties. Third-harmonic generation for the polymers were measured using Maker fringe method. Apart from this, I also used Hyper Raleigh Scattering method to measure second-harmonic generations of some other compounds. Some of the monomers were obtained in single crystal form whose structures were determined using single crystal X-ray diffractometer.

(iii) I worked in the Laboratory of Prof. M. M. Haley at University of Oregon at Eugene. There, I was involved in preparing dehydrobenzoannulenes(DBAs) and its analogues. I was using heteroaryl groups such as thioephene to replace the phenyl ring of DBAs. These systems are conjugated rigid systems with potential NLO as well as liquid crystalline properties. My research was aimed towards both the above mentioned properties.

## **Professional work experience :**

(i) During my tenure at Polyolefins Industries Limited at Thane, India as a Research Officer, I was involved in three ongoing projects. I completed one of the projects successfully wherein the purity and yield of an accelerator for rubber was enhanced thereby making it more efficient. The other projects involved development of new antioxidant for rubber industries and development of a pesticide. In both the projects significant progress was achieved. While working in the industry, I was successful in interacting well and in maintaining good interpersonal relationship with other coworkers of R&D department as well as of production department.

(ii) As a research staff in Institute of Chemical reaction Science at Tohoku University and attached to Prof. H. Nakanishi's research group, my main research area of interest continued to be design and preparation of conjugated monomers and their polymerization to get NLO active materials. Besides this, I was also using my expertise in single crystal growth and structure analysis, solid state NMR of polymers for structure determination and NLO property measurements. Other areas of research interest were liquid crystals and PLED materials. I was also involved in supervising students for their Master's and Doctoral research and report writing. Finally, I supervised in writing all the publication from Nakanishi's laboratory for International Journals, specially to ensure the clarity in presentation.

## **Membership in academic bodies :**

1. American Chemical Society, ACS-Organic Div., ACS-Polymer Div.
2. Polymer Society of Japan.
3. Chemical Society of Japan.

## **Scholarships held :**

1. Japan Society of Promotion of Science(JSPS) fellowship from Japan and held at Tohoku University, Sendai, Japan.
2. National Science and Technology Board(NSTB) fellowship by Singapore Government and held at National University of Singapore.
3. Senior Research Fellowship(Council of Scientific and Industrial Research, New Delhi, India).
4. Junior Research Fellowship(Council of Scientific and Industrial Research, New Delhi, India).
5. Junior Research Fellowship(Indian Institute of Technology, Bombay, India).

## PUBLICATIONS : Abhijit Sarkar

1. Colorimetric Biosensors based on PAMAM dendrimers. **Abhijit Sarkar**, Steven N. Kaganove, Peter R. Dvornic and Paul S. Satoh, *Polymer News*, in press (2005).
2. Self-assembled oligonucleotides conjugated to GaN semiconductor nanostructures for radiative decay engineering. Neogi, A.; Basu, P.; **Sarkar, A.**; Morkoc, H. in “*Organic and Nanocomposite Optical Materials*”, Cartwright, A.; Cooper, T.M.; Karna, S.; Nakanishi, H. eds., vol. 846, DD8.2, MRS, Warrendale, PA, 2005.
3. Novel Conjugated GaN semiconductor nanostructures for biophotonic application. Neogi, A., **Sarkar, A.**, Morkoc, H., *Electronic Letters*, **40**, 1605, 2004.
4. Colorimetric Nano-sensors based on amphiphilic PAMAM Dendrimers. **Sarkar, A.**; Satoh, P, Dvornic, P., Kaganove, S., *Polym. Prepr.*, **44(1)**, 1055, 2003.
5. Colorimetric Polydiacetylene Nano-sensors based on PAMAM Dendrimer Templates. **Sarkar, A.**; Satoh, P, Dvornic, P., Kaganove, S., *Polym. Prepr.*, **44(2)**, 191, 2003.
6. Nonlinear optical properties of dehydrobenzo[18]annulenes: expanded two-dimensional dipolar and octupolar NLO chromophores. **Abhijit Sarkar**, Joshua J. Pak, George W. Rayfield, Michael M. Haley, *J. Mater. Chem.*, **11**, 2943, 2001.
7. Synthesis of Polydiacetylenes from Novel Monomers Having Two Diacetylene Units Linked by an Arylene Group. Hiroshi Matsuzawa, Shuji Okada, **Abhijit Sarkar**, Hiro Matsuda and Hachiro Nakanishi, *Polymer J.*, **33**, 182-189, 2001
8. Synthesis and characterization of dehydrothieno[18]annulenes. **Abhijit Sarkar** and Michael M. Haley, *Chem. Commun.*, 1733-1734, 2000.
9. Polydiacetylenes for third order nonlinear optical materials. **Abhijit Sarkar**, Shuji Okada, Hiroshi Matsuzawa, Hachiro Nakanishi and Hiro Matsuda, FEATURE ARTICLE in *J. Mat. Chem.*, **10**, 819-828, 2000.
10. Improved Third-Order Nonlinear Optical Properties of Polydiacetylene Derivatives. Shuji Okada, Hachiro Nakanishi, Hiroshi Matsuzawa, Hideyuki Katagi, Toshiyuki Oshikiri, Hitoshi Kasai, **Abhijit Sarkar**, Hidetoshi Oikawa, Raul Rangel-Rojo, Takashi Fukuda and Hiro Matsuda, *SPIE Conference Proceedings*, **3796**, 76-87, 1999.
11. Thermal Behaviour of Diacetylenes with Formally Conjugated Heteroaryl Sidegroups. **Abhijit Sarkar** and Satya S. Talwar, *Bull. Chem. Soc. Jpn.*, **72**, 859, 1999.
12. Chemical and electrochemical polymerisation of thiophene containing diacetylenes. **A. Sarkar**, S. S. Talwar, S. Okada and H. Nakanishi, *Polym. Bull.*, **42**, 69, 1999.
13. Synthesis of Ladder Polymers containing Polydiacetylene Backbones connected with Methylene Chains and Their Optical Properties. Hiroshi Matsuzawa, Shuji Okada, **Abhijit Sarkar**, Hiro Matsuda and Hachiro Nakanishi, *J. Polym. Sci., Polym. Chem. Ed.*, **37**, 3537, 1999
14. A convenient synthesis of Aromatic ring substituted diacetylenes. **Abhijit Sarkar**, Shuji Okada, Hiro Matsuda and Hachiro Nakanishi, *Helv. Chim. Acta.*, **82**, 100, 1999.
15. Solid State Polymerization of Diacetylenes with  $\pi$ -conjugating Substituents for Third-order Nonlinear Optical Properties. **A. Sarkar**, N. B. Kodali and S. S. Talwar, *J. Macromol. Sci., Part A: Pure and Applied Chemistry*, **36**, 211, 1999.

