

# Ayyappanpillai Ajayaghosh

## Brief Biography:

Ajayaghosh, born (1962) in Vellimon, a village at Quilon, Kerala, completed his early education at the village school and subsequently obtained masters and Ph. D. in chemistry from Calicut University. While doing Ph. D. he was selected for the Young Scientist award at the 75<sup>th</sup> platinum jubilee session of the Indian Science Congress which fetched him a scientist post at CSIR-RRL (presently CSIR-NIIST), Thiruvananthapuram. His hard work and commitments made him known in the field of chemistry of organic functional materials. He introduced a new class of soft materials namely pi-gels and



studied the fundamental science behind the creation of such materials, which was widely accepted by the scientific community. Quality of his publications (162) are well appreciated and his work is well cited with more than 13000 citations with an h-index of 56. His research findings in the area of fluorescent molecular assemblies have translational potential to be applied as security labels for currency and documents and also for diagnostic purpose.

His research contributions are recognized with several prestigious awards including the **Shanti Swarup Bhatnagar Prize for Chemical Sciences (2007)**, the **Infosys Science Prize (2012)**, the **Silver Medal of the Chemical Research Society of India (2013)** and the **TWAS Prize for Chemistry 2013**. He was a **Swarnajayanti Fellow** and **Ramanna Fellow** of the DST, Govt. India and a **DAE Outstanding Researcher**. He is a recipient of The Thomson Reuters India Research Front citation award and the Clarivate Analytics (Web of Science) citation award 2017. He is a **Fellow of the three major Science Academies of India, an honorary fellow of the Kerala Academy of Sciences and a fellow of the World Academy of Sciences**. **Currently, he is a J. C. Bose National fellow of the DST-SERB, Govt. India and presently, the Director of CSIR-NIIST.**

Ajayaghosh is in the editorial board of several international and national journals. Since 2013, he serves as an Associate Editor of PCCP (RSC Journal) and as a senior editor of the Bulletin of the Chemical Society of Japan. He has been in the Editorial/Advisory Boards of Chemistry – An Asian Journal, RSC Advances, ChemPhotoChem, Accounts of Chemical Research and ACS Omega.

He has published 162 research papers of high quality, contributed to five book chapters and filed 13 patents. He has mentored 25 researchers for Ph. D. and more than 50 students for their master thesis. He has been a plenary or invited speaker to many national and international conferences and has delivered more than 300 scientific lectures. Ajayaghosh has published the maximum number of research papers in the journal Angewandte Chemie by an Indian scientist for which his author profile has been

featured in the same journal. He is the first chemist to receive the Infosys prize for physical sciences.

He has been helping many research, academic and funding institutions in the country by being in the selection committee, research council, board of studies and governing body.

He has been keenly interested in mentoring and motivating young scientists and students, several of them are faculties in academic and research institutions in India and abroad.

Ajayaghosh has proved his leadership quality at various levels in CSIR. He has a rich experience of research and administration for over 30 years in CSIR-NIIST at various levels as a scientist, project leader, Head of the Section, Head of the Division, as Dean of AcSIR and as the Director.

Ajayaghosh has a steady professional growth from a scientist at CSIR-NIIST to a CSIR Outstanding Scientist (Scientist H) and as the Director of the institute (since 2015), through hard work, determination and commitments and with the support his peers and colleagues. His leadership as the Director has fetched the institute a commendable achievement as one of the top publically funded R&D institutes in the country. As the Director of NIIST, he is leading and mentoring several industrially and socially relevant research problems and identified 5 major technologies for commercialization, in addition to the high quality human resource development through various academic programmes. Under his leadership, the institute has earned 30% external cash flow when compared to the CSIR expenditure to the institute which is in accordance with the Dehradun declaration.

In addition to the research and administrative responsibilities, Ajayaghosh is actively involved in science education, science popularization, science awareness programmes, organising conferences, workshops etc. He is passionate to give motivational science lectures to students of rural villages and government schools and colleges.

#### Infosys Science Prize: Jury Citation

Dr. Ajayaghosh has done landmark work that has advanced supramolecular chemistry, most especially in investigations that have led to the design and synthesis of molecular assemblies called organogels (pi-gels), a new class of materials with great potential for photonic and electronic applications. He has demonstrated that these self-assembled nanomaterials can be used to control the electronic energy transfer processes, paving the way for the development of superior light harvesting devices. He has synthesized and characterized nanomaterials that can be employed in organic electronic devices and in optical sensors to detect tiny amounts of TNT and many other biologically relevant substances.

# Curriculum Vitae

**Ayyappanpillai Ajayaghosh, FASc., FNASc., FNA, FTWAS**

**Director**

National Institute for Interdisciplinary Science and Technology (NIIST)

CSIR, Thiruvananthapuram 695 019

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**Professor, Chemical Sciences**

Academy of Scientific and Innovative Research (AcSIR)

## Personal Details:

**Date and place of birth** : July 30, 1962, Quilon, Kerala

**Nationality** : Indian

**Marital Status** : Married (Two children)

**Name of Spouse** : Ambili Ajayaghosh

**Present Position** : Director

**Residence** : Devadaru, TC 55/191, Kuttikkadu Lane  
Kaimanam, Pappanamcode P. O.  
Thiruvananthapuram 695 018, India  
Phone: +91 471 2491 592

## Academic Details:

DEGREE	YEAR	UNIVERSITY	CLASS	SUBJECT
B.Sc.	1982	Kerala	First	Chemistry
M. Sc.	1984	Calicut	First	Chemistry
Ph. D.	1989	Calicut	Best Thesis Award	Chemistry

### **Employment Record:**

1. **Scientist B** at the Photochemistry Research Unit, Regional Research Laboratory, Thiruvananthapuram from March 07, 1988 to March 06, 1991.
2. **Scientist C** at the Photochemistry Research Unit, Regional Research Laboratory, Thiruvananthapuram from March, 07, 1991 to March 06, 1996.
3. **Scientist E-I** at the Photochemistry Research Unit, Regional Research Laboratory, Thiruvananthapuram from March, 07, 1996 to December 31, 2000.
4. **Scientist E-II** at the Photosciences and Photonics Group, CSIR-NIIST, Thiruvananthapuram from January, 01, 2001 to December 31, 2004.
5. **Scientist F** at the Chemical Science and Technology Division, CSIR-NIIST, Thiruvananthapuram from January 2005 - July 2010.
6. **CSIR Outstanding Scientist (Director Level)** at CSIR-NIIST, Thiruvananthapuram from July 2010 – June 2015.
7. **Director** at CSIR-NIIST, Thiruvananthapuram from June 2015– till-date.

