CURRICULUM VITAE

Michael Matthew John TREACY

PERSONAL & GENERAL

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Date & Place of Birth:	13th October 1954	Londonderry, N. Ireland
Nationality:	Dual citizenship. United Kingdom; Naturalized United States Citizen	

EDUCATION

Cambridge University, St John's College, U.K.

1980 Ph.D. (Cavendish Laboratory). Thesis Title: "Electron Microscopy of Palladium and Platinum Catalysts". Supervisor, Dr. A. Howie.

1976 B.A. Hons. 2.1 Natural Sciences (Theoretical and Experimental Physics). Dissertation: "Dynamics of the Earth–Moon System". Supervisor, Prof. A. H. Cook.

St. John's College, Southsea, U.K.

1973 3 'A' levels (three grade A passes), Distinctions in Physics and Mathematics.

1971 10 'O' levels (six grade 1 passes).

PROFESSIONAL POSITIONS AND EXPERIENCE

6/2003–present	Professor, Department of Physics Arizona State University, AZ, USA
10/1990–11/2002	Senior Research Scientist NEC Research Institute, Inc., Princeton, N.J., USA
9/1984–10/1990	Staff Physicist Exxon Research & Engineering Co, Corporate Research, N.J., USA
9/1982–8/1984	Senior Physicist Exxon Chemical Company, Aromatics Technology Division, N.J., USA
4/1981–8/1982	Ingénieur (Grade II) Centre National d'Etudes des Télécommunications, Bagneux, Paris
1/1980–3/1981	IBM World Trade Post–Doctoral Position, IBM Thomas J. Watson Research Center, Yorktown Heights, N.Y., USA

ORGANIZATIONAL EXPERIENCE

- Co–Organizer of the Materials Research Society Symposium on "Microstructure and Properties of Catalysts" Editor Proceedings, Vol. No. 111. (12/1987)
- Meeting Chair 1991 Materials Research Society Fall meeting, with M. Yoo (Oak Ridge) & J. Phillips (Bell Labs).
- Treasurer, Editor, Executive Committee, 9th International Zeolite Conference, Montréal, 6/1992.
- Chairman of the Structure Commission of the International Zeolite Association, (7/2001 – present).
- Member of the Council of the International Zeolite Association (1998–2004).
- Member (retired) of the Steering Committee of the National Center for Electron Microscopy (1989–1994).
- Treasurer, Editor, Executive Committee, for the 12th International Zeolite Conference, Baltimore, 6/1998.

- Meeting Chair of Gordon Research Conference on "Zeolites and Layered Clays" 6/2002.
- Co-organizer of NSF Workshop on *In-situ Microscopy of the nano-World*, Tempe, AZ, 1/2006.
- Organizer of workshop on *Design and Synthesis of New Materials*, Santa Barbara, Aug 1-2, 2008.
- Personnel Committee for Department of Physics, Fall 2004 – spring 2006.
- Budget & Policy Committee for Department of Physics, fall 2006 – spring 2009.
- Colloquium Committee for Department of Physics, fall 2003 – present.
- Chair of the Physics Colloquium Committee, spring 2005 – fall 2008.
- **Director of the Undergraduate Physics Program at Arizona State University, fall 2004 – present**.

AWARDS

Wright Award 1974. Awarded by St. John's College Cambridge, for academic excellence.

Best Biological Poster at the 1995 Microscopy Society of America conference (best out of 160).

Barrer Award 1990. Awarded triennially by the Royal Society of Chemistry to a young scientist under age 36, for distinguished work in the area of zeolites.

Donald W. Breck Award 1996. Awarded triennially by the International Zeolite Association for the most significant contribution to molecular sieve science and technology during that 3-year period – for elucidating fault structures in FAU/EMT zeolites.

Elected Fellow of the American Physical Society, Nov 2004, *For the development of novel electron microscopy techniques and applications to advanced materials including catalysts, zeolites, carbon nanotubes and disordered structures*.

Outstanding Teacher 2006–2007. Awarded by the Department of Physics at Arizona State University based on nominations by students and faculty.

Distinguished Teaching Award 2007–2008 in honor of Zebulon Pearce. Presented by the College of Liberal Arts and Sciences at Arizona State University based on nominations by students and faculty.

Nominee for Professor of the Year at ASU, spring 2009.

Leverhulme Professorship at the University of Oxford, Department of Materials, UK. Sabbatical leave, Aug 2009 – July 2010.

TEACHING

(1) June 1998, Invited lecture on "The Basics of Crystal Symmetry" at U. Illinois, Dept of Materials Science, given to graduate students.

(2) (2001-2004) "Reach For The Stars". Astronomy coach for two students at Plainsboro, New Jersey, Middle School. They competed in the New Jersey qualifying tournament and the National Science Olympiad in 2002 (came 19th) and 2003 (came 10th). In 2004, the same team came first, although I did not coach them for that full year because I had moved to Arizona.

(3) Fall 2003. PHY132 at ASU. Taught laboratory class on Electricity & Magnetism. Acting T.A. to John Spence. (24 students)

(4) Fall 2003. PHY241. Substitute lecturer for Prof. D. J. Smith. 2 lectures. (About 70 students.)

(5) Spring 2004. PHY241 at ASU. Lecture course. 45×50-minute lectures on Thermodynamics, Optics and Modern Physics. (72 students.)

(6) Guest Lecture (75 minutes) for course on Nanomaterials organized by Profs. T. Picraux and D. J. Smith. Lecture Title was "Synchrotron X-ray and Neutron Scattering". (About 35 students)

(7) Fall 2004. PHY241 at ASU. Lecture course. 45×50-minute lectures on Thermodynamics, Optics and Modern Physics. Did all of the quiz and exam grading myself. (78 students.)

(8) ASU Winter School on High Resolution Electron Microscopy. Lecture on Imaging Theory 1, and lab. classes (Jan 2005). (About 60 students)

(9) Spring 2005. PHY241 at ASU. Lecture course. 45×50-minute lectures on Thermodynamics, Optics and Modern Physics. (71 students.)

(10) Fall 2005 PHY521 at ASU. Classical Mechanics. Taught at the graduate level, based on the Goldstein textbook. 26×75-minute lectures. (17 graduate students)

(11) Fall 2005. PHY241 at ASU. Substitute lecturer for Prof. D. J. Smith. 4 lectures. (About 70 students.)

(12) ASU Winter School on High Resolution Electron Microscopy. Lecture on Imaging Theory 1, and lab. classes (Jan 2006). (About 45 students.)

(13) Spring 2006. PHY241 at ASU. Lecture course. 45×50-minute lectures on Thermodynamics, Optics and Modern Physics. (68 students.)

(14) Spring 2006, PHY 541 (Surface Science) at ASU. Guest Lecture on *Catalysis*. (15 students.)

(15) Fall 2006. PHY521 at ASU. Classical Mechanics. Taught at the graduate level, based on the Goldstein textbook. 26×75-minute lectures. (27 graduate students.)

(16) Fall 2006. PHY 310 at ASU. Stood in for Professor McCartney to give 3 lectures. (~30 students)

(17) Spring 2007. PHY241 at ASU. Lecture course. 45×50-minute lectures on Thermodynamics, Optics and Modern Physics. (72 students.)