16. Polydiacetylenes from Asymmetrically Substituted Diacetylenes Containing Heteroaryl Side Groups for Third-Order Nonlinear Optical Properties. **A. Sarkar**, S. Okada, H. Matsuda and H. Nakanishi, *Macromolecules* , **31**, 9174, 1998.
17. Heteroaryl Functionalised Diacetylenes : Preparation and Solid State Reactivity. **Abhijit Sarkar** and Satya S. Talwar, *J. Chem. Soc. Perkin Trans. 1* , 4141, 1998.
18. First example of a polymerisable diacetylene monomer with directly linked sidegroup and the third-order nonlinear susceptibility of the polymer. **A. Sarkar**, S. Okada, H. Matsuda and H. Nakanishi. *Chemistry Lett.*, 1073, 1998.
19. A novel series of quinoline containing asymmetrically substituted polydiacetylenes for third-order nonlinear optical materials. **A. Sarkar**, S. Okada, H. Matsuda and H. Nakanishi, *Polym. Bull.*, **41**, 425, 1998.
20. Polydiacetylenes having Quinolyl Sidegroups for third-order nonlinear optical materials. **A. Sarkar**, S. Okada, H. Matsuda and H. Nakanishi, *J. Mat. Sci. Lett.*, **17**, 1449. 1998.
21. Octatetrayne with directly linked aromatic sidegroups : Preparation and characterisation. **A. Sarkar**, S. Okada, K. Komatsu, H. Matsuda and H. Nakanishi, *Macromolecules* , **31**, 5624, 1998.
22. Preparation of Asymmetrically substituted diacetylenes containing heteroaryl sidegroups and their solid state polymerisation. **A. Sarkar**, S. Okada, H. Matsuda and H. Nakanishi. *Mol. Cryst. Liq. Cryst.* , **315**, 65, 1998.
21. 1,8-Bis(2-thienyl)-1,3,5,7-octatetrayne. **A. Sarkar**, K. Komatsu, S. Okada, H. Matsuda and H. Nakanishi. *Acta Cryst.*, **C54**, 1519, 1998.
24. Dispersion of second molecular hyperpolarisability of diacetylene derivatives : Correlation with electronic and chemical structures. A. V. V. Nampoothiri, P. N. Puntambeker, B. P. Singh, R. Sachdeva, **A. Sarkar**, D. Saha, A. N. Suresh and S. S. Talwar. *J. Chem. Phys.*, **109**, 685, 1998.
25. Crystal Structure of 1-(2-thienyl)penta-1,3-diyne-5-ol. T. Manisekaran, **A. Sarkar**, S.S. Talwar and J.S. Prasad. *Mol. Cryst. Liq. Cryst. Sci. Technol. Sect. A* , **308**, 77-82, 1997.
26. Poly{1,2-di(2-selinyl)ethene}: a novel electroactive polymer with reduced band gap. S. C. Ng, H. S. O. Chan, H. H. Huang, T. T. Ong, **A. Sarkar**, K. Kumura, Y. Mazaki and K. Kobayashi. *J. Mater. Sci. Letts.*, **15**, 1684, 1996.
27. Synthesis of electrically conducting poly{2,2'-[5,5'-(1,2-ethynediyl)]bisthiophene}. S. C. Ng, H. S. O. Chan, L. S. Leong and **A. Sarkar**. *J. Mater. Sci. Letts*, **15**, 664, 1996.
28. Preparation and polymerisation of heteroaryl functionalised oligoynes. **A. Sarkar**, S. Okada, K. Komatsu, H. Matsuda and H. Nakanishi. *Polymer Preprints, Japan*, **45**, 1369, 1996.
29. Structure of 1,4-bis(3'-thianaphthyl)-buta-1,3-diyne. T. Manisekaran, **A. Sarkar**, S. S. Talwar and J.S. Prasad. *Mol. Cryst. Liq. Cryst. Sci. Technol. Sect. A*, **268**, 101, 1995.
30. Structure of 1,4-bis(1'-naphthyl)-buta-1,3-diyne. T. Manisekaran, **A. Sarkar**, L.P. Bhagwat, S.S. Talwar and J.S. Prasad. *Mol. Cryst. Liq. Cryst. Sci. Technol. Sect. A*, **268**, 55, 1995.
31. Structure of 1-(3-quinolyl)-4-(2-thienyl)-buta-1,3-diyne. M.J. Barrow, G.H.W. Milburn, Z. Zeng, **A. Sarkar** and S.S. Talwar. *Acta Cryst. C*, **C50**, 650, 1994.

