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**Benjamin M. and Mary Greenwood Anderson Professor of Engineering
Rice University, Houston, Texas**

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EDUCATION

Northwestern University, Evanston, IL; **Ph.D** in Materials Science and Engineering (1989)

Banaras Hindu University, India; **B. Tech.** in Metallurgical Engineering (1985)

EXPERIENCE

Rice University, Dept. of Mechanical Engineering & Materials Science, Houston, TX

Benjamin M. and Mary Greenwood Anderson Professor in Engineering (From 08/2007)

University Karlsruhe/ Institute of Nanotechnology Karlsruhe, Germany

Helmoltz-Humboldt Senior Awardee (several periods during 2008-2009)

Tsinghua University, Beijing, China

Guest Professor in Materials Science and Engineering (2008-2009)

Chinese Academy of Sciences, Hefei, China (2005)

Distinguished Professor, Institute of Physics

Rensselaer Polytechnic Institute, Materials Science and Engineering Department, Troy, NY

Henry Burlage Chair Professor in Engineering (September 2004 - 2007)

Director, RPI Interconnect Focus Center New York (September 2004 - 2008)

Professor with tenure (May 2001)

Associate Professor with tenure (December 99 – May 2001)

Assistant Professor, tenure track (January 97 – December 99)

ISIS, Universite Louis Pasteur, Strasbourg, France

Visiting Professor; Sabbatical Leave (March 2003 – August 2003)

Max-Planck-Institut fur Metallforschung, Stuttgart, Germany

Alexander von Humboldt Research Fellow (August 95 – December 96)

Laboratoire de Physique des Solides, Universite Paris-Sud, Orsay, France

Researcher *au* CNRS (May 93 – July 95)

Fundamental Research Laboratory, NEC Corporation, Tsukuba, Japan

Post-doctoral Researcher (April 90 – May 93)

RECOGNITION

Helmoltz-Humboldt Senior Award (2008)

Elected as Foreign Associate to the Mexican Academy of Sciences (2008)

Elected Honorary Member of Materials Research Society of India (2008)

Selected **Nano50TM** Innovator by Nanotech Briefs (2007)

Selected by Scientific American Magazine as one of *2006 Scientific American 50:*

Citation "Research Leader in the Material Progress category because of work over the past year creating super-resilient springs from carbon nanotubes that could one day be suitable for artificial joints"

MRS Medal (2006): Citation *"for important developments in the material science and applications of carbon nanotubes"*

Total of ~275 Peer Reviewed Publications with ~18,000 citations (*h factor* ~ 62)

(Articles related to published research has appeared in several popular journals over last decade; e.g. NY Times, Washington Post, Business Week, NPR, National Geographic, C&E News, MIT Technology Review, New Scientist, Science News etc.)

Guinness Book of World Records (2008): Darkest Material in the World (co-inventor)

Guinness Book of World Records (2006): Smallest Brush in the World (co-inventor)

Distinguished Alumnus Award, Department of Metallurgy, Banaras Hindu University (2005)

Kerala Center Award (2005)

RPI School of Engineering Research Award, 2003

National Science Foundation CAREER Award, 1998

Burton Award, Microscopy Society of America, 1997

Alexander von Humboldt Research Fellowship, 1995

Presidential Student Award, Electron Microscopy Society of America, 1989

Hadfield Medal for Outstanding Metallurgist, Calcutta (India), 1985
Bachelor of Technology Gold Medal, Banaras Hindu University (India), 1985
Advisory Board Member, *Petroleum Research Fund, ACS (2003-2006)*
Advisory Editorial Board Member of *Advanced Materials*
Advisory Editorial Board Member of *Small*
Editorial Board Member of *Carbon*
Advisory Editorial Board Member of *Journal of Experimental Nanoscience*
Advisory Editorial Board Member of *Small (VCH-Wiley Journal of Nanotechnology)*
Advisory Editorial Board Member of *International Journal of Nanomedicine*
Advisory Editorial Board Member of *Journal of Nanoscience and Nanotechnology*
Advisory Editorial Board of *TIP Revista Especializada en Ciencias Quimico-Biologicas*
Advisory Editorial Board Member of *Zeitschrift für Metallkunde*
Scientific Advisory Board *The Nanotech Company LLC*
Scientific Advisory Board *The Paper Battery Company Inc.*

RESEARCH INTERESTS

Carbon Based Materials (Carbon Nanofibers, Fullerenes and Nanotubes, Nanodiamond)
Nanostructured Materials (Nanoparticles, Self-assembled Nano-architectures)
Hybrid Nanocomposite Materials
Nanoscale Electrical Interconnects and Devices
Nanomaterials Enabled Energy Storage Systems, Nanomaterials in Energy
Electron Microscopy & Electron Spectroscopy
Sensors, Electromechanical Actuators
Nanoscale Materials of Natural and Biological Origin

BOOKS / SPECIAL ISSUES

1. "Making Functional Materials with Carbon Nanotubes"

MRS Conference Proceeding
Editors: P. Bernier, P. M. Ajayan, P. Nikolaev and Y. Iwasa
Year of Publication: 2002

2. "Nanocomposite Science and Technology",

VCH/Wiley Publishers
Book Authors: P. M. Ajayan, L. Schadler and P. Braun.
Year of Publication: 2003

3. Special Issue of *Journal of Materials Research (Focus: Nanotubes and Nanowires)*

Editors: R. Tenne, P. M. Ajayan, Z. L. Wang, Y. D. Li, and P. D. Yang
Issue: November 2006

PATENTS

1. P. M. Ajayan and S. Iijima, "Carbon nanotubule enclosing a foreign material", NEC Corporation, Japan, 1993. U.S. Patent (**#5,457,343**).
2. T. W. Ebbesen, P. M. Ajayan and H. Hiura, "Method of Purifying Carbon Nanotubes", NEC Corporation, Japan, 1993. U.S. Patent (**#5,641,466**).
3. R. W. Siegel, S. Chang, R. Doremus and P. M. Ajayan, "Ceramic Matrix Nanocomposites Containing Carbon Nanotubes For Enhanced Mechanical Behavior", 2002. U.S. Patent (**#6,420,293**).
4. Y. P. Zhao, Y. C. Chen, X-C. Zhang, N. Raravikar, P. M. Ajayan, T. M. Lu, G. W. Wang and L. S. Schadler, "Ultrafast All-Optical Switch using Carbon Nanotube Polymer Composites", 2004. U.S. Patent (**#6,782,154**).
5. A. Cao, G. Ramanath and P. M. Ajayan, "Directed assembly of highly-organized carbon nanotubes", 2007, U.S. Patent (**#7,189,430**).
6. P. M. Ajayan, G. Ramanath and Andres de la Gaurdia, "Method of transforming carbon nanotubes", 2008, U.S. Patent (**#7,217,404**).

- Several (~20) other patent applications/provisional pending -

REFEREED JOURNAL PUBLICATIONS

Total # of papers: 280

Total # of citations: ~17,400; h index (for citation) - 64

1. L. D. Marks, P. M. Ajayan and J. Dundurs, "Quasi-melting of small particles", **Ultramicroscopy**, 20, 77 (1986).
2. J. Dundurs, L. D. Marks and P. M. Ajayan, "Structural fluctuations in small particles", **Phil. Mag. A**, 57, 605 (1988).
3. P. M. Ajayan and L. D. Marks, "Quasimelting and phases of small particles", **Phys. Rev. Lett.**, 60, 585 (1988). *
4. P. M. Ajayan and L. D. Marks, "Experimental evidence for quasimelting in small particles", **Phys. Rev. Lett.**, 63, 279 (1989). *
5. P. M. Ajayan and L. D. Marks, "Evidence for sinking of small particles into substrates and implications for heterogeneous catalysis", **Nature**, 338, 139 (1989).
6. P. M. Ajayan and L. D. Marks, "Phase instabilities in small particles", **J. Phase Transitions**, 24, 229 (1990).
7. L. D. Marks and P. M. Ajayan, "Equilibrium shape of a buoyant particle", **J. Mater. Res.**, 5, 1496 (1990).
8. P. M. Ajayan and S. Iijima, "Wetting and de-wetting transitions of small metal particles on substrates under electron irradiation", **J. Colloid & Interface Sci.**, 147, 281 (1991).
9. S. Iijima and P. M. Ajayan, "Substrate and size effects on the coalescence of small particles", **J. Appl. Phys.**, 70, 5138 (1991).
10. S. Iijima and P. M. Ajayan, "Effects of electron irradiation and coulombic interactions on the structure and mobility of small particles and amorphous phases", **Rad. Eff. Def. Solids**, 118, 169 (1991).
11. P. M. Ajayan, T. Ichihashi and S. Iijima, "Electron irradiation damage and sputtering from oxidized silicon particles supported on amorphous carbon", **Rad. Eff. def. Solids**, 118, 281 (1991).
12. P. M. Ajayan and S. Iijima, "Electron beam enhanced flow and instability in amorphous silica fibers and tips", **Phil. Mag. Lett.**, 65, 43 (1992).
13. P. M. Ajayan and S. Iijima, "Sintering of confined silica in oxidized silicon particles", **J. Ame. Ceram. Soc.**, 75, 999 (1992).
14. P. M. Ajayan and S. Iijima, "Electron irradiation induced dynamical fluctuations in amorphous structures", **J. Non-Cryst. Solids**, 150, 423 (1992).
15. P. M. Ajayan and S. Iijima, "Smallest carbon nanotube", **Nature**, 358, 23 (1992).
16. T. W. Ebbesen and P. M. Ajayan, "Large scale synthesis of carbon nanotubes", **Nature**, 358, 220 (1992). *
17. S. Iijima, P. M. Ajayan and T. Ichihashi, "Growth model for carbon nanotubes", **Phys. Rev. Lett.**, 69, 3100 (1992). *
18. P. M. Ajayan, T. Ichihashi and S. Iijima, "Distribution of pentagons and shapes in carbon nanotubes and nanoparticles", **Chem. Phys. Lett.**, 202, 384 (1993). *
19. P. M. Ajayan and S. Iijima, "Capillarity induced filling in carbon nanotubes", **Nature**, 361, 333 (1993). *
20. P. M. Ajayan, T. W. Ebbesen, T. Ichihashi, S. Iijima, K. Tanigaki and H. Hiura, "Opening carbon nanotubes with oxygen and implications for filling", **Nature**, 362, 522 (1993). *
21. P. M. Ajayan, S. Iijima and T. Ichihashi, "Electron energy loss spectroscopy of carbon nanometer-size tubes", **Phys. Rev. B**, 47, 6859 (1993).
22. P. M. Ajayan, J. M. Lambert, P. Bernier, L. Barbedette, C. Colliex and J. M. Planeix, "Growth morphologies during cobalt-catalyzed single-shell carbon nanotube synthesis", **Chem. Phys. Lett.**, 215, 509 (1993).
23. P. M. Ajayan, C. Colliex, P. Bernier and J. M. Lambert, "Shape transformations in single layer carbon nanotubes", **Microsc. Microanal. Microstruct.**, 4, 501 (1993).
24. T. W. Ebbesen, P. M. Ajayan, H. Hiura and K. Tanigaki, "Purification of nanotubes", **Nature**, 367, 519 (1994). *
25. P. M. Ajayan, C. Colliex, J. M. Lambert, P. Bernier, L. Barbedette, M. Tence and O. Stephan, "Growth of manganese filled carbon nanofibers in the vapor phase", **Phys. Rev. Lett.**, 72, 1722 (1994).