### **Research Experience**

30 Years of research experience in the area of organic and macromolecular materials at the National Institute for Interdisciplinary Science and Technology (NIIST), CSIR, Thiruvananthapuram (1988 - to-date)

### **Academic/Teaching Experience**

**Visiting Faculty**, University of Tsukuba, October-December 2004

**Adjunct Professor**, IIT Kanpur 2002-2008

**Visiting Professor**, University of Osaka, July-September 2007

**Professor (Outstanding)**, AcSIR 2010-till date

**Dean**, Chemical Sciences, AcSIR 2010-2017

### **Administrative Responsibilities:**

1. **Head of the department**, Photosciences and Photonics, CSIR-NIIST, 2007-09
2. **Head of the department**, Chemical Sciences and technology Division, 2009-11
3. **Director-in-charge**, CSIR-NIIST, several occasion during 2010-2014
4. **Dean, Chemical Sciences, AcSIR**, 2011- July 2017
5. **Director**, CSIR-NIIST since June 2015

### **Major Awards**

1. **Young Scientist Medal (1988)**, by the Indian Science Congress Association, India.
2. **INSA Young Scientist Medal (1991)**, by the Indian National Science Academy, New Delhi.
3. **CRSI Bronze Medal (2002)**, by the Chemical Research Society of India.

4. **MRSI Medal (2007)**, by Material Research Society of India.
5. **Shanti Swarup Bhatnagar Prize (2007)**, awarded by CSIR, Govt. India.
6. **DAE Outstanding Researcher Award (2009)**, awarded by Dept. Atomic Energy, Govt. India.
7. **Thomson Reuters Research Excellence-India Research Front Award (2009)**.
8. **The Infosys Prize for Physical Sciences 2012** by Infosys Science Foundation.
9. **Khwarizmi International Award 2012** by Iranian Organisation for Science and Technology.
10. **Swadeshi Innovation Award 2012** by the Swadeshi Science Movement, Kerala.
11. **Sri Vidyadhiraja Samskrithi Puraskaram 2013** by Panmana Ashram, Quilon, Kerala.
12. **CRSI Silver Medal 2013** by Chemical Research Society of India.
13. **TWAS Chemistry Prize 2013** by The World Academy of Sciences, Trieste, Italy.
14. **ISAS National Award for Excellence in Science and Technology 2014** by Indian Society of Analytical Scientists.
15. **CHEMTECH CEW Award 2015** for Leadership and Excellence in Research and Development.
16. **J. C. Bose National Fellowship, 2015**, DST, Govt. India.
17. **Web of Science-India Research Excellence-Citation Award 2017** by Clarivate Analytics

### Other Honors

1. **Certificate of Merit (1987)** from the Indian Chemical Society for the best paper presentation, at the Convention of Chemists, 1987
2. **Special Award and Citation (1988)** of the Syndicate of Calicut University, Kerala, India for outstanding research contributions during 1985-1988
3. **Swarnajayanti Research Grant (2001)**, Special research grant to outstanding young researchers by DST, Govt. India
4. **Ramanna Fellow, DST (2007)**
5. **Adjunct Professor**, Material Science Programme, IIT, Kanpur
6. **Dean**, Chemical Sciences, Academy of Scientific and Innovative Research (AcSIR)
7. **A. V. Rama Rao Foundation Award Lecture** of JNCASR, Bangalore (2012)
8. **R. A. Mashelkar Endowment**, NCL Pune (2012)
9. **Chair on Nanoscience and Nanotechnology**, Centre for Nanoscience and Nanotechnology, Mahatma Gandhi University, Kottayam, Kerala, 2013
10. **Prof. K. K. M. Yusuff Endowment**, Cochin University of Science and Technology, 2013
11. **CHEMCON** distinguished speaker award, 2016.
12. **ISCB-2017** Award given by Indian Society of Chemists and Biologists.

### Academy Fellowships

1. **Fellow, Indian Academy of Sciences, Bangalore (2006)**
2. **Fellow, National Academy of Sciences, Allahabad, India (2011)**
3. **Fellow, Indian National Science Academy, New Delhi (2012)**
4. **Honorary Fellow, Kerala Academy of Sciences (2013)**
5. **Fellow, Royal Society of Chemistry, London (2014)**
6. **Fellow, The world Academy of Science (2015)**

### Research Fellowships

1. **INSA-JSPS Exchange Fellow (1993)**, Chiba University, Japan during Aug.1993 Dec.1993
2. **Alexander von Humboldt Fellow (1994)**, Max-Planck-Institut für Strahlenchemie, Germany, 1994-1996
3. **DST-DAAD Exchange Fellow (2001)**, University of Regensburg, Germany
4. **INSA-JSPS Exchange Fellow (2003)**, AIST Tsukuba, Japan during July-Sept.2003

### Past and Present Editorial Assignments

1. **Editorial board member**, Resonance, 2003 (Term completed)
2. **Editorial Board Member**, J. Chem. Sci. (Indian Academy of Science) (Term completed)
3. **International Editorial Advisory Board Member**, ACS Applied Materials & Interfaces (Term completed)
4. **International Editorial Advisory Board Member**, Chemistry – An Asian Journal (Term Completed)
5. **Associate Editor, Physical Chemistry Chemical Physics**, Royal Society of Chemistry (Ongoing)
6. **Senior Editor**, Bulletin of the Chemical Society of Japan (ongoing)
7. **Editorial Advisory Board Member**, RSC Advances, Royal Society of Chemistry (Ongoing)
8. **Editorial Adviosry Board Member**, Accounts of Chemical Research, American Chemical Society (Ongoing)
9. **Editorial Board Member**, Chemistry – An Asian Journal, Wiley-VCH (Ongoing)
10. **Editorial Board Member**, ChemPhotoChem, Wiley-VCH (Ongoing)
11. **Editorial Advisory Board Member**, ACS Omega, American Chemical Society (From January 2018 onward)