32. A Convenient Method for the Synthesis of Thienylacetylenes. **A. Sarkar**, P. Sekher, M.B. Kamath, L.P. Bhagwat, K.N. Babu, K. Rajalakshmi and S.S. Talwar. *Ind. J. Chem.*, **30B**, 360, 1991.

## PUBLISHED IN CONFERENCE PROCEEDINGS: Abhijit Sarkar

1. Diacetylenes with formally conjugated sidegroups: Precursors to liquid crystalline polymers ? **A. Sarkar**, K.N. Babu, P.K. Khandelwal, L.P. Bhagwat and S.S. Talwar. *Frontiers of Polymer Research*, Eds. Paras N. Prasad and J.K. Nigam, Plenum Press, New York, 1991, pp. 233.
2. Optical properties of Polydiacetylenes in solution and solid state. K.N. Babu, **A. Sarkar**, L.P. Bhagwat and S.S. Talwar. *Frontiers of Polymer Research*, Eds. Paras N. Prasad and J.K. Nigam, Plenum Press, New York, 1991, pp. 183.
3. Solid state and electrochemical polymerisation of novel diacetylene monomers. **Abhijit Sarkar**, Anuradha Kulkarni, A. Q. Contractor and S. S. Talwar. *Polymer Science- Contemporary Themes*, Ed. S. Sivram, Tata McGraw Hill, New Delhi, vol. 1, 1991, pp. 267.
4. Polymerisation of 1,4-bis(2-thienyl)-1,3-butadiyne and 1,4-bis(3-thienyl)-1,3-butadiyne. **Abhijit Sarkar**, Rakesh Sachdeva and Satya S. Talwar. *Polymer Science- Recent Advances*, Ed. I.S. Bhardwaj, Allied Publishers Ltd., New Delhi, vol. 1, 1994, pp. 278.
5. Synthesis and solid state polymerisation of novel diacetylenes. Lalita P. Bhagwat, Nagendra K. Babu, **Abhijit Sarkar** and Satya S. Talwar. *Polymer Science- Recent Advances*, Ed. I.S. Bhardwaj, Allied Publishers Ltd., New Delhi, vol. 1, 1994, pp. 82-87.
6. Synthesis and polymerisation studies of 3,3'-difunctional-2,2'-bithiophenes and bis(2-thienyl)acetylene. S.C. Ng, H.S.O. Chan and **A. Sarkar**. *Proceedings of IUPAC International Polymer Symposium*, Taipei, Nov. 14-16, 1994.
7. Synthesis and polymerisation of functional bithienylacetylenes. **A. Sarkar**, S.C. Ng and H.S.O. Chan. *Proceedings of the Third NUS symposium on Materials Science and Engineering, Singapore*, Eds. H.S.O. Chan et. al., 1994, pp. 113
8. Synthesis and electrochemical polymerisation of thiophene containing monomer. N. Toledo, H.S.O. Chan, S.C. Ng and **A. Sarkar**. *Proceedings of Science Research Congress*, 1994, Singapore, pp. 107.
9. Synthesis and characterisation of a novel polymer arising from 4-(2-thienyl) benzenamine. K.L. Chan, S.C. Ng, H.S.O. Chan and **A. Sarkar**. *Proceedings of Science Research Congress*, 1994, Singapore, pp. 100.
10. A Soluble and Electrically Conducting Polymer System Incorporating thiophene and acetylenic moieties. **A. Sarkar**, Leong L. San, Hardy S. O. Chan and Siu C. Ng. *Advanced New Materials and Emerging New Technologies*, Eds. P.N. Prasad, E. Mark and J.F. Fai, Plenum, New York, 1995, pp. 355.
11. Synthesis and Solid State Polymerisation of Heteroaryl Functionalized Tetraynes. **Abhijit Sarkar**, Shuji Okada, Hiro Matsuda and Hachiro Nakanishi. *Proceedings of the Spring Meeting of the Chemical Society of Japan, Tokyo*, 1996.
12. Preparation and Polymerisation of heteroaryl functionalised oligoynes. **A. Sarkar**, S. Okada, H. Komatsu, H. Matsuda and H. Nakanishi, *Proceedings of the Spring Meeting of the Polymer Society of Japan, Hiroshima*, 1996.
13. Preparation of Asymmetrically Substituted Diacetylenes containing Heteroaryl Sidegroups and their Solid State Polymerisation. **Abhijit Sarkar**, Shuji Okada, Hiro Matsuda and Hachiro Nakanishi. *Proceedings of the Spring Meeting of the Chemical Society of Japan, Kyoto*, 1997.
14. Preparation of Asymmetrically substituted diacetylenes containing heteroaryl sidegroups and their solid state polymerisation. **A. Sarkar**, S. Okada, H. Matsuda and H. Nakanishi. *Proceedings of the 8th International conference on Unconventional Photochemical System (UPS 8), Nara, Japan*, 1997.