(18) Fall 2007. PHY521 at ASU. Classical and Continuum Mechanics. Taught at the graduate level, based on the Goldstein textbook. Additional material on fluids and chaos. 26×75-minute lectures. (23 graduate students.)

(19) ASU Winter School on High Resolution Electron Microscopy. Two lectures on Imaging Theory 1 & II, and (Jan 2008). (About 70 students.)

(20) Spring 2008. PHY252 at ASU. Lecture and lab course. 26×110-minute lectures on Waves, Fluids, Thermodynamics and Optics. 12×110-minute lab classes. (42 students.)

(21) Fall 2008, PHY 521 at ASU. Classical and Continuum Mechanics. Taught at the graduate level, based on the Goldstein textbook. 26×75-minute lectures. (23 graduate students.)

(22) Spring 2009, PHY 252 at ASU. Lecture and lab course. 26×110-minute lectures on Waves, Fluids, Thermodynamics and Optics. 12×110-minute lab classes. (33 students.)

(23) Spring 2009, PHY 311 at ASU. Stood in for Prof. Barry Ritchie for 1 lecture.

RESEARCH GRANTS

- NSF GOALI award DMR 97-03906, co-Principal Investigator with J. M. Gibson at U. Illinois, supporting student Paul Voyles. "Atomic Correlations in Disordered Materials observed using Variable Coherence Transmission Electron Microscopy". $221,000.
- NSF GOALI award DMR 00-74273, co-Principal Investigator with P. J. Keblinski at Rensselaer Polytechnic, supporting students R. Kishora-Dash and Juyin Cheng. "Structure of Amorphous Materials by Fluctuation Microscopy and Atomic-level Simulation". 5/2004 – 5/2008, $240,000.
- Argonne National Laboratory (DOE) AWS-0046, "Fluctuation X-ray/Optical Microscopy Studies of disordered nano-scale and micro-scale assemblies", $267,622.
- NSF NER award CTS 0508434, co-PI with R. Sharma and P. Rez, "NER: Controlled Synthesis of carbon nanotubes with desired properties", 7/1/2005 – 6/30/2006, $100,000.
- Petroleum Research Fund, 46779-AC10. $84,000, "Zeolite structure prediction, and the identification of useful synthetic targets", 8/1/07 – 7/31/09.

- NSF MRI $3,277,750 "Acquisition of an aberration corrected high resolution analytical transmission electron microscope for advanced materials research", co-PI with R. Carpenter, S. Mahajan, D. J. Smith, J. C. H. Spence 10/1/2008 – 9/30/2011.
- NSF CDI-type I $255,559 "Collaborative Research: CDI-type I: "Discovery and design of new microporous zeolites.", PI with I. Rivin, Temple 9/1/2008 – 8/31/2011.
- Santa Barbara International Center for Materials Research (ICMR), $100,000, with Mike O'Keeffe (ASU), to run a Summer School and Workshop on Materials Design.
- UOP/Honeywell $30,000 unrestricted gift, to build a diffraction pattern database of hypothetical zeolites.

RESEARCH HIGHLIGHTS

- **Proposed, and demonstrated, the high-angle annular detector for STEM Z contrast**

My Ph.D. work was on the development of advanced TEM-based techniques for the characterization of supported Pt and Pd catalysts. At that time, Crewe's *Z* contrast technique seemed ideal for detecting high atomic number (*Z*) elements such as Pt, on low atomic number supports that are typical of supported catalysts. I demonstrated that diffraction produced strong contrast that overwhelmed the *Z*-contrast effect in crystals. In collaboration with supervisor A. Howie and L. M. Brown, I showed that upon increasing the annular detector inner collection angle, diffraction contrast could be suppressed. This work introduced the high-angle annular detector in Materials Science. Further, the *Z*-dependence of the signal improved to Z^2 because atomic screening effects are diminished. (This seemingly simple experiment required time and some considerable ingenuity to overcome design limitations in the early STEM instruments.) In later work, I demonstrated single Pt atom sensitivity in zeolites, with the channels clearly imaged giving us an indication as to the likely location of Pt atoms in the framework. I also showed that high angle annular dark field intensities could be used to estimate sub-nanometer particle sizes reliably. The high-angle annular detector is now a standard tool in (S)TEM studies of materials.

- **Identified a new deactivation mechanism in Pt/K-zeolite L aromatization catalysts**

My STEM *Z* contrast studies of Pt particles in the one-dimensional channels of zeolite L revealed that Pt particles agglomerate slowly with reaction time. The particles remain sufficiently small so that over 90% of the Pt atoms reside on particle surfaces. However, double-blockages in the zeolite channels effectively entomb a significant channel volume, and the loss of active Pt can be severe. I proposed a length-loading criterion for maintaining activity. The criterion is simple: there should not be enough Pt per channel to form two or more significant blockages. This hypothesis was confirmed when zeolite L supports with shorter channel lengths, but identical Pt loading, were tested. For proprietary reasons this work (1982–1985), which represents the culmination of my early *Z* contrast work, was published only in 1999. I won the prestigious Barrer Award (awarded triennially by the British Zeolite Association) in 1990 for part of this work.

- **Demonstrated the dominant role of elastic relaxation in TEM images of composition-modulated films**

My work at CNET in Paris was on spinodal decomposition of InGaAsP semi-conductors, which are used as photodiodes in fiber-optic telecommunications. Electron microscopy revealed pronounced quasi-periodic image contrasts that were traditionally ascribed to local composition fluctuations. In collaboration with J. M. Gibson and A. Howie, I showed that the contrast is primarily due to the bending of lattice planes near surfaces, which is induced by relaxation of stresses arising from the modulation in unit cell dimensions as the composition changes. Such bending produces strong diffraction contrasts. I derived equations for the bending, which remain useful for studies of strain modulation in all types of modulated thin films, from superlattices to ferroelectrics. This work also showed how to convert TEM lattice spacings into a local composition, allowing for the relaxed tetragonal distortions and their dependence on thickness.

- **Unraveled the structure of chiral zeolite beta**

Synthetic zeolite beta was first reported by Mobil in the mid 1960s. Its structure remained a mystery for over 20 years. The presence of planar faults in the sub-micron sized crystallites made it essentially impossible to solve the structure by conventional structure-refining methods. Using TEM to extract structure projections and the symmetry elements, in collaboration with J. M. Newsam, I showed that the structure comprises intimately intergrown right- and left-handed variants of a chiral tetragonal framework. (It later transpired that J. B. Higgins at Mobil had solved the structure 3 years earlier by model-building, but had not been allowed to publish.) The zeolite beta structure is important because it is a 3-dimensional 12-ring framework, with helical channels running along the c-axis. Nobody has synthesized the pure right- or left-handed forms yet, but such a pure end-member structure may have

applications in chiral separations. The methods I used, and the tools I created, in this work have been used by other researchers for structure determinations of other intergrown zeolite families.

- **Invented recursion algorithm for computing diffraction from faulted crystals – DIFFaX**

During the course of the zeolite beta work, I developed a recursion method of computing powder x-ray diffraction patterns in the presence of planar faults. This tool helped provide the crucial evidence supporting our model of zeolite beta. I am the primary author of the computer program *DIFFaX*, which has now become a standard tool for simulation of diffraction in planar-faulted crystals, and has been used widely by other researchers for over 20 years. I have used it successfully in many projects to identify fault patterns in layered crystal systems. The FORTRAN *DIFFaX* source code, with manual, is in the public domain.