26. J. M. Planeix, N. Coustel, B. Coq, V. Brotons, P. S. kumbhar, R. Dutartre, P. Geneste, P. Bernier and P. M. Ajayan, "Application of carbon nanotubes as supports in Heterogeneous catalysis", **J. Ame. Chem. Soc.**, 116, 7935 (1994). *
27. J. M. Lambert, P. M. Ajayan, P. Bernier, J. M. Planeix, V. Brotons, B. Coq and J. Castaing, "Improving conditions towards isolating single-shell carbon nanotubes", **Chem. Phys. Lett.**, 226, 364 (1994).
28. P. M. Ajayan, O. Stephan, C. Colliex and D. Trauth, "Aligned carbon nanotube arrays formed by cutting a polymer resin-nanotube composite", **Science**, 265, 1212 (1994). *
29. O. Stephan, P. M. Ajayan, C. Colliex, Ph. Redlich, J. M. Lambert, P. Bernier and P. Lefin, "Doping graphitic and carbon nanotube structures with boron and nitrogen", **Science**, 266, 1683 (1994). *
30. P. V. Huong, R. Cavagnat, P. M. Ajayan and O. stephan, "Temperature dependent vibrational spectra of carbon nanotubes", **Phys. Rev. B**, 51, 10048 (1995).
31. P. M. Ajayan, "Aligned carbon nanotubes in a thin polymer film", **Adv. Mater.**, 7, 489 (1995).
32. P. M. Ajayan, O. Stephan, Ph. Redlich and C. Colliex, "Carbon nanotubes as removable templates for oxide nanocomposites and nanostructures", **Nature**, 375, 564 (1995). *
33. P. M. Ajayan, "Carbon nanotubes; a new graphite architecture", **Cond. Matt. News**, 4, 9 (1995). **(Invited Review)****
34. P. M. Ajayan, "Carbon nanotubes and nanocomposites", **Fullerene Sci. Techno.**, 3 (3), 119 (1995).
35. A. Yu. Kasumov, I. I. Khodos, P. M. Ajayan and C. Colliex, "Electrical resistivity of one carbon nanotube", **Europhys. Lett.**, 34 (6), 429 (1996) .
36. O. Stephan, P. M. Ajayan, C. Colliex, F. Cyrot-Lackmann and E. Sandre, "Curvature induced bonding changes in carbon nanotubes", **Phys. Rev. B**, 53, 13824 (1996).
37. F. Banhart and P. M. Ajayan, "Carbon Onions as Nanoscopic Pressure Cells for Diamond Formation", **Nature**, 382, 433 (1996). *
38. P. M. Ajayan, "Structure and morphology of carbon nanotubes", in *Carbon Nanotubes: Preparation and properties*, edited by T. W. Ebbesen, CRC Press, New York, 1996, page 111-138. **(Book Chapter)****
39. Ph. Redlich, J. Loeffler, P. M. Ajayan, M. Rühle, J. Bill and F. Aldinger, "Boron Doping in Carbon Nanotubes and BCN Nanotubes", **Chem. Phys. Lett.**, 260, 465 (1996). *
40. E. Bengu, R. Plass, L. D. Marks, T. Ichihashi, P. M. Ajayan and S. Iijima, "Imaging the Dimers in Si(111)-(7X7)", **Phys. Rev. Lett.**, 77, 4226 (1996).
41. P. J. Britto, K. S. V. Santhanam and P. M. Ajayan, "Oxidation of Dopamine at Carbon Nanotube Electrodes", **J. Bioelectrochemistry**, 41, 121 (1996).
42. W. K. Maser, J. M. Lambert, P. M. Ajayan, O. Stephan and P. Bernier, **Synth. Met.**, 77, 243 (1996).
43. P. M. Ajayan, Ph. Redlich and M. Rühle, " Balance of Graphite Deposition and Multi-shell Carbon Nanotube Growth in the Carbon Arc Discharge", **J. Mater. Res.**, 12(1) , 244 (1997).
44. P. M. Ajayan, Ph. Redlich and M. Rühle, "Structure of Carbon Nanotube Based Nanocomposites", **J. Microscopy**, 185, 275 (1997).
45. F. Banhart and P. M. Ajayan, "Diamond Formation in Carbon Onions", **Adv. Mater.**, 9, 261 (1997).
46. D. L. Carroll, Ph. Redlich, P. M. Ajayan, J. C. Charlier, A. De Vita, X. Blase and R. Car, "Electronic Structure and Localized States at Carbon Nanotube Tips", **Phys. Rev. Lett.**, 78, 2811 (1997). *
47. W. K. Maser, I. Luk yanchuk, P. Bernier, P. Molini, S. Lefrant, Ph. Redlich and P. M. Ajayan, "Superconducting RNi₂B₂C (R= Y, Lu) Nanoparticles; Size Effects and Weak Links", **Adv. Mater.**, 9, 503 (1997).
48. F. Banhart, T. Fuller, P. Redlich and P. M. Ajayan, "The Formation, Annealing and Self-Compression of Carbon Onions under Electron Irradiation", **Chem. Phys. Lett.**, 269, 349 (1997).
49. P. M. Ajayan, "Carbon Nanotubes : Novel Architecture in Nanometer Spaces", **Progress in Crystal Growth and Characterizations of Materials**, 34, 37 (1997).
50. P. M. Ajayan and T. W. Ebbesen, "Nanometer Size Tubes of Carbon", **Rep. Prog. Phys.**, 60, 1025 (1997). **(Invited Review Article)** ***
51. C. Jeanguillaume, J. Bochet, F. Chehade, E. Hindie, P. M. Ajayan and P. Galle, "Cardiac Axis Change Between Prone and Supine Positioning May Contribute to Differences in ⁹⁹Tc^m-MIBI Myocardial SPET Imaging", **Nucl. Medicine Communication**, 18, 1161 (1997).
52. S. Curran, D. L. Carroll, P. M. Ajayan, P. Redlich, S. Roth, M. Rühle and W. Blau, "Picking Needles from the Nanotube-haystack", **Adv. Mater.**, 10, 311 (1998).
53. D.L. Carroll, S. Curran, P. Redlich, P. M. Ajayan, M. Rühle, and S. Roth, "Spatial Variations in the Electronic Structure of Pure and B-Doped Nanotubes" **Carbon**, 5-6, (1998).