### Membership in Academic and Research Advisory Boards

1. **Member, Board of Post-Graduate Studies in Chemistry (2001-2003)**, Mahatma Gandhi University, Kottayam, India (Completed)

2. **Member**, Board of Studies, Chemistry, CUSAT, Kerala (Completed)
3. **Chairman**, Board of Studies in Nanoscience and Technology, Univ. Kerala (Completed)
4. **Member, Research Council**, CSIR-North East Institute of Science and Technology, CSIR, Jorhat (2008-2010, Completed)
5. **Member, Research Council**, CSIR-NCL, Pune (Completed)
6. **Council Member**, Indo-French Centre for Promotion of Sciences (CEFIPRA)
7. **Member, Director Board**, Asian Nanoscience and Nanotechnology Association, Japan
8. **Member, Governing Board**, Sreenivasa Ramanujan Institute of Basic Sciences, Kottayam, Kerala
9. **Council member**, Chemical Research Society of India
10. **Member, Research Council**, CSIR-Indian Institute of Petroleum, Dehradun
11. **Sectional committee member**, chemical sciences, Indian Academy of Sciences, Begaluru
12. **Sectional committee member**, chemical sciences, Indian National Science Academy, New Delhi
13. **Member, Research Council**, CSIR-NCL, Pune
14. **Member, Board of Management**, IIST, Thiruvananthapuram

### **Association with Professional Bodies**

1. Life member, Chemical Research Society of India
2. Life member, Materials Research Society of India
3. Life member, Society for Polymer Science, India
4. Vice-president, Society for Polymer Science, India Trivandrum Chapter (Completed)
5. President, Society for Polymer Science, India Trivandrum Chapter
6. National Vice-president, Society for Polymers Science India

### **Research Interests**

1. **Macromolecular Chemistry** : (Polymer-based sensors, Conducting polymers, Low band gap polymers, Light emitting polymers)
2. **Functional Organic Materials** : (Organic dyes, Light emitting materials, Molecular sensors and Molecular probes)
3. **Supramolecular Chemistry** : (Molecular self-assembly, Organogels, Nanostructures)

### **Brief Description of Research Contributions and Scope of the Work:**

One of the grand challenges in chemistry, in the 21st century, is to understand the role of relatively weak noncovalent bonds in the construction of functional supramolecular architectures. Ajayaghosh has made original contributions in advancing the field of supramolecular chemistry, especially in the design and synthesis of molecular assemblies called pi-gels, a new class of materials formed out of organic pi-systems with great potential for photonic and electronic applications. To control both the size and shape of these soft nanomaterials, he designed hydrogen bond functionalities into fluorophores called phenylenevinylenes, to optimize weak noncovalent attractive interactions between the aromatic cores of the monomer units. These cleverly designed molecules self-assemble to nanoscale supramolecular architectures through hydrogen bond / aromatic-aromatic attractive interactions. Dr. Ajayaghosh was the first investigator to make functional pi-gelators designed from linear pi-systems as building blocks. He has shown that these self-assembled nanomaterials can be used as a soft scaffold to control electronic energy transfer processes, paving the way for the development of superior light harvesting devices. His 2001 paper in the journal of the *American Chemical Society* (*J. Am. Chem. Soc.* 2001, 123, 5148-5149) cleared the way for systematic exploration and exploitation of the properties of these designer organogels. He built on this early work in the construction of aesthetically appealing but functionally useful nanomaterials that can be employed for energy conversion and in optical sensors to detect tiny amounts of TNT and many other molecules of relevance. He is a leader in this exciting new area of materials chemistry. He has been recognised both nationally internationally for his research contributions in the field of molecular assemblies and soft materials. His publications are well cited in the literature. He has been an invited speaker to many national and international conferences on his research findings. He has motivated a large number of young researchers in the country and abroad and many of them are working on similar topics.

**Infosys Prize Jury Citation:**

Dr. Ajayaghosh has done landmark work that has advanced supramolecular chemistry, most especially in investigations that have led to the design and synthesis of molecular assemblies called organogels (pi-gels), a new class of materials with great potential for photonic and electronic applications. He has demonstrated that these self-assembled nanomaterials can be used to control the electronic energy transfer processes, paving the way for the development of superior light harvesting devices. He has synthesized and characterized nanomaterials that can be employed in organic electronic devices and in optical sensors to detect tiny amounts of TNT and many other biologically relevant substances.



## Research Supervision

- |    |                         |      |
|----|-------------------------|------|
| 1. | M. Sc. Students Trained | : 54 |
| 2. | Ph. D. Awarded          | : 25 |
| 3. | Ph. D. Theis Submitted  | : 02 |
| 4. | Ph. D. Ongoing          | : 09 |

## Major Projects Handled

1. DST project entitled "Organic Dye Based Macromolecular Electronic Conductors, Receptors and Noncovalent Assemblies: Synthesis and Properties of Novel Materials Derived from Oligo- and Polysquaraines." 1998-2001
2. DST project entitled "Crafting of Macromolecular Materials from Supramolecular Assemblies", under the Swarnajayanti scheme, 2001-2006.
3. DST project entitled "Chiral  $\pi$ -Electronic Gels and Helical Nanostructures: Self-Assembly of Conjugated Molecules to Photoactive Organic Materials" under invited category, 2004-2007.
4. Ramanna Fellowship programme entitled as "Photoactive Supramolecular Architectures: Design and Applications", 2006-2009.
5. DST project entitled "Functional nanomaterials of  $\pi$ -Conjugated Molecules", under the DST Nanoscience and Technology Initiatives, 2007-2010.
6. Indo-French project entitled, "Functional Hybrid Nanomaterials of Polymeric Gels and  $\pi$ -Conjugated Self-assemblies", supported by CEFIPRA, New Delhi, 2007-2010.
7. "Energy Efficient Organic Materials" CSIR Network programme, 2007-2012.
8. "Molecular and Supramolecular Architectures with Optoelectronic Functions", DAE, 2009-2014.
9. DBT project entitled "Detection of Zinc in Epileptic Condition Using Ratiometric Fluorescent Molecular Probes", 2013-2016.
10. DST J. C. Bose National Fellowship project entitled "Fluorescent Molecules and Assemblies for Sensing and Imaging" 2015 (on going).