- **Characterization of stacking fault patterns in faujasitic zeolites using TEM and DIFFaX simulations**

The tools I developed for studying zeolite beta where applied to studying the faulting distributions in the various faujasite-related synthetic zeolites, ranging from pure cubic FAU framework to the pure hexagonal EMT framework. Using TEM and DIFFaX, I showed that the faulting in these materials is correlated. Using the strain relaxation model, I showed that the strains associated with the stacking faults were reduced when faults were clustered. I won the prestigious Breck Award (awarded triennially by the International Zeolite Association) in 1996 for this work.

- **Combinatorial computer method for enumerating zeolite frameworks**

In collaboration with computer scientists K. Randall and S. Rao, I built a computer program to carry out a combinatorial search over every possible crystallographic graph in order to extract all of the 4-connected periodic zeolitic graphs. For one unique tetrahedral atom there are over 6,400 4-connected graphs, of which about 200 refine to regular tetrahedral topology. This work took over 10 years to bring to fruition, and discovered many new theoretical zeolite frameworks, and revealed some interesting idiosyncrasies in the *International Tables for Crystallography.* This work is collaboration with I. Rivin and Martin Foster. **This is an active research area.**

- **Fluctuation Microscopy: A powerful TEM technique for revealing medium-range order in amorphous materials.**

In collaboration with J. M. Gibson, we have shown that statistical analysis of the speckle observed in dark-field images of amorphous materials provides a measure of medium-range order. We have called this new analytical TEM technique *Fluctuation Microscopy.* We have used fluctuation microscopy to solve some long-standing problems in amorphous materials. We have shown that as-deposited amorphous germanium and silicon films contain paracrystalline regions. On annealing below the recrystallization temperature, Ge (but not Si) transforms to the lower-energy continuous random network. We have also shown that amorphous hydrogenated silicon (a-Si:H) undergoes a significant structural re-arrangement on light-soaking – an observation that may lead to an improved understanding of the Staebler-Wronski effect which currently limits the efficiency of a-Si:H solar cells. Fluctuation microscopy is now being used in several laboratories. This work remains active and has been extended to scanning x-ray microscopy of disordered nanomaterials (with I. McNulty and J. M. Gibson at Argonne), and also to scanning optical microscopy (student D. Kumar). **This is an active research area.**

- **Schläfli cluster methods for modeling amorphous tetrahedral models.**

Borrowing from my work on zeolite topologies, I have developed a simple topological tool for investigating medium-range order in models of amorphous tetrahedral semiconductors. Schläfli clusters are compact topological descriptors of the local connectivity around each atom. (It later emerged that they are similar to the earlier "local cluster" concept of L. W. Hobbs et al.) I have proposed that the diamond Schläfli cluster is the minimum atomic configuration that can be called "topologically cubic". Searching for such clusters is a fast effective tool for detecting medium range order in models of amorphous semiconductors.

- **In-situ TEM observations of domain switching in ferroelectric thin films.**

In collaboration with A. Krishnan, we made in-situ TEM observations of domain wall motion in thin single crystal ferroelectric materials under applied electric fields. I designed, and had built, a special TEM specimen holder that can heat, apply electric fields and shine light onto a sample. Our observations showed that domain walls do not move as rigid membranes. Instead, we proposed that domain walls move by allowing charged ripples to propagate along them. We developed a simple Landau-Ginsburg Free energy argument showing that ripples have a reduced barrier to switching. Ripples enable wall motion by a mechanism analogous to that for dislocation motion in crystal slip. We also showed that some domain walls are locked under certain electric field directions, representing an inherent contribution to ferroelectric fatigue and imprint.

- **Developed an effective dynamical diffraction Bloch wave explanation for the anomalous transmission of light through thin hole arrays.**

When light is shone on a thin metallic film, which has a periodic array of sub-optical wavelength diameter holes drilled through it, anomalously high intensities are transmitted at certain wavelengths. That is, more light gets through than would be expected from the projected hole area. The current popular explanation is that surface plasmons "guide" the light through the holes. I have developed an alternative dynamical diffraction Bloch wave theory that completely explains the anomalous transmission, and does so without resorting to special pleading about surface plasmons. The theory is fully general for 3-dimensional periodic gratings, and unlike the other theories, makes no simplifications or approximations to Maxwell's equations.

- **Exploited thermal vibrations to measure Young's modulus of carbon nanotubes**

Long carbon nanotubes that extend over holes in a TEM support film cannot be imaged clearly at their tips because of vibrations. The vibration amplitude at the tip can be several nanometers, and this blurring motion is normally a problem for high-resolution TEM studies. I realized that the vibrations are elastically relaxed phonons and represent heat motion. By measuring the r.m.s. vibration amplitude as a function of temperature, I estimated the Young's modulus to be ~1.8 teraPascal, which makes carbon nanotubes the stiffest known material. Later, in collaboration with T. W. Ebbesen, A. Krishnan and E. DuJardin, we applied this method to single-walled nanotubes and obtained values of ~1.2 TPa, which we believe are closer to the correct value. In collaboration with P. Yianilos, I developed a hidden-parameter-inferencing technique to improve and quantify the accuracy of the method. This unique application of TEM attracted international attention, including highlights in *Physics Today*, *C&E News*, *New Scientist*, *Bild der Wissenschaft* etc…

- **Designability of graphitic carbon cones.**

In collaboration with Ebbesen, Krishnan and DuJardin, we described in the journal *Nature* a special carbon black sample that comprised a high density of graphitic disks and cones. Our TEM analysis confirmed that the five topologically-allowed conical forms all occur in this sample, but with a preponderance of the 60° cone-angle variety. I explained this distribution with a simple model of graphitization. I pointed out that there are many more ways to circumscribe carbon rings around the tip of a cone than there are ways to imbed the same rings in planar graphite. For topologically flexible seeds, graphitic cones are more "designable" than planar graphite. With an assumed seed distribution, the model explains the observed cone distribution – highlighting the role of entropy in the formation of curved graphitic structures.

- **Primary author of the "Collection of Simulated XRD Powder Patterns For Zeolites".**

The Structure Commission of the International Zeolite Association maintains an up-to-date website describing the approved zeolite frameworks. Periodically, the Commission published updated handbooks describing zeolite frameworks and their diffraction patterns. I wrote a computer program that automates the production of the book "Collection of Simulated XRD Powder Patterns For Zeolites." This was not a trivial task, but was an enjoyable, instructive and satisfying challenge. The program is due to be used next in 2012-2013 for the sixth edition.

- **Mathematical tools for characterizing zeolite frameworks.**

In part-collaboration with I. Rivin and Martin Foster, I have developed a number of public-domain computational tools for characterizing zeolite frameworks. **TOTOPOL** is used to explore zeolite structural details and topologies. It is my primary tool when examining new framework proposals to the IZA Structure Commission. **DelaneysDonkey** is a whimsically-named code that executes a Delaunay triangulation of zeolite frameworks to identify the largest included sphere and the largest freespheres in a framework. This gives a good idea of the porosity characteristics. I wrote both computer programs.

