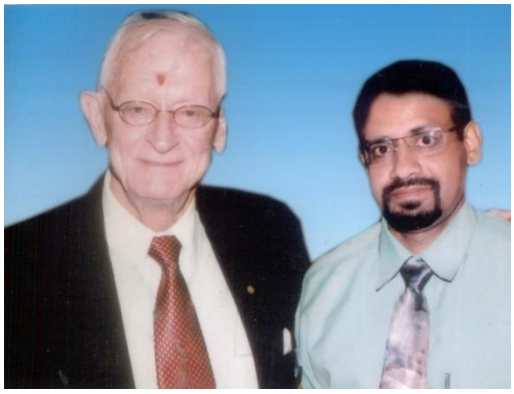

Sanjay Palsule Receiving Blessings of
Prof Alan G MacDiarmid
Noble Laureate (Chemistry 2000)

Dr SANJAY PALSULE

Associate Professor, Polymer Blends & Polymer Composites
Department of Polymer & Process Engineering
Indian Institute of Technology-Roorkee (Saharanpur India)

Education

- B E Chemical Engineering, Pt. R S University NIT Raipur India
- Ph D Heriot-Watt University, Edinburgh, Scotland UK

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Short-Bio-Data

Sanjay Palsule (b. 1967) received PhD from Heriot-Watt University, Edinburgh Scotland (UK) (January 1994) - with exemption for studies for Masters' Degree - directly after receiving B E (Chem Engg) from Pt R S University (now National Institute of Technology NIT Raipur India) (1989). The initial work (before BE Graduation) was on Poly Vinyl Chloride (1986-87 - Awarded with Young Scientists Award); and then on Polyurethanes – Ure-Alkyds (1987-88 in VSSC –ISRO awarded with All India First Prize by IIT Delhi; and published in the Journal - *Research & Industry* and Abstracted in Chemical Abstracts). After BE (ChE) the work was on Molecular Composites at QMW (University of London UK - 1990-1991) that was extended to Anoxic Molecular Composites (1991-95 at Heriot-Watt U Edinburgh UK and TU Eindhoven NL) and was patented by the European Space Agency. Since then work has been on Molecular Nano Composites, Tercet Molecular Nano Composites, Polymer Blends, Palsule process for Natural Fiber/Polymer Composites & Aerospace Polymers & Composites. Dr Palsule Discovered the science of - Anoxic Molecular Composites, Tercet Molecular Nano Composites, Macromolecular Micro Composites, Palsule process for Natural Fiber / Polymer Composites and also Palsule equation. Dr Palsule has 50 Publications and 6 Patents (Listed at the end).

Editorial-Responsibilities

- Editor-in-Chief, Reference Series on Polymers & Polymeric Composites (Springer Germany)

Former Affiliations

- Principal Investigator, ESA Project, Eindhoven University of Technology, The Netherlands (1994)
- Visiting Professor, Institute of Technology, RGPV Bhopal (1995-2000)
- Professor of Polymer Chemistry, Saurashtra University, Rajkot India (2000-2003)
- Professor of Polymer Science, Bundelkhand University, Jhansi, India (2003-2004)
- Head Department of Polymer Science, Bundelkhand University, Jhansi (India)

Honors and Awards

- Chief Guest for National Science Day (2011) in DMSRDE DRDO Ministry of Defense
- ESA Patent Award
- Overseas Research Students ORS Award of United Kingdom
- EUROAVIA URM Satellite Design Award
- The Rotary Foundation Graduate Scholarship
- Young Scientists Award

Organizer/Convener of Conferences, Seminars & Workshops

- Convener, International Seminar on Polymer Materials, New Delhi, (2000)
  Proceedings Published After Peer Review in *Advances in Polymer Technology*
- Coordinator, DST-BMBF Indo-German Workshop on Polymer Science & Technology, Rajkot

Invited Lectures and Chaired Sessions in Conferences, Seminars & Workshops

- Several Invited Lectures including those in Seminars and Conferences Organized by American Chemical Society, Institutes and Universities in India & Abroad
- Chaired Sessions in Several International and National Seminars & Conferences