**Invited Talks:** Approximately 280 (These include invited lectures and plenary talks in various national and international conferences).

## Recent Plenary Talks in Conferences:

1. Squaraines as molecular probes and self-assembly modules, East Asia Symposium on Advanced Materials and Functional Dyes, Osaka, Japan, June 2-6, 2009.
2. Self-assembled soft materials with tunable properties, International Conference on Materials for the Millennium (MATCON 2010), Kochi, India, January 11-13, 2010.

5. The chemistry and applications of self-assembled functional molecules, Kuwait Conference of Chemistry, Kuwait, March 6-9, 2010.
5. Self-assembled Soft Materials with Tunable Fluorescence and Their Application in Imaging, International Conference on Materials Science and Technology (ICMST 2010), Trivandrum, November 28-30, 2010.
6. Rationally Designed Molecular Probes for Analyte Sensing. International Analytical Science Congress, Kochi, November 24-27, 2010.
7. Fluorescent Noncovalent Macromolecular Architectures and Organogels from Thermal Imaging, Macro 2010, International Conference on Polymer Science and Technology, New Delhi, December, 14-17, 2010.
8. Superhydrophobic CNT Nanocomposites of Molecular Self-assemblies, Cochin Nano, International Conference on Nanoscience and Technology, Kochi, August 14-17, 2011.
9. New Fluorophores for Analyte Sensing and Bioimaging, 5th East Asia Symposium on Functional Dyes and Advanced Materials, Hanzhou, China, September 25-29, 2011.
10. Self-assembled Organic Nanostructures, International Conference on Nanomaterials (ICN 2012), MG University, Kottayam, India, January 13-14, 2012.
11. New Fluorophores for Analyte Sensing, Cell Imaging and Protein Labeling, Indian Analytical Science Congress, Kanyakumari, India, January 27-28, 2012.
12. R. A. Mashelkar Endowment Lecture, NCL Pune, August 13, 2012.
13. Supramolecular Polymerization of Fluorescent  $\pi$ -Systems and Their Properties, PolyTech 2012, Pune, December 15-17, 2012.
14. Molecular Assemblies with Diverse Architectures and Exceptional Properties, Chennai Chemistry Conference, CSIR-CLRI, February 8-10, 2013.
15. Molecular Assemblies in Energy, Environment and Health, Indian Society for Analytical Scientists Conference, Goa, August 15-17, 2013.
16. Molecular Aggregates and Hierarchical Assemblies of  $\pi$ -Systems, 5<sup>th</sup> ACCIS, North Bengal University, Darjeeling, November 21-23, 2013.
17. The Power of Fluorescent Molecular Assemblies, ICANN 2013, IIT Guwahati, December 1-3, 2013.
18. Photoresponsive Supramolecular Assemblies and Gels, Conference on Light in Chemistry, Materials and Biology, IIT Kharagpur, February 24-25, 2014.
19. The Azobenzene Photoswitch and Supramolecular Chirality, Asian Photochemistry Conference, Trivandrum, November 10-14, 2014.
20. Excited State Properties of Supramolecular Polymers and Organogels, 10<sup>th</sup> International Polymer Conference, Society for Polymer Science Japan, Tsukuba, Japan, December 2-5, 2014.
21. Electronic Properties of Thiophene Based Supramolecular Polymers and Organogels, Macro 2015, IACS, Kolkata, January 23-26, 2015.

22. Organic Semiconductor Assemblies for Energy Efficient Devices, IC-EEE, CUSAT, Kochi, February 4-6, 2015.
23. Linear-Systems Based Supramolecular Polymers and Hybrid Materials, APM 2015, IISc, Bangalore, February 19-21, 2015.
24. Nanoarchitectures by Molecular Assembly: A Case of a Self-cleaning Material, Nanoscience and Nanotechnology, Kerala University, Thiruvananthapuram, March 19-20, 2015.
25. Molecular Self-assembly and Self-cleaning Materials, National Conference on Smart Materials, Calicut University, March 24-25, 2015.
26. Fluorescent Molecular Assemblies for Sensing and Imaging, RAINSAT 2015, Sathyabhama University, Chennai, July 8-10, 2015.
27. Fluorescent Molecular Assemblies for sensing and imaging, ICNDC 2015, BITS Pilani, October 16-18, 2015.
28. Stimuli Responsive Fluorescent Molecular Assemblies, Challenges in Organic Materials and Supramolecular Chemistry (RSC ISACS 18), November 19-21, 2015.
29. Stimuli Responsive Fluorescent Molecular Assemblies, ICNEECS-15, Madurai Kamraj University, December 10-11, 2015.
30. Mimicking Natural Self-cleaning Property with Artificial Materials, Cochin Nano, CUSAT, Kochi, February 20-23, 2016.

## Foreign Visits

1. Chiba University, Japan, INSA-JSPS exchange scientist at the Department of Image Science, Aug-Dec 1993
2. Max-Planck Institut für Strahlenchemie, Mülheim, Germany, Alexander von Humboldt Fellow, Sep 1994-Feb 1996
3. University of Regensburg, Germany, DST-DAAD visiting scientist at the Institute for Organic Chemistry, Apr-Jun 1999
4. National Institute of Advanced Material Research, Tsukuba, Japan, INSA-JSPS exchange scientist, Jul-Sep 2003
5. Institute Charles Sadron, Strasbourg, France, Invited talk, Indo-French Symposium on Fibrillar Networks as Advanced Materials, Sep 2005
6. National University of Singapore, Singapore, Invite lectures at Nanyang Technological University, Nov 2005
7. National Taiwan Normal University, Tamkang University, National Tsing Hua University, National Taiwan University, Taiwan, Invited lecture, Nov 2005
8. Osaka, Japan, Invited lecture, International Conference on Functional pi-Systems, May 2006
9. Chiba University, Japan, DST-JSPS Exchange Project, Nov 2006