- **Flexibility of zeolite frameworks.**

In collaboration with Asel Sartbaeva, Stephen Wells and Mike Thorpe at ASU, we showed that almost all of the known zeolites exhibit a flexibility window when modeled as Ideal Zeolite Frameworks. This important result provides a key test of hypothetical frameworks; if they lack flexibility, the likelihood of them being realized in nature is diminished. The composition of the framework is important, as the presence of different-sized tetrahedra can promote or diminish flexibility. An active research topic at present is the exploration of the nullspace represented by the flexibility window, with a view to computing the configurational entropy of the framework. An open question at present is whether or not the entropic density is a maximum when the framework density is minimum. Intuition says "yes," but we are exploring this using advanced computational tools (collaboration with Vitaliy Kapko and Colby Dawson.) This is an active research area.

Refereed Journal Articles

(1) L. A. Freeman, A. Howie and M. M. J. Treacy,
Bright Field and Hollow-cone Dark-Field Electron Microscopy of Palladium and Platinum Catalysts,
J. Microsc., **111** 165–178 (1977).

(2) M. M. J. Treacy, A. Howie and C. J. Wilson,
Z Contrast of Platinum and Palladium Catalysts,
Philos. Mag., **A38** 569–585 (1978).

(3) M. M. J. Treacy and A. Howie,
Contrast Effects in the Transmission Electron Microscopy of Supported Crystalline Catalyst Particles
J. Catal., **63** 265–269 (1980).

(4) M. M. J. Treacy, W. Krakow, D. A. Smith and G. Trafas,
A Technique For Comparing the Bulk and Surface Structure of Defects in Thin Films Using the Scanning Transmission Electron Microscope,
Appl. Phys. Letts., **38** 341–345 (1981).

(5) M. M. J. Treacy,
Imaging With Rutherford Scattered Electrons in the STEM,
Scanning Electron Microsc., **1** 185–197 (1981).

(6) D. A. Smith and M. M. J. Treacy,
Low-Loss Surface Imaging and Transmission Electron Microscopy of Growth of Some Thin Films,
Applications of Surface Science, **11/12** 131–143 (1982).

(7) M. M. J. Treacy,
Optimizing Atomic Number Contrast in Annular Dark Field Images of Thin Films in the Scanning Transmission Electron Microscope,
J. Microsc. Spectrosc. Eléctron., **7** 511–523, (1982).

(8) F. Glas, M. M. J. Treacy, M. Quillec and H. Launois,
Interface Spinodal Decomposition in LPE InGaAsP Lattice-Matched to InP,
J. de Physique, **43** C5 11–16 (1982).

(9) C. Colliex and M. M. J. Treacy,
Le Microscope Eléctronique à Balayage et en Transmission, ou STEM,
in *Microscopie Eléctronique en Science des Materiaux*, ed. by B. Jouffrey, A. Bourret and C. Colliex, CNRS Publication (Paris) 391–424 (1983).

(10) M. M. J. Treacy and J. Bellessa,
On the Measurement of Surface Step Heights by Low-Loss Imaging in STEM,
Ultramicroscopy, **11** 173–178 (1983).

(11) M. M. J. Treacy,
Atomic Number Imaging of Supported Catalyst Particles Using the Scanning Transmission Electron Microscope,
in *Catalytic Materials: Relationship Between Structure and Activity*, ed. by T. E. Whyte, R. A. Dalla Betta, E. G. Derouane and R. T. K. Baker, ACS Symposium Series No. **248** 367–383 (1984).

(12) J. M. Gibson and M. M. J. Treacy,
The Effect of Elastic Relaxation on the Local Structure of Lattice-Modulated Thin Films,
Ultramicroscopy, **14** 345–350 (1984).

(13) J. M. Gibson, R. Hull, J. C. Bean and M. M. J. Treacy,
Elastic Relaxation in Transmission Electron Microscopy of Strained Layer Superlattices,
Appl. Phys. Letts., **46** 649–651 (1985).

(14) M. M. J. Treacy, J. M. Gibson and A. Howie,
On Elastic Relaxation and Long Wavelength Microstructures in Spinodally-decomposed InGaAsP Epitaxial Layers,
Philos. Mag., **A51** 389–417 (1985).

(15) M. M. J. Treacy, J. M. Newsam, R. A. Beyerlein, M. E. Leonowicz and D. E. W. Vaughan,
The Structure of Zeolite CSZ-1 Interpreted as a Rhombohedrally-Distorted Variant of the Faujasite Framework,
J. Chem. Soc. Chem. Commun. 1211–1214 (1986).

(16) M. M. J. Treacy and J. M. Gibson,
The Effects of Elastic Relaxation on TEM Studies of Thinned Composition- Modulated Materials,
J. Vac. Sci. **B4** 1458–1466 (1986).

(17) M. M. J. Treacy, R. C. Haushalter and S. B. Rice,
Transmission Electron Microscopy Study of the Reaction of Sn_9^{4-} Zintl Ions with Single Crystal Au Films,
Ultramicroscopy, **23** 135–150 (1987).

(18) M. M. Disko, M. M. J. Treacy, S. B. Rice, R. R. Chianelli, J. A. Gland, T. R. Halbert and A. F. Ruppert,
Spatially Resolved Electron Energy Loss Spectroscopy of MoS_2 Platelets,
Ultramicroscopy, **23** 313–320 (1987).

(19) M. M. J. Treacy and J. M. Newsam,
Electron Beam Sensitivity of Zeolite L,
Ultramicroscopy, **23** 411–420 (1987).

(20) M. M. J. Treacy, R. C. Haushalter and S. B. Rice,
Reaction of Sn_9^{4-} with Single Crystal Au: Textured Fiber Epitaxial growth of AuSn at Room Temperature,
Angew. Chemie. **26** 1155–1156 (1987).

(21) M. M. J. Treacy, J. M. Gibson, K. T. Short and S. B. Rice,
Channeling Effects From Impurity Atoms in the High Angle Annular Detector of the STEM,
Ultramicroscopy, **26** 133–142 (1988).

(22) M. M. J. Treacy and J. M. Newsam,
Two New Three–Dimensional Twelve–Ring Zeolite Frameworks of which Zeolite Beta is a Disordered Intergrowth,
Nature, **332** 249–251 (1988).

(23) M. M. J. Treacy and S. B. Rice,
Catalyst Particle Sizes from Rutherford Scattered Intensities,
J. Microsc., **156** 211–234 (1989).

(24) J. M. Newsam, M. M. J. Treacy, W. Koetsier and C. B. deGruyter,
Structural Characterization of Zeolite Beta,
Proc. R. Soc. Lond., **A420** 374–405 (1988).

(25) J. M. Newsam, M. M. J. Treacy, D. E. W. Vaughan, K. G. Strohmaier and W. J. Mortier,
The Structure of Zeolite ZSM–20; Mixed Cubic and Hexagonal Stackings of Faujasite Sheets,
J. Chem Soc. Chem. Commun., 493–495 (1989).

(26) D. E. W. Vaughan, M. M. J. Treacy, J. M. Newsam, K. G. Strohmaier and W. J. Mortier,
Synthesis and Characterization of Zeolite ZSM–20,
in *Zeolite Synthesis* ed. by M. L. Occelli and H. E. Robson, ACS Symposium Series No. **398** 544–559 (1989).