Research Areas & Research Groups

- Aerospace Polymers, Blends and Composites
- Polymeric Nano Materials
- Palsule Process

Aerospace Polymers, Blends & Composites:

- **Macromolecular Micro Composites (Project of DMSRDE/DRDO)**
  Our group is **the first** to propose the concept of and process Macromolecular Micro Composite that is a *melt processable* miscible blend of a flexible polymer and a quasi rigid polymer in which the flexible polymer is molecularly reinforced by quasi-rigid polymer. Research Group:
  - Dr Tithi Agarawal — Post Doctoral Research Fellow

- **Aerospace Composites**
  Fiber Reinforced Anoxic Polymer Composites

Polymeric Nano Materials and Nano Polymer Blends

- **Tercet Molecular Nano Composites**
  Our group is **the first** to propose the concept of and process Tercet Molecular Nano Composite in which a miscible blend of flexible polymers is reinforced at nano meter level by rigid rod macromolecule.

Polymer Composites

- **Palsule Process for Natural Fiber / Polymer Composites**
  Palsule process is the first matrix modification process, that uses chemically functionalized self compatibilizing polyolefin as matrix. In Palsule process, functional groups of natural fibers react with functionalized groups of self compatibilizing polymer and these chemical reactions / interactions impart fiber/matrix interfacial adhesion in natural fiber / polymer composites.

  Research Group:
  - Priyanka — Submitted (2013) and Received PhD
  - Anshu Anjali Singh — Submitted (2014) and Received PhD
  - Kishor Biswas — Submitted PhD Thesis
  - Dinesh — PhD Research Scholar
  - Atul K Maurya — PhD Research Scholar
  - Piyush Kumar — PhD Research Scholar
  - Harsha Varma — PhD Research Scholar

Equipment and Instruments Available

Processing

- Haake Rheocord
- Micro Twin Screw Extruder
- Micro Injection Molding Machine

Rheology

- Rheometer
- Dynamic Mechanical Thermal Analyzer

Mechanical Characterization

- Universal Testing Machine
- Izod and Charpy Impact Tester

Morphology

- Scanning Electron Microscope
- Transmission Electron Microscope
- X-Ray Photo Electron Spectroscopy

Thermal Characterization :

- Differential Scanning Calorimeter,
- Dynamic Mechanical Thermal Analyzer
- Thermo-gravimetric Analyzer

Laboratory Staff

- Sri Sudesh
- Sri Sushil

Courses Taught and Ongoing Courses : UG, PG & Pre-PhD

Undergraduate

- Polymer Properties — On Going in Autumn 2017 (2016-17 Session)
- Polymer Production Engineering — On Going in Autumn 2017 (2016-17 Session)
- Polymer Structure & Properties
- Polymer Characterization
- Polymer Blends
- Polymer Composites

Postgraduate

- Advanced Polymer Blends

Pre-PhD

- Engineering Polymer Composites — On Going in Autumn 2017 (2016-17 Session)

PhD and M Tech Thesis Supervision

PhDs Awarded under Supervision	4
PhD Thesis Submitted under Supervision	1
PhD Research ongoing under Supervision	4

List of PhD Supervision

Thesis Awarded

By IIT – Roorkee

1. Eco-Friendly Composites of Banana and Hardwood Fiber Reinforced Modified Polypropylene
   Priyanka (2014)

2. Natural Fiber/Polyolefin Composites with In-Situ Fiber/matrix Interfacial Adhesion
   Anshu Anjali Singh (2015)

Thesis Submitted

Bamboo Fiber & Bagasse Fiber Reinforced Functionalized Polyolefin Composites by Palsule Process (On-Going)
Kishor Biswas

By Bundelkhand University – Jhansi

3 Synthesis, Structure and Properties of Cationized, Hydrolyzed and Unhydrolyzed Polyacrylamide Grafted Chitosan
Sk. Akbar Ali (2006)
Co-Supervisor Prof R P Singh (VC University of Lucknow, Formerly at IIT-KGP)

4 Chemical Investigation and Grafting of Polysaccharides and Other Constituent From Plants
Pratibha Singh (2014)
Co-Supervisor Prof HP Bharti