10. University of California, Irvine, United States of America, Invited lecture, Indo-US frontiers of Science Symposium, Jan 2007
11. University of Osaka, Japan, Visiting Professor, Jul 2007
12. Dinard, France, Invited lecture at IFCOS meeting, Sep 2007
13. University of Dresden, Germany, Invited talk, International conference on Reactive polymers, Sep 2007
14. Arcachon, France, Invited talk, Aquitaine conference on Polymers, Oct 2007
15. University of Chiba, Japan, DST-JSPS exchange visit, Feb 2008
16. Chinese Academy of Sciences, China, Invited Talk, Nov 2008
17. National Institute of Materials, Tsukuba, Japan, Invited visiting Scientist, Dec 2008
18. Institute Charles Sadron, Strasbourg, France, For carrying out research work on IFCPAR Project, Mar-Apr 2009
19. National Institute of Materials, Tsukuba, Osaka, Plenary talk at the East Asia Symposium, May-Jun 2009
20. Rio de Jeniro, Brazil, A member of Indian delegation to participate in a Indo-Brazil symposium on Advanced Materials, Sep 2009
21. Kuwait, Plenary Lecture at Kuwait Conference of Chemistry, Mar 2010
22. Krutyn Summer School, Poland, Invited Speaker, FINELUMEN Vith International Krutyn Summer School IKSS2010, Jun 2010
23. Kyoto, Japan, Invited Lecture, International Conference on Science and Technology of Synthetic Metals, Jul 2010
24. Grenoble, France, invited talk in the Indo-French Center for Organic Synthesis (IFCOS) meeting, Sep 2010
25. Australian National University and Monash University, Australia, Invited talk, Nov 2010
26. Yonsei University and Seoul National University, Korea, Invited talk and Scientific Discussions at The Korean Chemical Society and another talk at Seoul National University, Apr 2011
27. NIMS, Tsukuba, Japan, Indo-Japan joint project (DST-JSPS), Aug-Sep 2011
28. Bangkok, Thailand, Invited Talk at 14th Asian Chemical Congress, Sep 2011
29. Hangzhou, China, plenary talk at 5th East Asia Symposium on Functional Dyes & Advanced Materials, Sep 2011
30. Beijing, China, Invited talk at the 10th "International Symposium on Functional pi electron systems", Oct 2011
31. AIST, Takamatsu and NIMS, Tsukuba, Japan Japan-India bilateral seminar on Supramolecular Nanomaterials for Energy Innovation, AIST, Takamatsu, Japan DST-JSPS research collaboration Oct 2012
32. University of Namur, Belgium, Special invitation for a departmental seminar and for conducting a Ph. D. Examination, Nov 2012

33. Iranian Research Organization for Science and Technology (IROST) – Khwarizmi International Award (KIA) – Secretariat, Iran, To receive the 26th Khwarizmi International Award (KIA), Tehran, Iran, Feb 2013
34. Brussels, Belgium, Editors Symposium at the Royal Society of Chemistry, Mar 2013
35. Autrans and Grenoble, France, 51st Scientific Council and 22nd Industrial Research Committee meetings and Seminar on "Successful Indo-French S&T Cooperation: CEFIPRA", May 2013
36. Taipei, Taiwan, invited speaker in the "15th International Symposium on Novel Aromatic Compounds" (ISNA-15), Jul-Aug 2013
37. NIMS, Tsukuba, Japan, Indo-Japan Joint Project (DST-JSPS), Oct 2013
38. Okayama University of Science, Okayama, Japan, invited speaker at the 10th Green Elements Research Symposium, Dec 2013
39. Kumamoto University, Japan, invited speaker at the 4th PHOENICS international symposium at Kumamoto Institute for Photo-Electro Organics, Feb-Mar 2014
40. France, 53rd Scientific Council and 24th Industrial Research Committee meetings and the Vision Group meeting of CEFIPRA, May 2014
41. Bordeaux, France, Invited lecture at the XXVth IUPAC Symposium on Photochemistry, Jul 2014
42. NUS, Singapore, Invited lecture at the Humboldt Kolleg symposium on Environment and Health in 21st Century, Sept 2014
43. Sultan Qaboos University, Muscat, to participate in TWAS 25th General Meeting and receive TWAS 2013 Prize in Chemistry, Oct 2014
44. Osaka University, Japan, Indo-Japan Joint Project (DST-JSPS) Osaka University, Japan and International Polymer Conference (IPC), Nov-Dec 2014
45. Tokyo, Japan, Invited Talk at the 2014 International Symposium on Supramolecular Chemistry & Functional Materials organized by CEMS, Tokyo, Japan, Dec 2014
46. Germany, Invited lecture at the conference at the Residence of Wurzburg. Wurzburg, Germany, March 2015
47. Australia, Visiting Professor for scientific discussion and invited talks, Institute for Frontier Materials at Deakin University, Australia, Apr-May 2015
48. France, 55<sup>th</sup> Scientific Council and 26<sup>th</sup> Industrial Research Committee meetings and Outreach Programme at Nice, France, May-Jun 2015
49. Japan, Indo-Japan joint project (DST-JSPS) Osaka Prefecture University, Japan, Sept 2015
50. London, Editor's Symposium of the Royal Society of Chemistry (RSC), Feb 2016
51. Japan, In connection with the joint research project under DST-JSPS bilateral agreement, Visit to NORITAKE CO. LTD to discuss the ongoing and future collaborative programmes and discussion with Fuji Films, October 2016

**List of Publications: 162** (H-index: 54 as of May 2018)

162. A Cyclometalated Ir(III) Complex as Lysosome Targeted Photodynamic Therapeutic Agent for Integrated Imaging and Therapy in Cancer Cells  
K. V. Sudheesh, P. S. Jayaram, A. Samanta, K. S. Bejoymohandas, R. S. Jayasree and **A. Ajayaghosh**  
**Chem. –Eur. J.** **2018**, DOI 10.1002/chem.201801918.
161. Supramolecular Reassembly of Self-Exfoliated Ionic Covalent Organic Nanosheets for Label-Free Detection of dsDNA.  
A. Mal, R. K. Mishra, V. K. Praveen, M. A. Khayum, R. Banerjee and **A. Ajayaghosh**  
**Angew. Chem., Int. Ed.** **2018**, DOI: 10.1002/anie.201801352.
160. A Hybrid Organogel of a Low Band Gap Diketopyrrolopyrrole with PC<sub>71</sub>BM: Phase Separated Morphology and Enhanced Photoconductivity.  
S. Ghosh, S. Das, A. Saeki, V. K. Praveen, S. Seki and **A. Ajayaghosh**  
**ChemNanoMat** **2018**, DOI: 10.1002/cnma.201800149.
159. Hybrid Materials of 1D and 2D Carbon Allotropes and Synthetic  $\pi$ -Systems  
B. Vedhanarayanan, V. K. Praveen, G. Das and **A. Ajayaghosh**  
**NPG Asia Mater.** **2018**, DOI: 10.1038/s41427-018-0017-6.
158. Stepwise Control of Host-Guest Interaction Using a Coordination Polymer  
R. D. Mukhopadhyay, G. Das and **A. Ajayaghosh**  
**Nat. Commun.** **2018**, 9, 1987.
157. Transforming a C<sub>3</sub>-Symmetrical Liquid Crystal to a  $\pi$ -Gelator by Alkoxy Chain Variation  
A. Sandeep, V. K. Praveen, D. S. Shankar Rao, S. Krishna Prasad and **A. Ajayaghosh**  
**ACS Omega** **2018**, 3, 4392.
156. Self-Assembly of Bodipy-Derived Extended  $\pi$ -Systems  
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### **Patents Filed/Granted**