(27) M. M. J. Treacy, S. B. Rice, A. J. Jacobson and J. T. Lewandowski,
An Electron Microscopy Study of Delamination in Dispersions of the Perovskite-Related Layered Phases $K[Ca_2Na_{n-3}Nb_nO_{3n+1}]$: Evidence for Single Layer Formation,
Chemistry of Materials, **2** 279–286 (1990).

(28) C. B. de Gruyter, J. P. Verduijn, J. Y. Koo, S. B. Rice and M. M. J. Treacy,
A Transmission Electron Microscopy Study of Grain Boundaries in Zeolite L,
Ultramicroscopy, **34** 102–107 (1990).

(29) S. B. Rice, J. Y. Koo, M. M. Disko and M. M. J. Treacy,
On the Imaging of Pt Particles in Zeolite Frameworks,
Ultramicroscopy, **34** 108–118 (1990).

(30) M. M. J. Treacy, J. M. Newsam and M. W. Deem,
A General Recursion Method for Calculating Diffracted Intensities from Crystals Containing Planar Faults,
Proc. R. Soc Lond. **A433** 499–520 (1991).

(31) J. M. Newsam and M. M. J. Treacy,
ZeoFile: A Stack of Zeolite Structure Types,
Zeolites, **13** 183–186 (1993).

(32) M. M. J. Treacy and J. M. Gibson,
Coherence and Multiple Scattering in '*Z* Contrast' Images,
Ultramicroscopy **52** 31–53 (1993).
Erratum to "Coherence and Multiple Scattering in '*Z* Contrast' Images",
Ultramicroscopy **54** 93 (1994).

(33) M. M. J. Treacy, J. M. Newsam and M. W. Deem,
Simulation of Electron Diffraction Patterns from Partially Ordered layer Lattices,
Ultramicroscopy, **52** 512–522 (1993).

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in *Amorphous and Microcrystalline Silicon Technology—1998*, ed. by S. Wagner, M. Hack, H. M. Branz, R. Schropp, and I. Shimizu, *Materials Research Society Symposium Proceedings* Vol **507** 837–842 (1998).

(38) J. M. Gibson, J-Y. Cheng, P. M. Voyles, M. M. J. Treacy, and D. C. Jacobson,
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In *Microstructural Processes in Infrared Materials* ed. by S. J. Zinkle, G. Lucas, R. Ewing and J. Williams, *Materials Research Society Symposium Proceedings* Vol **540** 27–30 (1999).

(39) A. Krishnan, M. E. Bisher and M. M. J. Treacy,
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Ion-Implanted Amorphous Silicon Studied by Variable Coherence TEM,
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Mater. Res. Soc. Symp. Proc. **589**, 247–252 (1999).

(41) M. M. J. Treacy, A. Krishnan, E. Dujardin, P. N. Yianilos and T. W. Ebbesen,
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Microsc. Microanal. **5** (Suppl 2: Proceedings) (Microscopy Society of America, Springer) 676–677 (1999).

(42) P. M. Voyles, M. M. J. Treacy, J. M. Gibson, H. C. Jin and J. R. Abelson,
Experimental Methods and Data Analysis for Fluctuation Microscopy,
in *Amorphous and Heterogeneous Silicon Thin Films 2000*, ed. by J. Bentley, U. Dahmen, C. Allen, I. Petrov, Materials Research Society Symposium Proceedings Vol **589** A2.4.1–A2.4.6 (2000).

(43) M. M. J. Treacy, P. M. Voyles and J. M. Gibson,
Topological Signatures of Medium Range Order in Amorphous Semiconductor Models,
in *Amorphous and Heterogeneous Silicon Thin Films 2000*, ed. by R. W. Collins, H. M. Branz, S. Guha, H. Okamoto, M. Stutzmann, *Materials Research Society Symposium Proceedings* Vol **609** A2.5.1–A2.5.6 (2001).

(44) P. M. Voyles, M. M. J. Treacy, H. C. Jin, J. R. Abelson, J. M. Gibson, S. Guha and R. S. Crandall,
Comparative Fluctuation Microscopy Study of Medium-Range Order in Hydrogenated Amorphous Silicon Deposited by Various Methods,
in *Amorphous and Heterogeneous Silicon Thin Films 2000*, ed. by R. W. Collins, H. M. Branz, S. Guha, H. Okamoto, M. Stutzmann, *Materials Research Society Symposium Proceedings* Vol **609** A2.4.1–A2.4.6 (2001).

(45) A. Krishnan, M. M. J. Treacy, M. E. Bisher, P. Chandra and P. B. Littlewood,
Displacement Charge Patterns and Ferroelectric Domain Wall Dynamics Studied by In-Situ TEM,
in *Ferroelectric Thin Films VIII*, ed. by R. W. Schwartz, P. C. McIntyre, Y. Miyasaka. S. R. Summerfelt and D. Wouters, Materials Research Society Symposium Proceedings Vol **596** 161–166 (2000).

(46) A. Krishnan, M. M. J. Treacy, M. E. Bisher, P. Chandra and P. B. Littlewood,
Maxwellian Charge on Domain Walls,
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(47) M. M. J. Treacy,
Deactivation of Pt/Zeolite-L Catalysts Studied by Z-Contrast,
Microsc. Microanal. **6** (Suppl 2: Proceedings) (Microscopy Society of America, Springer) xxx–xxx (2000).

(48) A. Krishnan, M. M. J. Treacy, M. E. Bisher, P. Chandra and P. B. Littlewood,
Maxwellian Charge on Ferroelectric Domain Walls in $KNbO_3$,
Microsc. Microanal. **6** (Suppl 2: Proceedings) (Microscopy Society of America, Springer) xxx–xxx (2000).

(49) P. M. Voyles, M. M. J. Treacy and J. M. Gibson.
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in New Methods, Mechanisms and Models of Vapor Deposition, ed. By H. N. G. Wadley, G. Gilmer, and W. Barker, Materials Research Society, Warrendale PA,
Mat. Res. Soc. Symp. Proc. Vol **616** 47–52 (2001).

(50) M. M. J. Treacy and J. Kilian,
Designability of Graphitic Cones.
Mat. Res. Soc. Symp. Proc. Vol **675** (2001).

(51) M. M. J. Treacy and J. M. Gibson,
Fluctuation microscopy: A technique for revealing atomic correlations in structurally noisy (disordered) materials
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(52) J-Y. Cheng, M. M. J. Treacy and P. J. Keblinski,
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in Amorphous and Nanocrystalline Silicon-Based Films – 2003, Ed. By John R. Abelson, Gautam Ganguly, Hideki Matsumura, John Robertson, Eric A. Schiff MRS Symposium Proceedings Series, Vol. 762, A5.18.1-6 (MRS, Warrendale, PA 2003).

(53) L. Fan, I. McNulty, D. J. Paterson, M. M. J. Treacy and J. M. Gibson
Fluctuation X-ray Microscopy for Measuring Medium-Range Order,
Mater. Res. Soc. Symp. Proc. Vol.840, Q6.7.1-Q.6.7.6 (2005).

(54) M. M. J. Treacy
Fluctuation Microscopy for the MASses,
Proceedings of the Microbeam Analysis Society (2005).