Supervision of Ongoing PhD Thesis of IIT – Roorkee

In IIT – Roorkee

1. Natural Reinforced Functionalized Thermoplastic Eklastomeric Polymer Composites by Palsule Process (On-Going)
   Dinesh

2. Natural Reinforced Functionalized Thermoplastic Eklastomeric Polymer Composites by Palsule Process (On-Going)
   Atul K Maurya

3. Natural Reinforced Functionalized Thermoplastic Polymer Composites by Palsule Process (On-Going)
   Piyush Kumar

4. Natural Reinforced Functionalized Thermoplastic Polymer Composites by Palsule Process (On-Going)
   Harsha Verma

Supervision of Thesis Awarded M Tech By Indian Institute of Technology-Roorkee (Awarded 19 + Ongoing 2)

M Tech Thesis on Palsule Process

1. Hardwood Fiber Reinforced Functionalized Self Compatibilizing Composites by Palsule process
   Ankit Jha (2015)

M Tech Thesis on Tercet Molecular Nano Composites

2. Molecular Composites & Tercet Molecular Nano Composites
   Anuja Baijal (2012)

3. Processing Structure & Properties of Tercet Molecular Nano Composite of PPTA/ PA6/PA-6, 6
   Sampat Singh Bhati (2013)

4. Structure and Properties of Super Molecular Composite (Tercet Molecular Nano Composites)
   Nilawar Sagar Ram (2013)

5. Processing, Structure and Properties of Polymeric Super Molecular Composite (Tercet Molecular Nano Composites)
   Vaibhav Singh (2013)

M Tech Thesis on Molecular Composites

6. Structure and properties of Molecular Composites of PPTA/FP
   Shyopat Ram (2014)

7. Structure and properties of Molecular Composites of PPTA/FP
   Himanshu Shekhar (2014)

8. Structure and properties of Molecular Composites of PPTA/FP 6
   Kuldeep Nagar (2014)

M Tech Thesis on Ternary Polymer Blends

9. Structure and Properties of Ternary Blends
   Nethagani Pramod (2013)

M Tech Thesis on Natural Fiber / Polymer Hybrid Composites

10. Natural & Recycled Natural Fibers / Polypropylene Hybrid Composites
    PSVG Bhardwaj (2015)

11. Recycled Natural & Natural Fibers / Polypropylene Hybrid Composites
    N Krishnan (2015)

M Tech Thesis on Natural Fiber / Polymer Composites

12. Effect of Compatibilizer on Mechanical properties of Bamboo Fiber Reinforced Low Density Polyethylene Composites
    Kavish Sethi (2011)

13. Effect of Compatibilizer on Mechanical Properties of Coconut Fiber Reinforced Low Density Polyethylene Composites
    Dibyaranjan Mekap (2011)
14. Effect of Compatibilizer on Mechanical properties of Jute Fiber Reinforced Low Density Polyethylene Compoistes
    Ankit Jhanwar (2011)
15. Optimization of Properties of Bagasse Fiber Reinforced Polypropylene Composite by Alkali Treatment
    Harish Kumar (2011)
    Co-Guide Dr. Praful Toke
16. Effect of Chemical modification of Flax Fiber on Mechanical, Morphological, Thermal and Rheological Properties of Flax Reinforced Polypropylene Composites
    Anshul Bansal (2011) Co-Guide Dr. Ajay K.Taraiya

M Tech Thesis on Polymer Composites & Nano Polymer Composites

17. Graphene Reinforced Cross Linkable Polyethylene (XLPE) Composites
    Mohd Farhan Ansari (2011) Co-Guide Dr. Ahmed Abdala
18. Development of Novel Hybrid Elastomeric Composites
    Dingse Esther Ch Momin (2012) Co-Guide Dr. M. Maiti

M Tech Thesis on Polymers

19. Study of Phase Inversion Process Parameters in Polyethetetherketone membranes
    Rajeev Rakesh Tamhankar (2012) Co-Guide Dr Ivo Vankelecom

LIST OF PATENTS [6] & PUBLICATIONS [50]

Patents (6)

4 Patents on Siloxane Molecular Composites in Europe, USA, Canada, Japan
Dr Sanjay as the Inventor. Patent Owner: European Space Agency

1. French Patent Application No 93 07 888 dtd 29 June 1993
2. European Patent Application No 94 401457.0 dtd 28 June 1994
3. US Patent Application No 08/267,583 dtd 29 June 1994
4. Japanese Patent Application No 146 793/1994 dtd 28 June 1994

Inventor and Owner of 2 Indian Patents on Anoxic Polymers in India.