54. P. Redlich, F. Banhart, Y. Lyutovich and P. M. Ajayan, "EELS Study of the Irradiation-induced Compression of Carbon Onions and Their Transformation to Diamond", **Carbon**, 5-6, 561 (1998).
55. P. M. Ajayan, V. Ravikumar and J. -C. Charlier, "Surface Reconstructions and Shrinking in Singlewalled Carbon Nanotubes", **Phys. Rev. Lett.**, 81, 1437 (1998).
56. C. -H. Kiang, M. Endo, P. M. Ajayan, G. Dresselhaus and M. S. Dresselhaus, "Size Effects in Carbon Nanotubes", **Phys. Rev. Lett.**, 81, 1869 (1998).
57. D. L. Carroll, P. Redlich, X. Blase, J. C. Charlier, S. Curran, P. M. Ajayan, S. Roth and M. Ruhle, "Effect of Nanodomain Formation on the Electronic Properties of Doped Carbon Nanotubes", **Phys. Rev. Lett.**, 81, 2332 (1998).
58. F. Banhart, P. Redlich and P. M. Ajayan, "Carbon Onions as Molecular Sieves for Metal Atoms", **Chem. Phys. Lett.**, 292, 554 (1998).
59. D. L. Carroll, P. M. Ajayan and S. Curran, "Local Electronic Structure in Ordered Aggregates of Carbon Nanotubes: STM/STS Study", **J. Mater. Res.**, 13 (1998).
60. S. Curran, P. M. Ajayan, W. Blau, D. L. Carroll, J. Coleman, A. Dalton, A. P. Davey and B. McCarthy, "Composite from PPV and Carbon Nanotubes: A novel material for molecular optoelectronics", **Adv. Mater.**, 10, 1091 (1998). *
61. P. M. Ajayan and V. Ravikumar, Book Review on " Reflection Electron Microscopy and Spectroscopy for Surface Analysis" by Z. L. Wang, Materials Research Society Bulletin, 23 (10), 82 (1998). (**Invited Book Review**)**
62. L. S. Schadler, S. C. Giannaris and P. M. Ajayan, "Load Transfer in Carbon Nanotubes", **Appl. Phys. Lett.**, 73, 3842 (1998). *
63. P. J. Britto, K. S. V. Santhanam, A. Rubio, A. Alonso and P. M. Ajayan, "Improved Charge Transfer on Carbon Nanotube Electrodes" **Adv. Mater.**, 11, 154 (1999).
64. L. Kiss, R. Vajtai and P. M. Ajayan, "Random Walk in Gas Vortices and Nanotube Self-Assembly", **Phys. Stat. Solidi**, (b) 214, R3 (1999).
65. T. Abatemarco, J. Stickel, J. Belfort, B. P. Frank, P. M. Ajayan and G. Belfort, "Fractionation of Multiwalled Carbon Nanotubes by Cascade Membrane Microfiltration", **J. Phys. Chem. B**, 103, 3534 (1999).
66. P. M. Ajayan, "Nanotubes from Carbon", **Chemical Reviews**, 99, 1787, 1999. (**Invited Review Article**)** *
67. C. Downs, J. Nugent, D. Duquette, K. S. V. Santhanam and P. M. Ajayan, "Efficient polymerization of aniline at carbon nanotube electrodes", **Adv. Mater.**, 11, 1028 (1999).
68. S. Curran, A. P. Davey, J. Coleman, A. Dalton, B. McCarthy, S. Maier, A. Drury, D. Gray, M. Brennan, K. Ryder, M. Lamy de la Chapelle, C. Journet, P. Bernier, H. J. Byrne, D. L. Carroll, P. M. Ajayan, S. Lefrant and W. Blau, "Evolution and evaluation of the polymer/nanotube composite", **Synth. Met.**, 103, 2559 (1999).
69. P. M. Ajayan, "Carbon Nanotubes", Handbook for Nanostructural Materials and Nanotechnology", Volume 5, Ed. H. S. Nalwa, Academic Press, Chapter 6, page 375-403 (2001). (** **Book Chapter**)
70. X. Blase, J. C. Charlier, A. De Vita, R. Car, P. Redlich, M. Terrones, H. Terrones, D. L. Carroll and P. M. Ajayan, "Boron-mediated growth of long and helicity selected carbon nanotubes", **Phys. Rev. Lett.**, 83, 5078 (1999).
71. P. Redlich, D. L. Carroll and P. M. Ajayan, "High resolution imaging and spectroscopy in nanoscale structures", **Current Opinions in Solid State and Materials Science**, 4, 325 (1999).
72. P. M. Ajayan, J. C. Charlier and A. Rinzler, "Carbon nanotubes: from macromolecules to nanotechnology", **Proc. Nat. Acad. Sci.**, 96, 14199 (1999).
73. F. Banhart, J. C. Charlier and P. M. Ajayan, "Dynamic behavior of Ni atoms in graphitic lattices", **Phys. Rev. Lett.**, 84, 686 (2000).
74. H. Terrones, M. Terrones, E. Hernandez, N. Grobert, J. C. Charlier and P. M. Ajayan, "New metallic allotropes of planar and tubular carbon", **Phys. Rev. Lett.**, 84, 1716 (2000).
75. J. N. Coleman, A. B. Dalton, S. Curran, A. Rubio, A. P. Davey, A. Drury, B. McCarthy, B. Lahr, P. M. Ajayan, S. Roth, R. C. Barklie and W. J. Blau, "Phase separation of carbon nanotubes and turbostratic graphite using a functional organic polymer", **Adv. Mater.**, 12, 213 (2000).
76. P. M. Ajayan, J. Nugent and R. W. Siegel, "Autocatalytic growth of carbon micro-trees", **Nature**, 404, 243 (2000).
77. P. M. Ajayan, L. S. Schadler, C. Giannaris and A. Rubio, "Mechanical response of singlewalled carbon nanotubes in polymer nanocomposites", **Adv. Mater.**, 12, 750 (2000). *
78. M. Terrones, H. Terrones, F. Banhart, J. -C. Charlier and P. M. Ajayan, "Coalescence of singlewalled carbon nanotubes", **Science**, 288, 1227 (2000).

80. B. Wei, Z. J. Zhang, G. Ramanath and P. M. Ajayan, "Liftup growth of carbon nanotubes on patterned substrates", **Appl. Phys. Lett.**, 77, 2985 (2000).
81. A. B. Dalton, C. Stephan, J. N. Coleman, B. McCarthy, P. M. Ajayan, S. Lefrant, P. Bernier, W. J. Blau, and H. J. Byrne, "Selective interaction of a semiconjugated organic polymer with single-wall nanotubes", **J. Phys. Chem.**, B, 104, 10012 (2000).
82. Z. J. Zhang, B. Wei, G. Ramanath and P. M. Ajayan, "Substrate self-selective growth of aligned carbon nanotubes", **Appl. Phys. Lett.**, 77, 3764 (2000).
83. J. M. Nugent, K. S. V. Santhanam, A. Rubio and P. M. Ajayan, "Fast electron transfer kinetics on multiwalled carbon nanotube microbundle electrodes", **Nanoletters**, 1, 87 (2001).
84. Z. J. Zhang, G. Ramanath and P. M. Ajayan, D. Goldberg and Y. Bando, "Radial patterns of carbonated silica microfibers", **Adv. Mater.**, 13, 197 (2001).
85. P. M. Ajayan and R. Vajtai, "Properties and applications of carbon nanotubes", **Carbon Filaments and Nanotubes: Common Origins, Differing Applications**, Eds. L. P. Biro, C. A. Bernardo, G. G. Tibbets and Ph. Lambin, NATO Science Series E: Applied Sciences, Vol. 372, pages 315-330, 2001. **(Book Chapter)****
86. B. Wei, R. Vajtai, Z. J. Zhang, G. Ramanath and P. M. Ajayan, "Carbon nanotube-MgO cube networks", **Journal of Nanoscience and Nanotechnology**, 1, 35 (2001).
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88. Z. J. Zhang, P. M. Ajayan, G. Ramanath, J. Vacik and Y. H. Xu, "Growth, structure and optical properties of carbon-reinforced silica fibers", **Appl. Phys. Lett.**, 78, 3794 (2001).
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91. R.W. Siegel, S.K. Chang, B.J. Ash, J. Stone, P.M. Ajayan, R.W. Doremus, L.S. Schadler, "Mechanical behavior of polymer and ceramic matrix nanocomposites", **Scripta Mater.**, 44, 2061 (2001).
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95. A. Cao, X. Zhang, C. Xu, J. Liang, D. Wu, X. Chen, B. Wei and P. M. Ajayan, "Grapevine-like growth of singlewalled carbon nanotubes among vertically aligned multiwalled nanotube arrays", **Appl. Phys. Lett.**, 79, 1252 (2001).
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98. Y.J. Jung, B.Q. Wei, J.M. Nugent and P.M. Ajayan, "Controlling the growth of carbon microtrees", **Carbon**, 39, 2195 (2001).
99. Y. P. Zhao, B. Q. Wei, P. M. Ajayan, G. Ramanath, G. W. Wang, T. M. Lu, A. Rubio and S. Roche, "Frequency dependent electrical transport in carbon nanotubes", **Phys. Rev. B**, 64, 125417 (2001).
100. Z. J. Zhang, B. Wei, R. Vajtai, J. Ward, G. Ramanath and P. M. Ajayan, "Select pathways to carbon nanotube film growth", **Advanced Materials**, 13, 1767 (2001).
101. F. Banhart, N. Grobert, M. Terrones, J. -C. Charlier and P. M. Ajayan, "Metal atoms in carbon nanotubes and related nanoparticles", **International Journal of Modern Physics B**, 15, 4037 (2001). **(Invited Review Article)****
102. R. Vajtai, K. Kordás, B. Q. Wei, J. Békési, S. Leppävuori and P. M. Ajayan, "Carbon nanotube network growth on palladium seeds", **Materials Science and Engineering C**, 19, 271 (2002).
103. P. R. Supranowicz, P. M. Ajayan, K. R. Ullmann, B. P. Arulanandam, D. W. Metzger and R. Bizios, "Enhancement of select osteoblast functions pertinent to new bone formation by alternating current stimulation", **J. Biomedical Materials Research**, 59, 499 (2002).