(55) R. Sharma, P. Rez and M.M.J. Treacy
In situ observations of the effect of synthesis conditions on the growth rates and mechanisms of carbon nanotubes.
Microscopy and Microanalysis (2005)

(56) M. M. J. Treacy
Fluctuation Microscopy: What is it?
Microscopy Today, 20–21 Sept. (2005).

(57) L. Fan, D. J. Paterson, I. McNulty, M. M. J. Treacy, D. Kumar, P. Du, U. Wiesner, J. M. Gibson
Characterization of medium-range order in organic-inorganic hybrid nanomaterials by fluctuation x-ray microscopy.
SRMS-5 Conference, Chicago July 30- Aug.2, SRMS5- 172 (2006).

(58) M. M. J. Treacy, M. Brown, P. Rez, G.H. Du and R. Sharma
In-Situ TEM Observations of Carbon Nanotube Growth By The Catalytic Decomposition of Acetylene
Microscopy and Microanalysis (2006).

(59) M. M. J. Treacy, A. Rougee, and P.R. Buseck
Fluctuation Electron Microscopy of Shungite, a Disordered Natural Carbonaceous Material.
Microscopy and Microanalysis (2006).

(60) L. Fan, D. Paterson, I. McNulty, M. M. J. Treacy, D. Kumar, P. Du, U. Wiesner, and J. M. Gibson,
Characterization of Medium-range Order in Self-Assembled Organic-inorganic Hybrid by Fluctuation X-ray Microscopy.
Mater. Res. Soc. Symp. Proc. Vol. **960** Materials Research Society, 0960-N09-09 (2007).

(61) R. Sharma, Edward Moore, Peter Rez and M.M.J. Treacy,
Selective fabrication of iron particles for atomic level observation of carbon nanotube growth,
Microscopy and Microanalysis (2008).

(62) E. S. Moore, R. Sharma, P. Rez, M. M. J. Treacy and A, Gamalski,
In Situ Synthesis of Fe Catalyst and Carbon Nanotubes by Chemical Vapor Deposition,
Microscopy and Microanalysis, **14** 10–11 (2008).

(63) J. M. Gibson and M. M. J. Treacy
Defocus as an ineffective means of changing spot size for fluctuation microscopy,
Journal of Physics: Conference Series **186** 012053 (2009).

Proceedings and Books

(1) M. M. J. Treacy, J. M. Thomas and J. M. White,
Microstructure and Properties of Catalysts
Materials Research Society Symp. Proc. Vol **111** (1988).

(2) R. Von Ballmoos, J. B. Higgins and M. M. J. Treacy,
Proceedings of the Ninth International Zeolite Conference,
Butterworth-Heinemann, Stoneham Massachusetts (1993).

(3) M. M. J. Treacy, J. B. Higgins R. von Ballmoos,
Collection of Simulated XRD Powder Patterns For Zeolites,
Third Edition, Elsevier (1996).

(4) M. M. J. Treacy, B. K. Marcus, M. E. Bisher and J. B. Higgins,
Proceedings of the twelfth International Zeolite Conference
Materials Research Society, Warrendale, USA (1998)

(5) M. M. J. Treacy and J. B. Higgins
Collection of Simulated XRD Powder Patterns For Zeolites,
Fourth Edition, Elsevier, (2001).

(6) R. Sharma, P. A. Crozier and M. M. J. Treacy
Dynamic *in-situ* electron microscopy as a tool to meet the challenges of the nanoworld,
NSF Workshop Report (Aug. 2006).

(7) M. M. J. Treacy and J. B. Higgins
Collection of Simulated XRD Powder Patterns For Zeolites,
Fifth Edition, Elsevier, (2007).

INVITED LECTURES

National/International Conferences

(1) "Z Contrast of Supported Catalyst Particles in the STEM", Institute of Physics Conference, Electron Microscopy and Microanalysis Group, Brighton (9/1979).

(2) "Le Microscope Eléctronique à Balayage et en Transmission, ou STEM", lecture presented in French at the Bombannes Summer School, Bordeaux (8/1981).

(3) "Optimizing Atomic Number Contrast in Annular Dark Field Images of Thin Films in the Scanning Transmission Electron Microscope" presented in French at TEM conference, Reims (1982).

(4) "Atomic Number Imaging of Supported Catalyst Particles Using the Scanning Transmission Electron Microscope", American Chemical Society Conference on *Catalytic Materials: Relationship Between Structure and Activity*, San Francisco (1983).

(5) "Transmission electron Microscopy of Surfaces and particles", Solid State Physics Gordon Conference, Plymouth NH (6/1985).

(6) "Detection and Imaging of Supported Catalyst Particles", in *Materials Problem solving with the Transmission Electron Microscope*, Annual Materials Research Society Fall Symposium, Boston (12/1986).

(7) "Stress and Rhombohedral Distortion in Platelet Faujasite-type Zeolites", Annual Microbeam Analysis Society Conference, Hawaii (1987).

(8) "The Art of the Possible: An Overview of Catalyst Specimen Preparation Techniques for TEM Studies", in *Specimen Preparation for Transmission Electron Microscopy of Materials*, Annual Materials Research Society symposium (12/1988).

(9) "Measurement of Particle Sizes in the STEM Using High–Angle Annular Detector Image Intensities", Annual Microscopy Society of America Conference, (8/1988).

(10) "High Spatial–Resolution Microanalysis in the Petrochemical Industry", Annual Microscopy Society of America meeting, Albuquerque NM (8/1988).

(11) "Characterization of faulted zeolites", Solid State Chemistry Gordon Conference, (1988).

(12) "Elastic Relaxation and TEM Image Contrasts in Thin Composition–Modulated Semiconductor Crystals", in *Evaluation of Advanced Semiconductor Materials by Electron Microscopy*, NATO conference (10/1988).

(13) "Structure-Property relationships in Catalysts", Annual American Society of Metallurgists conference, Cleveland (10/1991).

(14) "Intergrowths in Zeolite Structures", American Chemical Society Symposium on Molecular Sieves, New York (1992).

(15) "The influence of Intergrowths on Zeolite Properties", conference on "Natural Zeolites, (1993).

(16) "A recursion method for simulating diffraction from faulted crystals", American Crystallographic Association, Albuquerque (8/1993).

(17) "Z-contrast: the real and the imagery", Frontiers of Electron Microscopy, Berkeley (6/1994).

(18) "In Z-contrast, Not All That Glistens is High-Z", Annual Microscopy Society of America Conference (8/1995).

(19) "Combinatorial Methods for Generating Zeolite Frameworks" Zeolites and Layered Materials Gordon Conference (6/1995).

(20) "Dark Field Speckle: Is It More Than Just Spots Before The Eyes?", Frontiers of Electron Microscopy, Chicago, (6/1996).

(21) "A combinatorial method for generating new zeolite frameworks", International Union for Crystallography Conference, Seattle, (8/1996).

(22) "Disorder in crystals and order in amorphous materials: a TEM and diffraction study", American Crystallographic Association, St. Louis (7/1997).

(23) "Mechanical Properties of Carbon Nanotubes Inferred from TEM", Annual Microscopy Society of America Conference (8/1997).

(24) "Zeolite families and their faulty relatives", DOE workshop on *Partially disordered chemical systems*, Santa Fe, NM (5/1998).

(25) "Young's Modulus of Carbon Nanotubes by TEM", National Center for Electron Microscopy colloquium, Berkeley (6/1998).