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2. White light emitting organogel and process thereof – PCT/IN08/00372 (Pub. No. WO/2009/084006, NF No. 0106NF2007/IN Grant Date. 02/09/2015, Patent No. 268527)
3. Pyrrole end-capped bipyridine assay powder for selective detection of zinc ions and a process for the preparation thereof – (Pub. No. WO/2009/084007, Appl. No. PCT/IN08/00374, NF No. 0105NF2007/WO)
4. A Fluorescent composite film material for security documentation and detection of chlorinated solvent vapors and a process for preparation thereof-(Appl. No. 0576DEL2010, NF No. 0050NF2009/IN)
5. A reusable thiophene end capped bipyridine fluorescent assay for the detection of cyanide anions in aqueous and biorelevant samples and a process thereof (Appl. No. 1899DEL2009, NF No. 0122NF2009/IN)
6. Molecular probes with high fluorescence for solid-state lighting, selective discrimination of counteranions of zinc, two photon imaging (Appl. No. 0367DEL2011, NF No. 0170NF2010/IN) JP Patent Granted (NF No. 0170NF2010/JP, Grant Date. 10/07/2015, Patent No. 5773377)
7. Fluorescent materials for self-erasable writing, authentic security labeling, currency counterfeit prevention and process for the preparation thereof (Appl. No. 2294DEL2011, NF No. 0139NF2011/IN) US Patent Accepted (US 2013/0209665 A1, Aug. 15,2013) US Patent Granted (Grant Date. 21/04/2015, Patent No. 9012688)

8. A squaraine based fluorescent probe and a process for the preparation thereof (NF No. 0180NF2012)
9. Method of preparation of urease and gold quantum cluster mediated nanobiosensor for the detection of blood urea and the process involved (Appl. No. 1567/CHE/2012 NF No. IN201201567-14).
10. Composite of a Supramolecular Black dye and Elastomer as a Near Infrared (NIR) Filter for Photography, Security and Forensic Related Applications (*Patent number*: 201711002216).
11. Development of Superhydrophobic Coatings for Energy Saving Mechanical Motion and Related Applications (Application Number: 0165NF2017).
12. Hybrid Planar Light Concentrator with Adaptable Transparency (Provisional Application No. 201811008500) 2018.
13. Process for the Preparation of Pyrylium Salts (Application No. 201811004385) 2018.

### **Technologies developed / under commercialization**

Some of the fluorescent materials, NIR dyes and hybrid materials developed by Ajayaghosh's research group are patented and are further under evaluation for security and energy saving applications. For example, a fluorescent molecular assembly developed by his team exhibits fluorescence color change when comes in contact with water which is demonstrated as security label for currencies and documents. A near infrared transmitting dye has been developed and used as a security ink for invisible barcode printing. Flexible lense coated with this ink can be used for NIR photography.

A superhydrophobic material based coating formulation has been developed for the underwater coating of aquatic vessels for energy saving application. This material has been shown to be useful for removing oil spill. Negotiations with industries are in progress for further developing commercially viable coating formulations.

A hybrid planar light concentrator (HPLC) system with switchable transparency modes and improved lateral light concentration by integrating geometrical optics and luminescent light concentrator technologies has been filed for patent. The technology is enabled by steering a luminescent liquid waveguide (LLW) into the void space of light couplers embedded in the planar light concentrator (PLC), wherein the refractive index (RI) of the LLW is matched with the RI of PLC to achieve switchable transparency modes. This HPLC system will leads

to a multifunctional power window when coupled with a photovoltaic (PV) cell and hence can function as a smart window that controls incident light propagation, at the same time generate electricity using the laterally directed light. Asahi Glass is interested in further developing this technology and is currently under discussion.

Currently, Ajayaghosh is leading a team for the production of large area dye sensitized light conversion devices for the conversion of indoor light into electricity for IoT and other low power device applications. Indigeneous production of large area devices is a challenge and unmet need of the country. In collaboration with Elixir Technologies NIIST is developing indigeneous large area device fabrication facility with the support of DST. Such devices will be integrated with indoor table tops and walls to generate low power required for various sensors and IoT devices. This is a priority area of of Government of India under the Make-in-India programme.

As the Director, Ajayaghosh is the mentor of a major technology developed by NIIST for the beneficiation of ilmenite to synthetic rutile, a raw material for  $\text{TiO}_2$  production. The new ecofriendly technology of NIIST minimizes the use of acid leaching and can convert ilmenite with 50-60%  $\text{TiO}_2$  to above 92%  $\text{TiO}_2$ . A pilot plant trial run has been successfully completed jointly with M/s V. V. Minerals. CSIR-NIIST is presently negotiating with M/s. VV Minerals for marketing the above technology for setting up of a commercial plant of 30000 tonnes synthetic rutile per year. Efforts are also on for commercialising the above technology with the other mining industries such as Trimex Sands and Ashapura Chemicals.



## Cover pages in journals:



## Infosys Science Foundation Prize Description

The Infosys Prize for Physical Sciences is awarded to Dr. A. Ajayaghosh for his pioneering development of methods for the construction of supramolecular functional materials, which can be employed as components in organic electronic devices and in powerful substance selective optical sensing and imaging.