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278. S. Sahoo, R. Marangati, S. Lastella, G. Mallick, S. Karna, P. Sharma, P. M. Ajayan, "Reversible separation of SWNT s in bundles" **Appl. Phys. Lett.**, 93, 083120 (2008).
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INVITED TALKS

Total # of talks: 244

Includes 12 tutorials and short courses

1. "Structure and Growth of Carbon Nanotubes", American Chemical Society Meeting, Denver, Colorado, U.S.A. (March 1993).
2. "Exotic Forms of Carbon", Universite Montpellier II, Montpellier, France (July 1994).
3. "Structure of Carbon Nanotubes", Indian Institute of Science", Bangalore, India (December 1994).
4. "Carbon Nanotubes", Centre d'Etude de Chimie Metallurgique, CNRS, Vitry, France (February 1995).
5. "EELS From Carbon Nanotube Structures", International Winterschool on Electronic Properties of Novel Materials", Kirchberg, Austria (March 5-12, 1995).
6. "Carbon Nanotubes and Related Composites: Structure and Growth", C, Soot and Sun; French-American Workshop, Odeillo, France (October 8-12, 1995).
7. "Carbon Nanotubes and Nanocomposites", Institut des Materiaux des Nantes, Nantes, France (14 October, 1995).
8. "Nanocomposites Based on Carbon Nanotubes", Materials Research Society Fall Meeting, Boston, U. S. A. (November 27-30, 1995).
9. "Carbon Nanotubes and Nanocomposites", Max-Planck-Institute für Festkörperforschung, Stuttgart, Germany (December 12, 1995).
10. "Carbon Nanotubes and Nanocomposites", Ecole Polytechnic Federale des Lausanne, Lausanne, Switzerland (February 5, 1996).
11. "Carbon Nanotube Based Nanocomposites", NEC Research Institute, Princeton, New Jersey, U.S.A. (March 7, 1996).
12. "Carbon Nanotube and Related Nanocomposites", Rensselaer Polytechnic Institute, Troy, New York, U.S.A. (March 11, 1996).
13. "Structure and Properties of Carbon Nanotubes", German Carbon Society Meeting, Dartmund, Germany (March 14, 1996).
14. "Novel Architecture in Nanometer Space", Chimie et les Surprises du Carbone, Ecole de Chimie, Paris, France (March 19, 1996).
15. "Growth of Carbon Nanotubes", NATO Workshop on Atomic and Molecular Wires, Les Houches, France (May 6-10, 1996).
16. "Analysis of Filled Carbon Nanotubes", Gordon Conference on Phase Transitions in Non-metallic Solids, New England College, New Hampshire, U.S.A. (June 10-14, 1996).
17. "Properties of Carbon Nanotubes", Meeting of the French Microscopy Society, Rennes, France (June 26-28, 1996).
18. "Nanostructures From Carbon Nanotubes", XIth European Congress on Microscopy, Dublin, Ireland (August 26-30, 1996).
19. "Architecture of Carbon Nanostructures", Seminar, Tata Institute of Fundamental Research, Bombay, India (January 2, 1997).
20. "Carbon Nanostructures", Materials Science Seminar, Rensselaer Polytechnic Institute, Troy, NY, U.S.A., (February 20, 1997).
21. "Nucleation and Growth of Diamond inside Carbon Onions", Molecular Nanostructures: International Winterschool on Electronic Properties of Novel Materials, Kirchberg in Tirol, Austria (March 1, 1997).
22. "The Architecture of Carbon Nanostructures", Materials Science & Engineering Colloquim Series, Northwestern University, Evanston, U.S.A. (March 11, 1997).
23. "Carbon Nanotubes", Readings in Chemical Engineering, Rensselaer Polytechnic Institute, Troy, NY, U.S.A. (April 7, 1997).
24. "Architecture of Carbon Nanostructures: From Nanotubes to Diamond", Special Seminar, General Electric Corporation, Schenectady, NY, U.S.A. (April 10, 1997).
25. "Carbon Onions as Nanoscopic Pressure Cells for Diamond Formation", Electrochemical Society Meeting, Montreal, Qubec, Canada (May 5, 1997).
26. "Topology and Doping Related Electronic Structure in Carbon Nanotubes: Experimental Study", Adsorbent Carbon Workshop and Science of Carbon Nanotube Workshop, Lexington, Kentucky (June 10, 1997).

27. "Activity and Reactivity of Carbon Nanotubes: Relation to Structure and Topology", NAMITECH, NEDO Joint Workshop on the Microscopies of Nanotubular Structures", Nantes, France (October 28, 1997).
28. "Carbon Nanotubes: Past, Present and Future", Special Seminar, Trinity College, Dublin, Ireland (October 31, 1997).
29. "Carbon Architecture in Nanometer Space", Physics Colloquium, SUNY Binghamton, NY (November 24, 1997).
30. "Carbon Nanotubes: The Ultimate Fiber?", Physics Seminar, Department of Physics & Astronomy, Clemson University, Clemson, S.C. (February 19, 1998).
31. "Structure & Phase Stability Inside Carbon Onions", Colloquium, Department of Materials Science & Engineering, North Carolina State University, Raleigh, N.C. (February 20, 1998).
32. "Structure and Topology of Carbon Nanostructures: Tubes and Onions", ", Colloquium, Department of Materials Science & Engineering, SUNY, Stonybrook, N.Y. (March 25, 1998).
33. "Surface and Interface Properties of Multiwalled Carbon Nanotubes", Electrochemical Society Meeting, San Diego, C.A. (May 2, 1998).
34. "Novel Filler Based Applications of Carbon Nanotubes", Seminar, GE Plastics, Selkirk, N.Y. (June 15, 1998).
35. "Applications of Carbon Nanotubes", Cooology, Universidad, Nacional Autonoma de Mexico, Mexico City, Mexico (August 27, 1998).
36. "Multiwalled Carbon Nanotubes for Applications", International Materials Congress, Cancun, Mexico (September 1, 1998).
37. "Realities of Applications of Carbon Nanotubes", Carbon Nanotechnology Meeting, University of Sussex, Brighton, England (September 11, 1998).
38. "Defects in Carbon Nanostructures", Department of Materials Science & Engineering Seminar, University of Kentucky, Lexington, KY (October 7, 1998).
39. "Nanotube Applications: Materials Science Perspective", Department of Physics, University of North Carolina, Chapel Hill, NC (February 3, 1999).
40. "Nanocomposites: Introduction", Engineering Foundation Conference, Nanocomposites: Design and Applications, Girdwood, Alaska (March 28-April 2, 1999).
41. "Carbon Nanotubes: Macromolecules to Nanotechnology", German-American Frontiers of Science meeting, Potsdam, Germany (June 8-June 11, 1999).
42. "Novel Architectures in Nanometer Space", Institute of Magnetism, CSIS, Madrid, Spain (July 6, 1999).
43. "Dynamic Interfaces in Carbon Nanostructures", Microscopy Society of America Annual Meeting, Portland, Oregon (August 2- August 4, 1999).
44. "Carbon Nanotubes and Related Structures: Experiment and Theory", International Materials Congress, Cancun, Mexico (August 31, 1999).
45. "Nanocomposites from Carbon Nanotubes", Carbon Nanotechnology Meeting, University of Sussex, Brighton, England (September 10, 1999). *Digital Instruments Lecture*
46. "Metal-Carbon Onions: Phase Stability", International Symposium on Cluster and Nanostructure Interfaces, Richmond, Virginia (October 27, 1999).
47. "Carbon Nanotube Polymer Composites", Materials Research Society Fall Meeting, Symposium on nanostructured and nanocomposite materials, Boston, MA (December 1, 1999).
48. "Carbon Nanostructures", National Institute for Research in Inorganic Materials, Tsukuba, Japan (December 20, 1999).
49. "Impact of Carbon Nanostructures", Joint Research Center for Atom Technology, c/o National Institute for Advanced Interdisciplinary Research, Tsukuba, Japan (December 24, 1999).
50. "Carbon Nanotubes: New Opportunities", National Institute of Materials and Chemical Research, Tsukuba, Japan (December 24, 1999).
51. "Defects in Carbon Nanostructures", Department of Materials Science & Engineering, Georgia Institute of Technology, Atlanta, GA (February 22, 2000).
52. "Tailoring Carbon Nanotubes: Experiment and Theory", Mardi Gras Conference, Louisiana State University, Baton Rouge, LA (March 2, 2000).
53. "From Carbon Nanotubes to Nanocomposites: Opportunities in Materials Technology", Key Note address, International Conference on Research Trends in Science and Technology, Beirut, Lebanon (March 7, 2000).
54. "Topological and Dopant Defects in Carbon Nanostructures", ICMCTF (AVS meeting), San Diego, CA (April 10, 2000).