1. Anoxic Molecular Composite Indian Patent No 188 292 (2002) With Sanjay Palsule as the sole inventor and Owner
2. Anoxic Fibre Reinforced Composite Indian Patent No 187466 (2002) With Sanjay Palsule as the sole inventor and Owner

LIST OF REPRESENTATIVE PUBLICATIONS

Invited Encyclopedia Articles, Papers in Peer-Reviewed Journals & Seminars and Patents

INVITED ENCYCLOPEDIA ARTICLES

1. **Sanjay Palsule**, Anoxic Polymer Materials, The Polymeric Materials Encyclopedia, Editor, Prof. J C Salamone, Volume No.1, Page Nos 252-264, CRC Press, Boca Raton, FL, USA (1996)
2. **Sanjay Palsule**, Molecular Composites : The Third Generation Polymers, The Polymeric Materials Encyclopedia, Editor, Prof. J C Salamone Volume No. 6, Page Nos 4448 – 4457, CRC Press, Boca Raton, FL, USA (1996),

PAPERS IN PEER-REVIEWED JOURNALS

Papers on Palsule Process

1. Anshu Anjali Singh and **Sanjay Palsule,** Jute fibre reinforced chemically functionalized high density Polyethylene (JF/CF-HDPE) composites with in-situ fibre/matrix interfacial adhesion by *Palsule process* **Composite Interfaces**, 20 (8): 553 (2013).
2. Priyanka and **Sanjay Palsule,** Banana fiber/chemically functionalized polypropylene composites with *in-situ* fiber/matrix interfacial adhesion by *Palsule process*, **Composite Interfaces** 20(5) 309 (2013)
3. Anshu Anjali Singh and **Sanjay Palsule,** Coconut fiber reinforced chemically functionalized high-density polyethylene (CNF/CF-HDPE) composites by *Palsule* process, **Journal of Composite Materials** 48(29) 3673 (2014)
4. Anshu Anjali Singh, **Sanjay Palsule,** Jute fiber reinforced chemically functionalized polypropylene (JF/CF-PP) self compatibilizing composites by Palsule Process; *Journal of Composite Materials* **50(9)** 1199–1212 (2016)
5. Kishor Biswas, **Sanjay Palsule,** Bamboo fiber reinforced self compatibilizing functionalized polypropylene composites by Palsule proces; *Polymers & polymer Composites;* **24(8)** 663-674 (2016)

Papers on Tercet Molecular Nano Composites

6. **Sanjay Palsule**, Anuja Baijal, Sampat Singh Bhati, Concept of Tercet Molecular Nano Composites and Preliminary Studies on [PPTA/(PA-6/PA-66)] System of Miscible Blend of Polyamide-6/Polyamide-6,6 Molecularly Reinforced at Nano Level By Poly-p-phenylene-terephthalamide
   Polymers & Polymer Composites, 23(6) 407 (2015)

Papers on Molecular Composites

7. **Sanjay Palsule**, Molecular Composites: Potential Third Generation Polymers for Aerospace Applications
   European Space Agency Journal, ESA Journal, **17** 133-145 (1993)

8. **Sanjay Palsule** and J M G Cowie, Miscibility in Molecular Composites of Polyamide-imide/ Polyetherimide
   Polymer Bulletin 33 241-247 (1994)

Papers on Natural Fiber / Polymer Composites

9. Pratibha Singh, Vishal Verma, KN Pandey, RM Mishra, Vijai Kumar, **Sanjay Palsule,** Studies on Ipomea batata fiber reinforced compatibilized PP composites
   International Journal of Science & Technology, 1(2), 65 - (2011)