Congratulatory Message From Jury Chair: Prof. Shrinivas Kulkarni

"The committee was impressed with two of his achievements. The first one was development of superior light harvesting devices. These are devices which can convert light to energy i.e.

photonic. And the second area was the detection of very tiny amounts, centigrams of TNT and other dangerous substances with a rather simple step."

### **Bio**

Dr. A. Ajayaghosh was appointed the Director of the National Institute for Interdisciplinary Science and Technology (CSIR-NIIST), Thiruvananthapuram, India, in June, 2015. He obtained his Master's degree in Science (1984) from Kerala University and a Ph. D (1988) from Calicut University. He joined the Regional Research Laboratory, CSIR (presently CSIR-NIIST), as a Scientist in 1988. He was the Alexander von Humboldt Fellow at the Max Plank Institute for Strahlen Chemie, Germany (1994-96).

He has received several awards such as the Thomson Reuters Research Excellence Award (2009), the Outstanding Researcher Award of the Department of Atomic Energy (DAE) (2009), the Ramanna Fellowship of the Department of Science and Technology, India (DST) (2007) and the Shanti Swarup Bhatnagar Prize for Chemical Sciences (2007).

He has published several articles, book chapters and filed patents in the areas of molecular self-assembly, molecular probes and fluorescent materials. He is a Fellow of all the three Science Academies of India, and is on the international advisory board of the journal, *Chemistry-An Asian Journal*. He is holding an additional position as the Dean of Chemical Sciences, Academy of Scientific and Innovative Research (AcSIR), CSIR, New Delhi.

### Scope Of Work

One of the grand challenges in chemistry, in the 21st century, is to understand the role of relatively weak noncovalent bonds in the construction of functional supramolecular architectures. Dr. Ajayaghosh has done brilliant work in advancing the field of supramolecular chemistry, especially in the design and synthesis of molecular assemblies called pi-gels, a new class of materials formed out of organic pi-systems with great potential for photonic and electronic applications. To control both the size and shape of these soft nanomaterials, he designed hydrogen bond functionalities into fluorophores called phenylenevinylenes, to optimize weak noncovalent attractive interactions between the aromatic cores of the monomer units. These cleverly designed molecules self-assemble to nanoscale supramolecular architectures through hydrogen bond / aromatic-aromatic attractive interactions. Dr. Ajayaghosh was the first investigator to make functional phenylenevinylene organogels from designed building blocks. He has shown that these self-assembled nanomaterials can be used as a soft scaffold to control electronic energy transfer processes, paving the way for the development of superior light harvesting devices. His 2001 paper in the journal of the *American Chemical Society (J. Am. Chem. Soc. 2001, 123, 5148-5149)* cleared the way for systematic exploration and exploitation of the properties of these designer organogels. He built on this early work in the construction of aesthetically appealing but functionally useful nanomaterials that can be employed for energy conversion and in optical sensors to detect tiny amounts of TNT and many other molecules of relevance. He is a leader in this exciting new area of materials chemistry.

## Jury Citation

Dr. Ajayaghosh has done landmark work that has advanced supramolecular chemistry, most especially in investigations that have led to the design and synthesis of molecular assemblies called organogels (pi-gels), a new class of materials with great potential for photonic and electronic applications. He has demonstrated that these self-assembled nanomaterials can be used to control the electronic energy transfer processes, paving the way for the development of superior light harvesting devices. He has synthesized and characterized nanomaterials that can be employed in organic electronic devices and in optical sensors to detect tiny amounts of TNT and many other biologically relevant substances.

## **A Few Media Links and News**

### **Men of Cutting-edge Science**

<http://www.openthemagazine.com/article/science/men-of-cutting-edge-science>

### **The 7 magnificent**

<http://newindianexpress.com/education/edex/article1418167.ece>

### **Infosys award for NIIST scientist**

<http://timesofindia.indiatimes.com/city/thiruvananthapuram/Infosys-award-for-NIIST-scientist/articleshow/17341490.cms>

### **Bonding with chemistry**

<http://www.thehindu.com/life-and-style/bonding-with-chemistry/article4265298.ece>

### **Scientist featured in German journal**

<http://www.thehindu.com/todays-paper/tp-national/tp-kerala/scientist-featured-in-german-journal/article3860934.ece>

### **Molecular mastermind**

<http://www.hindustantimes.com/News-Feed/India/Meet-India-s-bright-young-minds/Article1-367874.aspx>

### **Infosys Science Foundation**

<http://www.infosys-science-foundation.com/prize/laureates/2012/ajayaghosh.asp>

### **India's top Chemistry expert creates magic with gels**

<http://ibnlive.in.com/news/indias-top-chemistry-expert-creating-magic-with-gels/313289-3.html>

### **Invention to detect fake currency gets US patent**

<http://timesofindia.indiatimes.com/home/science/Invention-to-detect-fake-currency-gets-US-patent/articleshow/24195534.cms>

## Men of Cutting-edge Science

19 January 2013|by [Lhendup G Bhutia](#)



A renowned algebraic number theorist who plays the tabla, a biologist trying to unravel the mysteries of the human cell, a scientist who can transform the industrial-scale production of plastic materials, and another who is working on a cancer screener that can be used at home—all of them Indians at the cutting edge of science and technology who were awarded the Infosys Prize 2012

### THE SCIENTIST WHO CAN STOP COUNTERFEITERS

If Dr Ayyappanpillai Ajayaghosh, a scientist based in Thiruvananthapuram, succeeds in his latest project, a lung cancer screening process will neither require the help of a medical professional nor need to be done in a hospital. The individual can simply cough onto a strip of paper, and, under the glare of a UV torch, check if the strip changes colour. If it does not change, it would indicate that the individual is not suffering from the illness.

Dr Ajayaghosh, winner of the Physical Sciences prize, is one of the country's foremost supramolecular chemistry scientists, a relatively new field of chemistry. Here, as opposed to traditional chemistry which focuses on covalent bonds between molecules, the weaker and reversible noncovalent interactions between molecules are examined.

“Nobody knows how molecules come together to form structures. But we are trying to understand that, to understand how molecules communicate with each other, and how we can recreate molecular structures,” says the 50-year-old senior scientist at the National Institute for Interdisciplinary Science and Technology. The focus of his research is on organogels or pi-systems, a new class of molecular assemblies that possess strong fluorescent and electronic properties. Extremely sensitive to their environment, whenever these organogels come in contact with or sense a foreign surrounding, they can stop emitting light or change colour.