55. "Carbon Nanotube Research: A Progress Report", Special Seminar, GE Plastics, Selkirk, N.Y. (April 17, 2000).
56. "Defects in Carbon Nanotubes", Colloquium, Indian Institute of Science, Bangalore, India (May 18, 2000).
57. "Synthesis and Applications of Carbon Nanotubes", Special Seminar, GE India, Bangalore, India (May 19, 2000).
58. "Materials Science Applications of Carbon Nanotubes-I & II", Lectures, NATO-ASI workshop, Budapest, Hungary (June 16-28, 2000). **
59. "Issues in Growth and Processing of Carbon Nanotubes", Seminar, Max-Planck-Institute fur Metallforschung, Stuttgart, Germany (July 21, 2000).
60. "Role and Impact of Defects in Carbon Nanostructures", NANO 2000, Sendai, Japan (August 22, 2000).
61. "Structure and Growth of Carbon Nanotubes", Seminar, NTT Basic Research Laboratories, Atsugi (near Tokyo), Japan (August 25, 2000).
62. "Synthesis and Properties of Carbon Nanotubes", NSF-CNRS Nanomaterials Workshop, Montreal, Canada (October 25, 2000).
63. "Growth of Carbon Nanotubes on Planar Substrates: A Closer Look", Department of Applied Physics and Advanced Technology, UNAM, Juriquilla, Queretaro, Mexico (December 13, 2000).
64. "Growth of Carbon Nanotubes on Planar Substrates: A Closer Look", Institute of Physics, Autonomous University of San Luis Potosi, San Luis Potosi, Mexico (December 14, 2000).
65. "Defects in Carbon Nanostructures", Jawaharlal Nehru University/Indian Institute of Technology Delhi Joint Seminar, Delhi, India (December 27, 2000).
66. "Tailoring structure and Growth of Carbon Nanotubes", International Conference on Science and Technology of Nanostructured materials, Puri, India (January 5, 2001).
67. "Defects in Carbon Nanotubes", Seminar, Department of Chemistry, Princeton University, Princeton, NJ (February 1, 2001).
68. "Carbon Nanotube Based Nanocomposites", Tutorial: Putting Nanotubes to Work, American Physical Society Meeting, Seattle, WA (March 11, 2001). **
69. "Tailoring Carbon Nanotube for Applications", Seminar, Philip Morris USA, Richmond, VA (April 4, 2001).
70. "Defects in Carbon Nanostructures", Seminar, Rochester Institute of Technology, Rochester, New York (April 10, 2001).
71. "Early Stages of Carbon Nanotube Film Growth; Nanotube Domains", Materials Research Society Meeting (Spring), San Fransisco, CA (April 18, 2001).
72. "Defects in Carbon Nanostructures", Seminar, NASA Ames Research Center, Mountain View, CA (April 20, 2001).
73. "Impact of Defects in Carbon Nanotubes", Seminar, Tsinghua University, Beijing, P.R. China (May 18, 2001).
74. "Nanocomposites from Carbon Nanotubes", Seminar, Institute of Physics, Chinese Academy of Sciences, Beijing, P.R. China (May 21, 2001).
75. "Tailoring the Growth of Carbon Nanotubes by CVD", Seminar, Xian Jiaotong University, Xian, P.R. China (May 22, 2001).
76. "Building carbon nanotube architectures by CVD", Chinese Youth Symposium on Nanomaterials and Applications, Institute of Solid State Physics, Chinese Academy of Sciences, Hefei, P.R.China (May 25, 2001).
77. "Tailoring the growth of carbon nanotube architectures", Perspectives in Physical Metallurgy, Indian Institute of Science, Bangalore, India (July 12, 2001).
78. "Building carbon nanotube architectures", Seminar, ABB Corporate Research, Ladenburg, Germany (July 23, 2001).
79. "Building carbon nanotube architectures", Seminar, Department of Physics, University of Ulm, Ulm, Germany (July 24, 2001).
80. "Building carbon nanotube architectures", Seminar, Max-Planck-Institute fur Metallforschung, Stuttgart, Germany (July 25, 2001).
81. One Day Workshop on Nanotechnology and Precision Engineering, University Putra Malayasia, Malayasia (August 8-9, 2001). **
82. "Nanocomposites from carbon nanotubes", Filler Technology session, Annual meeting of the American Chemical Society, Chicago (August 26, 2001).
83. "Building carbon nanotube architectures", Seminar, TORAY Corporation, Nagoya, Japan (October 2, 2001).

84. "Fabrication of highly organized carbon nanotube architectures", Tsukuba Symposium on Carbon Nanotube: In Commemoration 10th Anniversary of Discovery, Tsukuba, Japan (October 5, 2001).
85. "Growth of organized carbon nanotube structures", Colloquium, Drexel University, Philadelphia, PA (October 25, 2001).
86. "Growth of organized carbon nanotube structures", Seminar, Seagate Media Research Center, Fremont, CA (November 1, 2001).
87. "Growth of organized carbon nanotube structures", Special seminar, Materials Science and Engineering Department, Clemson University, Clemson, SC (November 15, 2001).
88. "Building carbon nanotube architectures", Bio-MEMS and smart nanostructures Conference, Adelaide, Australia (December 17, 2001).
89. "Organized Carbon Nanotube Architectures", Seminar, Argonne National Laboratory, Argonne, IL (January 11, 2002).
90. "Organized Carbon Nanotube Architectures", Mardi Gras 2002 Conference, Baton Rouge, Louisiana (February 9, 2002).
91. "Organized Assembly of Carbon Nanotubes", International Conference on Research trends in Science and Technology, Organized by the Lebanese American University, Beirut and Byblos, Lebanon (March 4, 2002).
92. "Nanotechnology and Applications", Short Course at the International Conference on Research trends in Science and Technology, Organized by the Lebanese American University, Beirut and Byblos, Lebanon (March 4, 2002). **
93. "Center for Directed Assembly of Nanostructures at RPI", Brookhaven Nanocenter Workshop, Brookhaven National Laboratory, Upton, New York (March 7-9, 2002).
94. "Nanocomposites from Carbon Nanotubes", Nanotube School organized at the US Patent & Trademark Office, Washington, DC (May 2, 2002). **
95. "Building Architectures with Carbon Nanotubes", Seminar, Department of Electrical Engineering, University of South Carolina, Columbia, SC (May 15, 2002).
96. "Building Architectures with Carbon Nanotubes", Seminar, Dpto. Fisica de Materiales, Facultad de Quimicas, U. Pais Vasco, Centro Mixto CSIC-UPV/EHU, Apdo. 1072, 20018 San Sebastian/Donostia. Spain (June 14, 2002).
97. "Building Architectures with Carbon Nanotubes and Exploring their Applications", NANO-2002, St. Petersburg, Russia (17 June, 2002).
98. "Materials in Nanotechnology: Nanotubes to Nanocomposites", World Engineering Congress, Sarawak, Malaysia (23 July, 2002)
99. "Organized Assembly of Carbon Nanotubes", NATO-ASI workshop, Crete, Greece (29 July, 2002). **
100. "Synthesis and Assembly of Nanostructures", Short Course, NY-Nanotech Symposium, AVS Regional Meeting, Rensselaer Polytechnic Institute, Troy, New York (7 August, 2002). **
101. "Building Architectures with Carbon Nanotubes", NY-Nanotech Symposium, AVS Regional Meeting, Rensselaer Polytechnic Institute, Troy, New York (8 August, 2002).
102. "Building Architectures with Carbon Nanotubes", CANEUS (Canada-Europe-Japan Space agencies) Workshop on Nanotechnology, Canadian Space Agency, Montreal, Canada (August 26, 2002).
103. "Carbon Nanotubes and Nanotechnology", Colloquium, Department of Physics, Banaras Hindu University, Varanasi, India (September 1, 2002).
104. "Building Organized Carbon Nanotube Structures", Special Seminar, ARCI (Indian Department of Defense Institute), Hyderabad, India (September 2, 2002).
105. "Building Organized Carbon Nanotube Structures", Conference on BioMEMS and Biomedical Nanotechnology, Columbus, Ohio (September 8, 2002).
106. "Building Organized Carbon Nanotube Structures", Seminar, GE Global Research Center, Schenectady, New York (September 23, 2002).
107. "Impact of Carbon Nanotubes in Nanotechnology", NSF US-Romania workshop, Brasov, Romania (October 2, 2002).
108. "Building Organized Carbon Nanotube Structures", US Army Research Laboratory, Aberdeen Proving Ground, Maryland (October 8, 2002).
109. "Building Architectures with Carbon Nanotubes", Colloquium, Department of Materials Science and Engineering, University of Illinois, Urbana-Champaign, IL (October 28, 2002).
110. "Defects in Carbon Nanostructures", Nanohour Seminar, Beckman Institute, University of Illinois, Urbana-Champaign, IL (October 29, 2002)