(26) "The search for new zeolite frameworks", Plenary Lecture 12th International Zeolite Conference (7/1998).

(27) "Y Contrast of Single Shell Carbon Nanotubes: determination of Young's Modulus by Observing Thermal Vibrations", Annual Microscopy Society of America Conference, Portland, OR (08/1999).

(28) "Deactivation of Pt/Zeolite-L Catalysts Studied by Z-Contrast" Annual Microscopy Society of America Conference, Philadelphia, PA (08/2000).

(29) "Designability of carbon cones", Annual Materials Research Society Spring meeting, (4/2001).

(30) "Enumeration of Zeolite Frameworks", Mansfield College Meeting, SSG on Solid State Chemistry, Oxford, UK (4/2003).

(31) "Fluctuation microscopy: A technique for revealing atomic correlations in structurally noisy (disordered) materials", SPIE (International Society for Optical Engineering) Conference, Santa Fe, NM (6/2003).

(32) "Finding the Meaningful Spatial Patterns in Structural Noise", Keynote talk at the first Symposium on Fluctuation Electron Microscopy and Nanoscale Ordering in Amorphous Materials" at U. Illinois, Urbana-Champaign (6/2003).

(33) "Enumeration of Hypothetical Zeolite Frameworks", Keynote speaker at the North East Corridor Zeolite Association (NECZA) meeting (12/2003).

(34) "Detecting the Meaningful Spatial Patterns in Structurally Noisy Materials by Fluctuation Microscopy", Arizona Imaging and Analysis Society, ASU, Tempe (3/2004).

(35) "A sharper view of Randomness? What aberration-corrected imaging of amorphous materials can reveal", Savannah, GA (8/2004). (I was unable to attend at the last minute.)

(36) "Extracting the "signal" from structurally noisy material", NIRT Workshop on Nanoscale Materials, Tempe, AZ (12/2004).

(37) "Fluctuation Microscopy for the MASses", invited tutorial (videotaped) at the M&M2005 conference, Honolulu, (8/2005)

(38) "Towards a database of hypothetical zeolites", invited, PACIFICHEM05, Honolulu, (not given due to illness) (12/2005).

(39) "Fluctuation x-ray microscopy: What it tells us about medium-range order in self-assembled materials", APS User's Meeting (5/2006.)

(40) "Fluctuation microscopies with electron, x-ray and optical probes". International workshop on nanoscale order in amorphous and partially ordered solids, (7/2007).

(41) "Glimpsing order within the disarray" Plenary lecture at the EMAG meeting in Glasgow (8/2007).

(42) "Designer zeolites", Invited talk, symposium on Turning Points in Solid State, Materials and Surface Science, Fitzwilliam College, (12/2007).

(43) "Designer zeolites", workshop on "Design and Synthesis of New Materials", Santa Barbara, (8/2008).

(44) "Fluctuation Microscopy", invited talk at Air Products, Allentown PA (01/2007).

(45) "Future Needs for Microscopy", NAS Workshop CMMP2010, Newport Beach CA (01/2007).

(46) "Probing medium-range structural correlations by fluctuation microscopy", Invited talk, Symposium, Cambridge UK, (7/2007).

(47) "Designer Zeolites", invited Nanomaterials colloquium at ASU, (10/2007).

(48) "What spatial variation in diffraction tell us about amorphous materials", David Cockayne Symposium, Oxford (9/2009).

(49) "Weeding and Harvesting Zeolite Graphs", Workshop on Global Optimization of structures, University College London, (7/2006).

(50) "Fluctuation X-ray Microscopy", APS User's Meeting, Argonne National Laboratory (05/2006).

Seminars and Colloquia

(1) "Hollow cone studies of Pt and Pd catalysts", Metal Physics Seminar, Cavendish Laboratory. (7/1977).

(2) "Weak beam imaging", Metal Physics General Seminar, Cavendish Laboratory. (2/1978).

(3) "Z-contrast of Pt and Pd catalysts", Metal Physics Seminar, Cavendish Laboratory. (7/1978).

(4) "Z contrast imaging in the STEM", Metal Physics Seminar, Cavendish Laboratory. (7/1979).

(5) "Z contrast imaging in the STEM", Seminar at IBM T. J. Watson Research Labs. (7/1979).

(6) "Imaging With Rutherford Scattered Electrons in the STEM", Seminar at AT&T Bell Labs. (12/1980).

(7) "Z contrast imaging in the STEM", Seminar at Cornell University (12/1980).

(8) "TEM of supported Catalysts", Exxon, Linden, NJ (3/1981).

(9) "Z contrast", Institut Français du Pétrole, Paris (2/1982).

(10) "Spinodal decomposition in InGaAsP quaternary semiconductors", Karlsruhe, (10/1981).

(11) "Scanning Transmission Electron Microscopy of Catalysts", Exxon, Linden, NJ (4/1982).

(12) "Z contrast in the Scanning Transmission Electron Microscope", U. Arizona (4/1982).

(13) "The Macintosh in an Electron Microscope Lab.", Round Valley Computer Symposium NJ (5/1986).

(14) "The Effects of Elastic Relaxation on TEM Studies of Thinned Composition-Modulated Materials", Exxon Semiconductor Conference, (1986).

(15) "Transmission electron microscopy of zeolite catalysts", Presentation to President of Exxon Research & Engineering Co., Clinton, NJ (5/1988).

(16) "Characterization of faulting in zeolites", Seminar at North Western University (5/1989).

(17) "Deactivation mechanisms of the EXAR catalyst", Presentation to President of Exxon Research & Engineering Co. (7/1989).

(18) "Characterization of faulting in zeolites", Seminar at Penn. State (1/1990).

(19) "Imaging with Rutherford scattered electrons", Seminar at Internal Exxon Conference, Clinton (4/1990).

(20) "Z contrast imagining of supported catalysts", Seminar at NEC Princeton (4/1990).

(21) "Electron Microscopy of Inorganic Solids", Lecture at Princeton Chemistry Department (1990).

(22) "Characterization of defects in Zeolites", Barrer Award Plenary Lecture, British Zeolite Association meeting, Durham (3/1991).

(23) "Imaging with Rutherford Scattered Electrons in the TEM", NEC Tsukuba, Japan (10/1991).

(24) "DIFFaX: A Fortran Program for Computing Diffraction From faulted Crystals", BioSym Workshop on Molecular Modeling and Simulation, San Diego (10/1991).

(25) "Imaging Complex Materials Using Rutherford Scattered Electrons in the TEM", Princeton Electrical Engineering Department, (1/1992).

(26) "Atomic Number Imaging in the Transmission Electron microscope", Workshop on *Imaging of Complex Materials*, Princeton Materials Institute, (5/1992).

(27) "Combinations, graphs and zeolite frameworks", NECI Internal colloquium, (11/1993).

(28) "From Graphs and Gaping Holes to Gasoline: A combinatorial Method for Generating New Zeolite Frameworks", Colloquium, U. Illinois, (11/1995)

(29) "The Basics of Crystallographic Symmetry", lecture to graduate students at U. Illinois (11/1995).

(30) "Variable Coherence Microscopy: A Rich Source of Structural Information from Disordered Materials", Cornell (11/1995)

(31) "A Combinatorial Method for generating new zeolites", U. Ohio, Chemistry Department, (1/1996).