Using these properties, Dr Ajayaghosh has showed how such organogels can be used as security labels for important documents. For instance, currency notes can sport thin strips containing such organogels. Whenever a UV torch is beamed on it, the strip will glow. Forged notes, however, will not exhibit such a property. “I believe science should not simply be focused on theory; it should be able to provide solutions to the world’s problems. And the potential of these pi-systems is simply tremendous. From having its use as a chemical marker in diagnosing diseases, like cancer, at early stages, it can be used to detect explosives such as trinitrotoluene (TNT) and landmines,” he says. Dr Ajayaghosh has also shown that these molecular assemblies can generate electricity and be used to build superior light harvesting devices.

## **The 7 magnificent**

By Shilpa Vasudevan | Published: 14th January 2013 12:00 AM | Last Updated: 13th January 2013 03:32 PM

### **A. Ajayaghosh**

Profile: Prof Ajayaghosh, a senior scientist at National Institute for Interdisciplinary Science and Technology (NIIST), CSIR, Thiruvananthapuram, was awarded the Infosys honour for physical sciences. He obtained his master’s in science from Kerala University in 1984 and a PhD from Calicut University in 1988. He joined the Regional Research Laboratory, CSIR (presently NIIST), as a scientist in 1988. He has received several awards such as the Thomson Reuters Research Excellence Award (2009), Outstanding Researcher Award of the Department of Atomic Energy (DAE) (2009), Ramanna Fellowship of the Department of Science and Technology, India (DST) (2007), and the Shanti Swarup Bhatnagar Prize for chemical sciences (2007). He is a Fellow of the Indian Academy of Sciences, National Academy of Sciences, India, and is on the international advisory board of the journal, Chemistry-An Asian Journal. He



is a CSIR-Outstanding Scientist at CSIR-NIIST, Thiruvananthapuram and the Dean of Chemical Sciences, Academy of Scientific and Innovative Research (AcSIR), New Delhi.

**Work:** Prof Ajayaghosh has studied supramolecular chemistry, with emphasis on design and synthesis of molecular assemblies called organogels, a new class of materials with great potential for photonic and electronic applications. To control both the size and shape of these soft nanomaterials, he designed hydrogen bond functionalities into fluorophores called phenylenevinylenes, to optimise weak noncovalent attractive interactions between the aromatic cores of the monomer units. Prof Ajayaghosh was the first investigator to make functional phenylenevinylene organogels from designed building blocks. He has shown that these self-assembled nanomaterials can be used to control electronic energy transfer processes, paving the way for the development of superior light harvesting devices.

**Interests:** In between engaging in research and associate works, and the travel that comes with his academic pursuits, Prof Ajayaghosh relaxes through music and gardening.

**Winnerspeak:** Basically I am a chemist who is interested in the interdisciplinary area of chemistry with focus on advance materials. My research is about understanding how molecules can communicate to each other and how subsequently these interactions lead them (the molecules) to organise themselves to form molecular architecture. Studying this is important for designing advance materials. Research proves that there are special kinds of molecules with electronic properties that can conduct electricity, charge between molecules, emit light when excited, etc. Applications of these molecules include sensing of certain other molecules, imaging certain kinds of systems like biological cells, security applications, etc. The ultimate aim of any designer is to make sure their work is useful to the society they are in. In this regard, I want to make sure these molecules find practical applications, which have a direct bearing on common man.

## THE TIMES OF INDIA

### Invention to detect fake currency gets US patent

[Laxmi Ajai Prasanna](#) | TNN | Oct 15, 2013, 03.33 PM IST

THIRUVANANTHAPURAM: How often does one check fake currency? Rarely, though there is a 400 per cent increase in counterfeit currency circulation in the country according to the national financial intelligence unit. Now to prevent that, Kerala born outstanding scientist of CSIR's National Institute of Interdisciplinary Science and Technology (NIIST) Dr Ayyappanpillai Ajayaghosh has devised a novel scientific solution.

Ajayaghosh has invented a fluorescent material to easily identify counterfeit currency. He has

applied for patent to the US and the patent office has cleared the first hurdle by approving its publication. "The molecules developed have the potential to detect fake currency and show properties of sensors to detect diseases," NIIST director Dr.Suresh Das told TOI on Thursday. "Circulation of fake currency is a threat to the country's security and economy. Present invention provides a novel fluorescent molecule which exhibits emission colour change when in contact with moisture or water and it can be used to prevent fake currency and for security labelling," Ajayaghosh told TOI.

"On normal paper currency, when coated with this fluorescent chemical molecule, it results in blue emitting surfaces on which writing is possible using water as ink. On moistening, blue colour turns to green and images undergo self- erasal after six hours and the colour turns back to blue if it's original," Ajayaghosh said. If its fake currency, there will be no change in colour," he said.

"Possibility of using these fluorescent molecules to create Test Scrip's and cheap diagnostic kits to detect cancer and other diseases are being explored. It is a dream project and discussion is on with doctors at the Regional Cancer Centre here," he said. A patient suffering from cancer or other diseases will be prone to severe metabolic changes resulting in exhalation of 45 per cent high chemicals which may be obnoxious. The patient can be asked to directly blow through a pipe, after placing the test scrip at the vent to detect the disease. Studies are on for that, Ajayaghosh said.

"For four of his previous inventions, Ajayaghosh has already received the US patent. The publication by the US patent office for the invention of fluorescent molecule now is an indication that the US patent is expected soon," said Praveen Raj, a scientist at NIIST. His four previous inventions that received US patent include, White light emitting organogel which has potential applications in full color displays with color filters and in various lighting applications, Process of selective detection of cyanide anions which can be applied to detect cyanide content since many plants and fruits are known to contain cyanides, Pyrrole end-capped bipyridine assay powder for selective detection of zinc ions as variation in zinc concentration is reported to be responsible for neurological disorders such as Alzheimer's, Parkinson's disease and Epilepsy, then Nanocomposite material useful for the preparation super hydrophobic coating which has potential application over aircraft surfaces, especially the wings, satellite-warps and such constructs as barrier layers for transporting water through canals and water pipes and micro fluid devices.