111. "Building Architectures with Carbon Nanotubes", Seminar, Department of Chemistry, University of Massachusetts, Dartmouth, Massachusetts (October 30, 2002).
112. "Small Things, Big Opportunities", Breakfast talk, Temple Gates of Heaven (Jewish Synagogue), Schenectady, NY (November 10, 2002) **
113. "Fabrication of Highly Organized Carbon Nanotube Architectures", Seminar, Chemistry Division, Naval Research Laboratory, Washington, DC (November 18, 2002).
114. "Building Organized Architectures with Carbon Nanotubes", Colloquium, Institute of Materials Science – Polymer Program, University of Connecticut, Storrs, CT (November 20, 2002)
115. "Fabrication of Organized Carbon Nanotube Architectures", Seminar, ISIS, Universite Louis Pasteur, Strasborug, France (January 7, 2003).
116. "Fabrication of Highly Organized Carbon Nanotube Architectures", Seminar, Institut de Physique te Chimie des Matériaux de Strasbourg, CNRS, Strasbourg, France (January 7, 2003).
117. "Carbon Nanotubes: Complex Structures by Simple Techniques", International Conference On Metallurgical Coatings And Thin Films, San Diego, CA (April 30, 2003).
118. "Building Organized Architectures with Carbon Nanotubes", Colloquium, Department of Polymer Engineering, University of Akron, Akron, OH (May 2, 2003).
119. "Building Organized Architectures with Carbon Nanotubes", Special Seminar, Department of Physics, University of Geneva, Geneva, Switzerland (May 12, 2003).
120. "Fabrication of Organized Carbon Nanotube Architectures", Seminar, Institute of New Materials, University of Saarbrücken, Saarbrücken, Germany (June 10, 2003).
121. "Fabrication of Organized Carbon Nanotube Architectures", Seminar, Department of Materials Science, TU Darmstadt, Darmstadt, Germany (June 11, 2003).
122. "Fabrication of Organized Carbon Nanotube Architectures", Seminar, Department of Materials Science and Engineering, Royal Institute of Technology (KTH), Stockholm, Sweden (July 18, 2003).
123. "Synthesis, Characterization and Properties of One Dimensional Nanostructures", Summer School on Functional Nanostructures, Bad Herrenalb, Germany (September 27, 2003). **
124. "Building Organized Architectures with Carbon Nanotubes", Conference on Functional Nanostructures, Karlsruhe, Germany (October 2, 2003).
125. "Building Organized Architectures with Carbon Nanotubes", Seminar, ACS Chapter, SUNY, Oneonta, New York (October 7, 2003).
126. "Fabrication of Organized Carbon Nanotube Architectures", Seminar, Department of Chemical Engineering and the NASA URETI Center, Princeton, New Jersey (October 13, 2003).
127. "Synthesis and Properties of 1-D Nanostructures", Workshop at the Nanoparticles 2003 Conference, Boston, MA (October 26, 2003). **
128. "Why Nanotechnology", First Szeged International Workshop on Advances in Nanoscience", Szeged, Hungary (October 28, 2003). **
129. "Directed Assembly of Singlewalled Nanotubes and Applications of Nanotubes", First Szeged International Workshop on Advances in Nanoscience", Szeged, Hungary (October 28, 2003).
130. "Fabrication of Organized Carbon Nanotube Architectures", Conference on Functional Semiconductor Nanostructures, NTT Research Laboratories, Atsugi, Japan (November 12, 2003).
131. "Fabrication and Applications of Carbon Nanotube Architectures: Progress and Challenges", Seminar, International Materials Institute, Tohoku University, Sendai, Japan (November 14, 2003).
132. "Carbon Nanotube Architectures", Seminar, Department of Physics and Chemistry, Osaka City University, Osaka, Japan (November 17, 2003).
133. "Fabrication of Functional Carbon Nanotube Architectures", The 7th International Conference on Atomically Controlled Surfaces, Interfaces and Nanostructures, Nara, Japan (November 19, 2003).
134. "Applications of Carbon Nanotube Architectures", Seminar, , SINTEF, Oslo, Norway (November 26, 2003).
135. "Complex Carbon Nanotube Architectures by Simple Techniques", ICON-2004, Chandigarh, India (December 23, 2003).
136. "Fabrication of Organized Carbon Nanotube Architectures", Seminar, Regional Research Laboratory, Trivandrum, India (December 31, 2003).
137. "Fabrication of Organized Carbon Nanotube Architectures", Seminar, Vikram Sarabhai Space Center, Trivandrum, India (December 31, 2003).
138. "Organized Carbon Nanotube Architectures for Applications", The 11th International Symposium on Advanced Materials (Frontiers of Nanomaterials and Colloid Chemistry), Tokyo, Japan (March 9, 2004).
139. "Fabrication of Organized Carbon Nanotube Architectures", Seminar, Electrical Engineering Department, Texas A&M University, College Station, Texas (March 11, 2004).

140. "Organized Carbon Nanotube Architectures for Applications", Seminar, Materials Science and Engineering Department, University of Florida, Gainesville, FL (March 24, 2004).
141. "Organized Carbon Nanotube Architectures for Applications", Seminar, Mechanical Engineering Department, University of Hawaii, Honolulu, Hawaii (April 15, 2004).
142. "Carbon Nanotubes: Looking into Future", US-French Workshop on Nanotechnology, Honfleur, France (May 6, 2004).
143. "Fabrication of Organized Carbon Nanotube Architectures", Seminar, Structural Materials Branch, AFRL/MLBC, Wright-Patterson AFB, Dayton, OH (May 12, 2004).
144. "Fabrication of Organized Carbon Nanotube Architectures", Hilliard Symposium, Northwestern University, Evanston (May 13, 2004). (*Keynote Talk*)
145. "Organized Carbon Nanotube Architectures for Applications", Nanofactory Workshop, Meijo University, Nagoya, Japan (May 29, 2004).
146. "Directed Assembly of Carbon Nanotube Structures", DARPA Workshop on Direct Write Technology, Seward, Alaska (June 29, 2004).
147. "Carbon Nanotubes and Nanocomposites", ACS Meeting (Polymers and Coatings Session), Philadelphia (August 25, 2004).
148. "Carbon Nanotubes Structures for Applications", AFOSR MURI Workshop on Tribology, Annapolis, MD (November 4, 2004).
149. "Fabrication of Complex Functional Carbon Nanotube Architectures", MRS Fall Meeting, Boston, MA (November 30, 2004).
150. "Tailoring Carbon Nanotube Architectures for Applications", Agilent Technologies, San Jose, CA (December 9, 2004).
151. "Carbon Nanotubes and Applications", IIT-B Nanotechnology Workshop, Mumbai, India (January 6, 2005). (*Keynote Lecture*)
152. "Fabrication of Complex Functional Carbon Nanotube Architectures", Special Lecture, Goodyear Corp., Akron, Ohio (February 4, 2005).
153. "Carbon Nanotube Architectures and Applications", Akron Polymer Group Lecture, Department of Polymer Science, Akron University, Akron, Ohio (February 4, 2005).
154. "Organized Carbon Nanotube Architectures", Special Seminar, Department of Electrical Engineering, Louisiana State University, Baton Rouge, LA (February 9, 2005).
155. "Carbon Nanotubes and Applications", Research Trends in Science and Technology, International Conference, Beirut, Lebanon (March 8, 2005). (*Keynote Lecture*)
156. "Carbon Nanotube Structures for Interconnect Applications", Special Seminar, Components Research Division, Intel Corporation, Hillsboro, Oregon (March 18, 2005).
157. "Carbon Nanotube Architectures for Applications", Special Seminar, YTC America Inc., Camarillo, CA (March 23, 2005).
158. "Carbon Nanotube Architectures for Applications", Seminar, Department of Textiles and Materials Science, University of Massachusetts, Dartmouth, MA (April 21, 2005).
159. "Controlled Fabrication of Carbon Nanotube Architectures", Nano-Biotechnology Center Seminar, Cornell University, Ithaca, NY (May 3, 2005).
160. "Nanomaterials: Synthesis, Assembly, Properties and Applications of Nanostructures", Short Course, NanoBusiness Alliance Meeting, New York City, NY (May 22, 2005). **
161. "Carbon Nanotube Architectures for Applications", ASM New York Chapter Meeting, GE Global Research Center, Schenectady, NY (April 24, 2005).
162. "Carbon Nanotube; Structure, Properties and Applications", Short Course, University of Oulu, Oulu, Finland (May 30, 2005). **
163. "Carbon Nanotube Architectures for Applications", NANOMAT Birkeland Conference, Trondheim, Norway (June 2, 2005).
164. "Controlled Assembly of Carbon Nanotube Architectures", Seminar, Wake Forest University, Greensboro, NC (June 10, 2005).
165. "Organized Carbon Nanotube Architectures for Applications", Seminar, Pacific Northwest National Laboratory, Richland, WA (June 16, 2005).
166. "Controlled Fabrication of Carbon Nanotube Based Structures", Colloquium, ISSP, Chinese Academy of Sciences, Hefei, China (July 15, 2005).
167. "Carbon Nanotubes and Applications", Zhejiang University, Batou (Inner Mongolia), China (July 16, 2005).
168. "Carbon Nanotubes and Applications", Gansu Technology University, Lanzhou, China (July 19, 2005).