10. Anshu Anjali Singh, Priyanka, **Sanjay Palsule**, Processing and Thermal Characterization of 5% Coconut Fibre Reinforced Compatibilized Polypropylene Composites
    International Journal of Applied Engineering Research, **6(18)**, 2861 - (2011)

11. Dibyaranjan Mekap, **Sanjay Palsule**, Secondary Fiber / Recycled Polypropylene Composites
    Journal of Research in Chemistry, 5 (5) 655-659 (2012)

Papers on Polymer Synthesis

12. **Sanjay Palsule** and S K Nema, Synthesis, Characterisation and Applications of Soyabean Oil Derived Polyurethanes : A Techno-Economic Study
    Research & Industry, **36** 208-213 (1990)

Papers in International Conference Proceedings

13. Sanjay Palsule, Macromolecular Nano Composites, IUPAC Conference on Polymers for Advanced Tech SPS 2004 (India)

14. Sanjay Palsule, Anoxic Fiber Reinforced Composites, DST BMBF Indo-German W/S on Polym Sci & Tech DST (India) 2002

15. Sanjay Palsule, Anoxic Polymer Materials, International Seminar On Polymer Materials, CIPET, (2000)

16. Sanjay Palsule, Molecular Composites, IUPAC Macro Akron USA IUPAC (1994)

17. Priyanka, Anshu Anjali Singh, Sanjay Palsule and JS Upadhyay, Study of thermal properties of 5% and 10% coconut Fiber/Polypropylene Composites, Proceeding of Indo-Japan Conference on Frontier Nanomaterials for Energy (FNE-2012) Sharda University, Noida, 9-11 January 2012 page-71

18. Anshu Anjali Singh, Priyanka, and Sanjay Palsule, Effect of different fiber load on tensile properties of coconut fiber reinforced compatibilized polypropylene composites Proceeding of Indo-Japan Conference on Frontier Nanomaterials for Energy (FNE2012) Sharda University, Noida, 9-11 January 2012 page-72

19. Anshu Anjali Singh and Sanjay Palsule, Mechanical Properties of 5% Coconut Fiber Reinforced Compatibilized Polypropylene Composites, Proceedings of the Inernational Conference on Advances in Materials and Manufacturing Technology-2011, (AMMT-2011), Chitkara University, Rajpur India, Page-34

20. Dibyaranjan Mekap and Sanjay Palsule, Maleic Anhydride Modified Polyethylene Compatibilizer for 15% coconut Fiber Reinforced Polyethylene Composites with Improved Tensile & Flexural Modulus, Proceedings of the Inernational Conference on Advances in Materials and Manufacturing Technology-2011, (AMMT-2011), Chitkara University, Rajpur India, Page-79

21. Kavish Sethi and Sanjay Palsule, 10% Bamboo Fibre Reinforced Polyethylene Composites Compatibilized by Maleic Anhyrride Modified Polyethylene for Improved Flexural Properties

22. Proceedings of the Inernational Conference on Advances in Materials and Manufacturing Technology-2011, (AMMT-2011), Chitkara University, Rajpur India, Page-97

23. Mohd Farhan Ansari, Ahmed Abdala and Sanjay Palsule, Nano Composites of Cross Linked Polyethylene Reinforced by 3% Graphene, Proceedings of the Inernational Conference on Advances in Materials and Manufacturing Technology-2011, (AMMT-2011), Chitkara University, Rajpur India, Page-120

24. Priyanka and Sanjay Palsule, Thermal Properties of 10% Coconut fibre / Polypropylene Composites, Proceedings of the Inernational Conference on Advances in Materials and Manufacturing Technology-2011, (AMMT-2011), Chitkara University, Rajpura India, Page-144

25. Anshu Anjali Singh, Sanjay Palsule. "Jute Fiber Reinforced Modified Polyolefin Matrix Composites by a new method for *in-situ* Fiber/Matrix Interfacial Adhesion". International Conference on Advancements in Polymeric Materials. APM-2013. (Lucknow, India)

26. Priyanka and Sanjay Palsule. Green Composites with in-situ fiber/matrix interfacial adhesion: hardwood fiber reinforced modified polyolefin matrix composites. *International Conference on Advancements in Polymeric Materials (APM)*; 2013; Mar 01-03, CIPET-Lucknow.