15. Preparation and Characterisation of polydiacetylenes from Heteroaryl Functionalised Butadiynes. **Abhijit Sarkar**, Shuji Okada, Hiro Matsuda and Hachiro Nakanishi. Poceedings of the *Spring Meeting of the Polymer Society of Japan, Kyoto, Japan*, 1998.
16. Improved Third-Order Nonlinear Optical Properties of Polydiacetylene Derivatives. Shuji Okada, Hachiro Nakanishi, Hiroshi Matsuzawa, Hideyuki Katagi, Toshiyuki Oshikiri, Hitoshi Kasai, **Abhijit Sarkar**, Hidetoshi Oikawa, Raul Rangel-Rojo, Takashi Fukuda and Hiro Matsuda, Proceedings of the *SPIE's 44th Annual International Conference, Denver, USA*, July, 1999.
17. Design and Synthesis of Dehydrobenzoannulenes Containing Thiophene Moieties. **Abhijit Sarkar** and Michael M. Haley. Proceedings of the *Spring Meeting of American Chemical Society, San Fransisco, USA*, March, 2000.
18. First Hyperpolarizability of Dehydrobenzo[18]annulenes: A New 2D Nonlinear Optical Chromophore. **Abhijit Sarkar**, George W. Rayfield and Michael M. Haley, Proceedings of the *Spring Meeting of American Chemical Society, San Diego, USA*, April, 2001.
19. Colorimetric Nano-sensors based on amphiphilic PAMAM Dendrimers. **Sarkar, A.**; Satoh, P, Dvornic, P., Kaganove, S., Proceedings of the *Spring Meeting of American Chemical Society, New Orleans, USA*, March, 2003.
20. Colorimetric Polydiacetylene Nano-sensors based on PAMAM Dendrimer Templates., **Sarkar, A.**; Satoh, P, Dvornic, P., Kaganove, S., Proceedings of the *Spring Meeting of American Chemical Society, New York, USA*, September, 2003.
21. Self-assembled olegonucleotides conjugated to GaN semiconductor nanostructures for radiative decay engineering. Neogi, A.; Basu, P.; **Sarkar, A.**; Morkoc, H. *Conference on Lasers and Electro-optics*, San Fransisco, USA, CThF78, May, 2004.
22. Self-assembled olegonucleotide Semiconductor conjugated to GaN nanostructures for biophotonic applications. Neogi, A.; Li, J.; **Sarkar, A.**; Neogi, P.B.; Gorman, B.; Golding, T.; Morkoc, H. *MRS Meeting, Boston, USA*, December, 2004.