169. "Carbon Nanotubes and Applications", Indian Institute of Science, Bangalore, India (August 2, 2005).
170. "Carbon Nanotubes and Nanotechnology", Seminar, National Institute of Technology, Calicut, India (August 12, 2005).
171. "Organized Carbon Nanotube Architectures for Applications", Seminar, Cochin University of Science and Technology, Cochin, India (August 16, 2005).
172. "Fabrication of Carbon Nanotube Hybrids: A Collaboration between RPI and IPICYT", Materials World Network, International Materials Congress, Cancun, Mexico (August 24, 2005).
173. "Organized Carbon Nanotube Architectures for Applications", Special Seminar (Distinguished Alumnus Award Ceremony), Benaras Hindu University, Varanasi, India (October 3, 2005).
174. "Organized Carbon Nanotube Architectures for Applications", Seminar, University of Hyderabad, Hyderabad, India (October 4, 2005).
175. "Organized Carbon Nanotube Architectures for Applications", Colloquium, Colgate University, Colgate, NY (November 11, 2005).
176. "Carbon Nanotubes and Applications", Seminar, City College of New York, CUNY, NY (November 21, 2005).
177. "Fabrication of Carbon Nanotubes", Seminar, Intel Corporation, Chandler, AZ (Dec. 7, 2005).
178. "Materials in Nature and Biomimetic Strategies", Short Course, IPICYT, San Luis Potosi, Mexico (December 20-23, 2005). **
179. "Controlled Assembly of Carbon Nanotube Structures", Seminar, Rice University, Houston, TX (January 23, 2006).
180. "Engineering of Carbon Nanotube Architectures", Seminar, California Institute of Technology, Pasadena, CA (February 22, 2006).
181. "Carbon Nanotubes: The Tall Order", Seminar, University of Southern California, Los Angeles, CA (February 23, 2006).
182. "Controlled Assembly of Carbon Nanotube Structures", Brandon Symposium, TMS Meeting, San Antonio, TX (March 13, 2006).
183. "Engineering of Carbon Nanotube Architectures", ICONSAT, New Delhi, India (March 16, 2006).
184. "Carbon Nanotubes and Applications – Update", Seminar, Banaras Hindu University, Varanasi, India (March 21, 2006).
185. "Engineering of Carbon Nanotube Architectures", NSLS/CFN User Meeting, Brookhaven National Laboratory, Upton, NY (May 15, 2006).
186. "Controlled Assembly of Carbon Nanotube Structures", Special Seminar, IIT Madras, Chennai, India (July 24, 2006).
187. "Engineering of Carbon Nanotube Architectures", Nano-biotechnology Conference, Pune, India (August 10, 2006).
188. "Engineering of Carbon Nanotube Architectures", International Conference on Trends in nanotechnology, Cochin, India (August 18, 2006).
189. "Controlled Assembly of Carbon Nanotubes", NANO2006, Bangalore, India (August 25, 2006).
190. "Engineering of Carbon Nanotube Architectures", Seminar, Helsinki University of Technology (August 15, 2006).
191. "Nanocomposites: A tour de Force", ASME International Conference on Multifunctional Nanocomposites, Honolulu, Hawaii (August 20, 2006).
192. "Engineering of Carbon Nanotube Architectures", Missouri Nanoalliance Meeting, University of Missouri, Columbia, MO (October 7, 2006). (*Keynote Lecture*)
193. "Engineering of Carbon Nanotube Architectures", Workshop on Carbon Technologies, Pennsylvania State University, State College, PA (October 16, 2006).
194. "Engineering of Carbon Nanotube Architectures", Kavli US-Chinese National Academy of Science Meeting, Irvine, CA (October 27, 2006).
195. "Engineering of Carbon Nanotube Architectures", Seminar, Rutgers University, New Brunswick, NJ (November 17, 2006).
196. "Engineering of Carbon Nanotube Architectures", Seminar, University of Pennsylvania, Philadelphia, PA (November 16, 2006).
197. "Controlled Assembly of Carbon Nanotubes" MRS Medal Talk, Symposium Q, Materials Research Society Fall Meeting, Boston, MA (November 27, 2006).
198. "Carbon Nanotube Architectures and Applications" *Distinguished Lecture Series*, Northeastern University, Boston, MA (November 28, 2006).
199. "Engineering of Carbon Nanotubes" MRS Medal Talk, Symposium G, Materials Research Society Fall Meeting, Boston, MA (November 29, 2006).

200. "Engineering of Carbon Nanotubes" Gordon Research Conference on Chemistry of Hydrocarbon Resources, Venture, CA (January 9, 2007).
201. "Engineering of Carbon Nanotubes" Special seminar, Applied Materials, San Jose, CA (January 11, 2007).
202. "Controlled Assembly of Carbon Nanotubes", IFC-MSD Focus Center Workshop, MIT, Cambridge, MA (March 23, 2007).
203. "Carbon Nanotube Growth: Understanding or Lack of", Singlewalled Nanotube Growth Workshop, Canyon of the Eagles, Texas (April 17, 2007).
204. "Carbon Nanotubes – Related Technologies and Engineering Concepts", Seminar, Air Force Research Labs, Dayton, OH (April 20, 2007).
205. "Engineering Carbon Nanotube Architectures", Nanotechnology Symposium, Polytechnic University of Brooklyn, Brooklyn, NY (April 23, 2007).
206. "Engineering Carbon Nanotube Architectures", Nanotube 07, Ouro Preto, Brazil (June 25, 2007) (*Keynote Lecture*).
207. "Applications of Carbon Nanotubes", Seminar, KMUTT, Bangkok, Thailand (July 4, 2007).
208. "Engineering Carbon Nanotube Architectures", Nanotechnology Workshop, Seoul National University, Seoul, South Korea (July 11, 2007).
209. "Engineering Carbon Nanotube Architectures", Seminar, Inje University, Pusan, South Korea, (July 13, 2007).
210. "Engineering Carbon Nanotube Architectures", Seminar, Department of Mechanical Engineering, University of Houston, Houston, Texas (September 20, 2007).
211. "Engineering Carbon Nanotube Architectures", Seminar, US Army Research Laboratories, Adelphi, MD (October 2, 2007).
212. "Engineering Carbon Nanotube Architectures", Seminar, Department of Materials Science, University of Texas at Arlington, Arlington, Texas (October 12, 2007).
213. "Engineering Carbon Nanotube Architectures", Seminar, Department of Chemistry, Southern Illinois University Carbondale, Carbondale, Illinois (October 20, 2007).
214. "Assembly and Applications of Carbon Nanotubes", Seminar, McGill University, Montreal, Canada (November 10, 2007).
215. "Applications of Carbon Nanotubes", Seminar, School of Engineering, Brown University, Providence, RI (November 26, 2007).
216. "Applications of Carbon Nanotubes", Seminar, R&D Division, Bharat Petroleum Corporation Limited, New Delhi, India (December 11, 2007).
217. "Engineering at the Nanoscale - Carbon Nanotube Experience", New Professor Colloquium, School of Engineering, Rice University, Houston, Texas (January 24, 2008).
218. "Carbon nanotubes – Looking into Future", Cascadia Nanotechnology Symposium, Vancouver, BC, Canada (March 3, 2008). *Plenary Lecture*
219. "Organized Carbon Nanotube Architectures", EPSCOR Nanotechnology Conference, Oklahoma City, Oklahoma (March 7, 2008).
220. "Engineering of Carbon Nanotubes for Applications", TMS Annual Meeting, New Orleans, Louisiana, March 10 (2008).
221. "Engineering of Carbon Nanotubes", MRS Spring Meeting, Symposium P on Carbon Nanotubes and Related Low Dimensional Materials, San Francisco, CA (March 24, 2008).
222. "Hybrid Nanowire Architectures", MRS Spring Meeting, San Francisco, CA (March 25, 2008).
223. "Carbon Nanotubes to Graphene Interconnects", Rice Workshop on Future Computing, Rice University, Houston, Texas (April 2, 2008).
224. "Engineering and Applications of Carbon Nanotubes", Conference on Nanotechnology and Medicine, Wake Forest University, Salem, NC (April 7, 2008).
225. "Engineering of Carbon Nanotubes", ACS Annual Meeting, New Orleans, Louisiana (April 10, 2008).
226. "Engineering of Carbon Nanostructures", Seminar, INT – Forschungszentrum, Karlsruhe, Germany (April 17, 2008).
227. "Carbon Nanotubes to Graphene Interconnects", SRC Workshop on Graphene Devices and Interconnects, MIT, Cambridge, MA (May 8, 2008).
228. "Engineering at the Nanoscale - Carbon Nanotube Experience", Natex Workshop, Dallas, Texas (May 13, 2008)
229. "Engineering and Applications of Carbon Nanotubes", Seminar, Nanotechnology Group, NASA, Houston, Texas (May 28, 2008)

230. "Electrical Interconnects from Carbon Nanotubes, Nanowires and Graphene", Interconnect Focus Center Workshop, Albany, New York (June 19, 2008).
231. "Engineering Carbon Nanotubes for Applications", Department Seminar, Chemical and Biological Engineering Department, Rice University, Houston, Texas (August 28, 2008).
232. "Engineering Carbon Nanotubes", Department Seminar, Department of Physics, University of Houston, Houston, Texas (October 7, 2008).
233. "Engineering at the Nanoscale - Carbon Nanotube Experience", SANES Workshop, University of Szged, Szged, Hungary (October 9, 2008).
234. "Engineering at the Nanoscale – Future and Challenges", International Symposium on the occasion of 10 year INT and opening of the Karlsruhe NanoMicro Facility (KNMF), Forschungzentrum, Karlsruhe, Germany (October 13, 2008).
235. "Nanocomposites and Applications", Lockheed Martin Lecture, Rice University, Houston, Texas (October 17, 2008).
236. "Engineering and Applications of Carbon Nanotubes", Special Seminar, Materials Science and Engineering Department, McMaster University, Hamilton, Ontario, Canada (October 23, 2008).
237. "Electrical Interconnects: Carbon Nanotubes, Graphene and Beyond", e-Lecture Series, Focus Center Program (October 23, 2008).
238. "Engineering at the Nanoscale – Future and Challenges", Distinguished Lecture, Xerox Research Laboratories, Ontario, Canada (October 24, 2008).
239. "Nanotechnology and Future", Lecture via Skype, Yearly Festival of Engineering Students, National Institute of Technology (NIT), Calicut, Kerala, India (October 25, 2008).
240. "Darker than Dark Material using Nanotechnology", Introductory Lecture to Anime Fans, Premier of Animation Movie – Darker than Dark -, Houston, Texas (November 18, 2008).
241. "Engineering Carbon Nanotubes for Applications", Special Seminar, FormFactor, Livermore, California (November 20, 2008).
242. "Engineering and Applications of Carbon Nanotubes", International Workshop on Carbon Materials, Jawaharlal Nehru Center for Advanced Scientific Research, Bangalore, India (December 10, 2008).
243. "Engineering at the Nanoscale and Nanotechnology Applications", Bangalore Nano 2008, Bangalore, India (December 12, 2008).
244. "Engineering at the Nanoscale – Future and Challenges", Keynote Presentation, Micro and Nanotechnologies Interdisciplinary Workshop, Indian Institute of Science Centennial Celebration, Bangalore, India (December 14, 2008).