27. Sanjay Palsule & Anupa Ullahayan, Recycling of Waste PE Foams And its Environmental Impact Assessment, Proceedings National Seminar on Recent Adv on Polym Tech India SLIET (2005)

28. Sanjay Palsule, Ramakrishna Malkapuram & Sweta Bharadwaj, Processing of glass/Phenolic composites By vacuum resin transfer molding process Proceedings National Seminar on Recent Adv on Polym Tech India SLIET (2005)

29. Sanjay Palsule, Rk Malkapuram, Rosy Kumari, Himani Gupta, Sturcture,properties & failure of Glass fiber reinforced Polypropylene composites Proceedings National Seminar on Recent Adv on Polym Tech India SLIET (2005)

30. Sanjay Palsule, Rk Malkapuram, Rosy Kumari, Failure of jute fiber reinforced Polypropylene Composites Proceedings National Seminar on Recent Adv on Polym Tech India SLIET (2005)

31. Sanjay Palsule, & Sweta Bharadwaj, Structure & Properties of Aramid (Kevalr) Fiber Reinforced Polypropylene composites Proceedings National Seminar on Recent Adv on Polym Tech India SLIET(2005)

32. Sanjay Palsule, Molecularly Reinforced Polymer Blends, Proceeding of 5th National Conference on Plastics & Rubber Technology (POLYCON-11) DPST, SJCE Mysore, 25-26 April 2011 page-40

33. Pratibha Singh, RM Mishra, Vijai Kumar Sanjay Palsule, Ipomea batata fiber reinforced compatibilized polypropylene Composites: Studies on Tensile Modulus Proceeding of 5th National Conference on Plastics & Rubber Technology (POLYCON-11) DPST, SJCE Mysore, 25-26 April 2011 page-76

34. Anshu Anjali Singh, Priyanka and Sanjay Palsule, Coconut fiber reinforced compatibilized polypropylene Composites: Effect of Compatibilizer Content on tensile Properties, Proceeding of 5th National Conference on Plastics & Rubber Technology (POLYCON-11) DPST, SJCE Mysore, 25-26 April 2011 page-112

35. Sanjay Palsule, Anshu Anjali Singh, Priyanka, Ankit Jhanwar, Dibyaranjan Mekap and Kavish Sethi, Compatibilization of Polyethylene for Bamboo, Coconut and Jute Fiber Reinforced Polyethylene Composites, Proceeding of 5th National Conference on Plastics & Rubber Technology (POLYCON-11), DPST, SJCE Mysore, 25-26 April 2011 page-128

36. Ankit Jhanwar and Sanjay Palsule, Evaluation of Amount of Compatibilizer for Jute Fiber Reinforced Compatibilized Polyethylene Composites, Proceeding of 5th National Conference on Plastics & Rubber Technology (POLYCON-11), DPST, SJCE Mysore, 25-26 April 2011 page-144

37. Dibyaranjan Mekap and Sanjay Palsule, Optimization of Compatibilizer Content for Coconut Fiber Reinforced Compatibilized Polyethylene Composites, Proceeding of 5th National Conference on Plastics & Rubber Technology (POLYCON-11) DPST, SJCE Mysore, 25-26 April 2011 page-160

38. Kavish Sethi and Sanjay Palsule, Compatibilization of Bamboo Fiber Reinforced Polyethylene Composites, Proceeding of 5th National Conference on Plastics & Rubber Technology (POLYCON-11), DPST, SJCE Mysore, 25-26 April 2011 page-162

Personal Details

- Formerly, The Rotary Foundation's Indian Ambassador in London (UK) [1990-91]
- Former Secretary & Member Rotary Club Saharanpur Continental
- Former Vice President Bharat Vikas Parishad – Siddhartha, Saharanpur
- Founder & General Secretary, Ramakrishna Vivekananda Ashrama, Saharanpur
- Citizen of Republic of India
- Unmarried / Single
- Date of Birth 07 February 1967