PHD STUDENTS GRADUATED

1. Dr. Odile Stephan (Ph. D, 1995) (Co-advised with Professor Christian Colliex)
Universite Paris-Sud, Orsay, France
2. Dr. Philipp Redlich (Ph. D, 1997) (Co-advised with Professor Manfred Rühle)
Max-Planck-Institute für Metallforschung (Dessertation an der Universität Stuttgart)
3. Dr. Tarek Suwan de Fillipe (Ph. D, 1998) (Co-advised with Prof. Shyam Murarka)
Department of Materials Science & Engineering, Rensselaer Polytechnic Institute
4. Dr. John Nugent (Ph. D, 2001) (Co-advised with Prof. Richard Siegel)
Department of Materials Science & Engineering, Rensselaer Polytechnic Institute
5. Dr. Jonathan Ward (Ph. D, 2002)
Department of Materials Science & Engineering, Rensselaer Polytechnic Institute
6. Dr. Yungjoon Jung (Ph. D, 2003)
Department of Materials Science & Engineering, Rensselaer Polytechnic Institute
7. Dr. Nirupama Chakrapani (Ph. D, 2004)
Department of Materials Science & Engineering, Rensselaer Polytechnic Institute
8. Dr. Nachiket Ravavikar (Ph. D, 2004) (Co-advised with Prof. Linda Schadler)
Department of Materials Science & Engineering, Rensselaer Polytechnic Institute
9. Dr. G. Viswanathan (Ph. D, 2004) (Co-advised with Prof. C. Ryu)
Department of Chemical and Bichemical & Engineering, Rensselaer Polytechnic Institute
10. Dr. Aravind Vijayaraghavan (Ph. D, 2005)
Department of Materials Science & Engineering, Rensselaer Polytechnic Institute
11. Dr. Yoon Choi (Ph.D, 2006)
Department of Engineering Sciences, Rensselaer Polytechnic Institute
12. Dr. Sarah Lastella (Ph. D, 2006) (Co-advised with Prof. C. Ryu)
Department of Chemistry, Rensselaer Polytechnic Institute
13. Dr. Pavan Raja (PhD, 2007) (Co-advised with Prof. O. Nalamasu, D. Thomson, A. Sharma)
Department of Chemical Engineering, Rensselaer Polytechnic Institute
14. Dr. Xuesong Li (PhD, 2007)
Department of Materials Science and Engineering, Rensselaer Polytechnic Institute
15. Dr. Sunil Pal (PhD, 2007) (Co-advised with Prof. T. Borca)
Department of Mechanical Engineering, Rensselaer Polytechnic Institute
16. Sumanjeet Kaur (PhD 2008) (Co-advised with Prof. R. Kane)
Department of Materials Science and Engineering, Rensselaer Polytechnic Institute
17. Sandeep Razdan (PhD 2008)
Department of Materials Science and Engineering, Rensselaer Polytechnic Institute
18. Justin Bult (PhD 2008) (Co-advised with Prof. L. Schadler)
Department of Materials Science and Engineering, Rensselaer Polytechnic Institute
19. Catherine Soldano (PhD 2008)
Department of Physics, Rensselaer Polytechnic Institute
20. Trevor Simmons (PhD 2008) (Co-advised with Prof. R. Linhardt)
Department of Chemistry, Rensselaer Polytechnic Institute

PRESENT PHD STUDENTS

F. S. Ou, A. Goyal, W. Gao, A. Sayyad, S. Tatabatei, R. Wahi, B. Carey, P. Cox, C. Galande

SPONSORED UNDERGRADUATES

Biju Babeendran, Jonathan Belfort, C. Downs, Jonathan Stickel, Tom Abatemarco, Cindy Giannaris, Jane Clayton, Amanda Gierman, Andre de la Gaurdia, Feng Qu, Lucas McMichael, Natasha Edmondson, Rory Leahy, Emer Lahiff, Denis Mc Carthy, Karsten Holders, Peter Marek, Paul Kovalov, Derek Benicewicz, Adam Parkinson, D. Hashim, H. Bowman

SPONSORED POSTDOCTORAL FELLOWS AND VISITORS

1. Prof. K. S. V. Santhanam (Summer 1998) – Visiting Scientist
2. Dr. Z. J. Zhang (August 1999 – August 2001) – Postdoctoral Fellow
3. Dr. B. Q. Wei (May 2000 – July 2003) – Postdoctoral Fellow
4. Dr. B. Gogia (March 2001 – December 2001) – Postdoctoral Fellow
5. Dr. R. Vajtai (July 2000 – Present) – Postdoctoral Fellow, Staff
6. Dr. A. Cao (January 2002 – June 2005) – Postdoctoral Fellow
7. Dr. S. Trasaboras (January 2002 - January 2003) – Postdoctoral Fellow

8. Dr. S. Talapatra (July 2002 – Present) – Postdoctoral Fellow
9. Prof. G. V. S. Shastri (Summer 2003) – Visiting Professor
10. Dr. Seamus Curran (June 2002 – July 2003) – Postdoctoral Fellow
11. Dr. Juyen Cheng (September 2003 – December 2004)
12. Prof. G. Meng (August 2002 – December 2004) – Visiting Scholar
13. Dr. Yungjoon Jung (August 2003 – June 2005) - Postdoctoral Fellow
14. Prof. Rick Geier (January 2004 – July 2004) – Visiting Professor (on Sabbatical)
15. Dr. Swastik Kar (January 2005 – 2008) – Postdoctoral Fellow
16. Dr. Navdeep Bajwa (May 2005 – 2007) – Postdoctoral Fellow
17. Dr. Ashavani Kumar (July 2005 – Present) – Postdoctoral Fellow
18. Dr. Victor Pushparaj (September 2005 – 2008) – Postdoctoral Fellow
19. Dr. M. M. Shajumon (November 2005 – Present) – Postdoctoral Fellow
20. Dr. Ana Laura Arrigas (May 2005 – September 2005; 2008) – Visiting Fellow (Mexico)
20. Dr. NiramolPunbusayakul (March 2005 – January 2007) – Visiting Student (Thailand)
21. Dr. Lijie Ci (2005 – Present) - Postdoctoral Fellow
22. Dr. Leela Mohan Reddy (2008 – Present) - Postdoctoral Fellow
23. Dr. Kaushik Balakrishnan (2008 – Present) - Postdoctoral Fellow
24. Dr. Prabir Patra (2007-2008) – Research Scientist
25. Dr. Sangeeta Sahoo (2006-2008) – Postdoctoral Fellow
26. Kenta Sawada (2008) – Visiting Doctoral Student
27. Prof. Anchal Srivastava (2008) – Visiting Fellow
28. Prof. You Zheng (2008) – Visiting Fellow
29. Changru Rong (2008) – Visiting Graduate Student
30. Jung Joo Yoo (2008) - Visiting Graduate Student
31. Yongjie Li (2008) - Visiting Graduate Student
32. Dr. Li Song (2008 - Present) – Postdoctoral Fellow

COURSES TAUGHT

1. Chemistry of Materials I (RPI)

Undergraduate Core-Engineering Course
 {1997 Fall (51 students); 1998 Fall (18 students); 2001 Fall (52 students)}

2. Chemistry of Materials II / Materials Science for Engineers (RPI)

Undergraduate Core-Engineering Course
 {1997 Spring (42 students); 1998 Spring (54 students); 1999 Spring (18 students);
 1999 Fall (38 students); 2000 Spring (40 students); 2000 Fall (52 students); Spring 2001 (34
 students); Fall 2002 (52 students)}

3. Nanostructured Materials (New course developed at RPI)

(Graduate Course) (co-taught with Prof. R. W. Siegel)
 {1997 Fall (17 students); 1998 Fall (23 students); 1999 Fall (18 students); Spring 2002 (11
 students) }

4. Science of Carbon (New course developed on RPI campus)

(Graduate Course) (co-taught with Prof. P. Keblinski) Fall 2001 (13 students)

5. Materials in Nature and Biomimetic Strategies (New course developed at RPI)

(Graduate Course) Spring 2004 (9 students); Fall 2005 (11 students)

6. Introduction to Materials Science (Rice)

Undergraduate Course
 2008 Fall (55 students)

NEW COURSES DEVELOPED

Nanostructured Materials (RPI)

The course “Nanostructured Materials” was developed at RPI in collaboration with Prof. R. W. Siegel. The graduate level course has been designed by incorporating state of the art knowledge that exists in the field so that students can be trained and educated in an area that is fast becoming one of the important topics of materials science discipline. We are one of the pioneering institutions in the country that has developed a course devoted to nanostructured materials and this has been pointed out by national agencies. The course has served as a flagship for educational outreach, which is part of several funded programs at RPI in the area of nanotechnology.

The course covers basic understanding of materials with grain sizes below 100 nanometers, the new physics that evolves at smaller length scales, techniques of characterization and measurement and structure-property correlations. The course is formatted in a seminar style and the students are make presentations in the class as well as create a web-based module on any selected topic in nanostructured materials. A web-site for the course has developed following these student modules at: <http://www.rpi.edu/dept/materials/COURSES/nano>

Science of Carbon (RPI)

This course is a graduate level course, for those interested in the science and technology of carbon, being offered for the first time on RPI campus. Carbon, as graphite, activated porous carbon, carbon fibers, diamond and diamond like carbon has many industrial applications. The new forms of carbons (like nanotubes) promises high-tech applications in electronics of the future. The emphasis in this course will be to introduce students to the science of different forms of carbon, from both theoretical and experimental points of view. Structure, properties and applications of different carbon structures will be discussed in detail. Special attention will be devoted to presenting new developments in this field and future perspectives.

Materials in Nature and Biomimetic Strategies (RPI)

Course offered twice (2004 Spring, 2005 Fall)