(32) "A combinatorial method for generating new zeolite frameworks", NECI (2/1996).

(33) "From graphs and gaping holes to gasoline: a combinatorial method for finding new zeolite frameworks", U. Maryland, Chemistry Department, (6/1996).

(34) "A combinatorial method for generating new zeolite frameworks", Stevens Institute of Technology (4/1996).

(35) "The search for new zeolite frameworks", Chemistry department, Lehigh University (9/1998).

(36) "Young's Modulus of Carbon Nanotubes by TEM", NECI colloquium (01/1999).

(37) "Anomalous Transmission in Thin Metallic Hole Arrays: A Diffraction Explanation", Colloquium, NECI. (11/1999).

(38) "Domain dynamics in Ferroelectrics", NEC Exhibit Miyazaki, Japan (07/1999).

(39) "Domain dynamics in Ferroelectrics", NEC Ultra-LSI Research Laboratory, Japan (07/1999).

(40) "Displacement Charge Patterns and Domain Interlocking in Polyaxial Ferroelectrics", Argonne National Labs., Illinois (10/2000).

(41) "Young's Modulus of Carbon Nanotubes by TEM", Colloquium, U. Illinois, Urbana-Champaign (6/2000).

(42) "Displacement Charge Patterns and Domain Interlocking in Polyaxial Ferroelectrics", NECI Journal Club Talk (11/2000).

(43) "Displacement Charge Patterns and Domain Interlocking in Polyaxial Ferroelectrics", Rennselaer Polytechnic (11/2000).

(44) "Speckly silicon, twitching nanotubes and transparent mirrors: a trio of interesting scattering experiments" Engineering and Physics Dept. U. San Diego (5/2000).

(45) "Young's Modulus of Carbon Nanotubes by TEM", Colloquium, Los Alamos National Labs. (5/2000).

(46) "Anomalous Transmission in Thin Metallic Hole Arrays: Diffraction vs. Surface Plasmons", Colloquium, Los Alamos National Labs. (5/2000).

(47) "Determining the Young's Modulus of Carbon Nanotubes by watching them twitch", Colloquium, U. Illinois, Urbana-Champaign, (10/2000).

(48) "Study of ferroelectric switching by in-situ TEM", colloquium, Argonne National Labs, Chicago IL, (11/2000)

(49) "Study of ferroelectric switching by in-situ TEM", colloquium, Rennsaeler Polytechnic, Troy NY, (11/2000)

(50) "Young's Modulus of Carbon Nanotubes by TEM", Colloquium, U. Davis, (10/2001).

(51) "Designability of carbon cones", NECI seminar, (6/2001).

(52) "In-situ optical microscopy of switching in ferroelectrics", NECI seminar, (11/2001).

(53) "Anomalous transmission in thin metallic hole arrays is a diffraction phenomenon, and is not caused by surface plasmons", NECI seminar, (3/2002).

(54) "Determining the Young's modulus of carbon nanotubes in the TEM", seminar at University College London, (9/2002).

(55) "Determining the Young's modulus of carbon nanotubes in the TEM", seminar at Washington University St. Louis, (9/2002).

(56) "Good fences make good neighbours. A TEM study of domain switching in ferroelectrics", seminar at University College London, (11/2002).

(57) "Determining the Young's modulus of carbon nanotubes in the TEM", seminar at Purdue University, W. Lafayette Indiana, (1/2003).

(58) "Do Surface Plasmons Really 'Cause' Anomalous Transmissions in Metal Hole Arrays?", seminar at Argonne National Laboratories, (1/2003).

(59) "Determining the Young's modulus of carbon nanotubes in the TEM", seminar at Argonne National Laboratories, (1/2003).

(60) "Determining the Young's modulus of carbon nanotubes in the TEM", seminar at Johns Hopkins University (2/2003).

(61) "Determining the Young's modulus of carbon nanotubes in the TEM", seminar at Arizona State University, (2/2003).

(62) "Enumeration of Zeolite Frameworks" seminar at Solid State Group Conference, Mansfield College, Oxford, April 7th 2003, (4/2003).

(63) "Enumeration of Zeolite Frameworks" seminar at Arizona State University Chemistry Department, (5/2003).

(64) "Do Surface Plasmons Really 'Cause' Anomalous Transmissions in Metal Hole Arrays?", seminar at Arizona State University Physics Department, (5/2003).

(65) "Enumeration of Zeolite Frameworks" seminar at ExxonMobil, Clinton New Jersey, (4/2003).

(66) "Fluctuation Microscopy: A technique for revealing atomic correlations" invited talk at the SPIE "Fluctuations and Noise" conference in Santa Fe, (6/2003).

(67) "Finding the meaningful spatial patterns in structural noise" keynote speaker at the first Fluctuation Microscopy Conference, Urbana-Champaign, Illinois (7/2003).

(68) "Enumeration of Hypothetical Zeolites", Keynote talk at the North East Corridor Zeolite Association Annual Meeting, (12/2003).

(69) "Fluctuation Microscopy: A New Technique for Detecting Order in Structurally Disordered Materials", Graduate Colloquium, ASU Physics & Astronomy, (2/2004).

(70) "Inferring Medium Range Order in Amorphous Materials from the Structural Fluctuations", Indiana University, (9/2005).

(71) "Fluctuation Microscopy: A New Technique for Detecting Order in Structurally Disordered Materials", Graduate Colloquium, ASU Physics & Astronomy, (3/2005).

(72) "The search for useful hypothetical zeolite frameworks", ASU NIRT meeting (04/2007).

(73) "Beam transit effects in single molecule diffraction", Cockayne Research Group (8/2009).

(74) "Beam transit effects in single molecule diffraction", Diamond Coherent Imaging Research Group (9/2009).

(75) "Designer Zeolites", Colloquium, U. Oxford Dept. of Materials (11/2009).

(76) "Designer Zeolites", Colloquium, U. Cambridge Dept. of Materials (11/2009).

(77) "Designer Zeolites", Colloquium, ETH Zurich, Switzerland (12/2009).

(78) "Fluctuation Microscopy", Colloquium U.Vienna, Austria (12/2009).

(79) "Designer Zeolites", Colloquium, U. Southampton Dept. of Chemistry (12/2009).

Patents

(1) D. E. W. Vaughan, K. G. Strohmaier, M. M. J. Treacy and J. M. Newsam, "Crystalline Zeolite ECR-35 and a Method for Producing Same", US Patent Number 5,116,590 May 26, 1992.

(2) M. J. Higgins. A. Krishnan, M. M. J. Treacy and S. Bhattacharya, "Reduction of imprint in ferroelectric devices using a depoling technique", US Patent Number 6,294,393, September 25, 2001.

Software

(1) J. M. Newsam and M. M. J. Treacy, "ZeoFile: A Stack of Zeolite Structure Types" - HyperCard Stack for Macintosh, containing an interactive zeolite structure database, with diffraction analysis software.

(2) M. M. J. Treacy, M. W. Deem and J. M. Newsam "*DIFFaX*: A computer Program for Calculating Diffraction From Faulted Crystals" - a FORTRAN Program for simulating peak broadening in diffraction patterns in the presence of stacking faults.

Unpublished Company Reports

IBM

(1) P. E. Batson and M. M. J. Treacy, "Bulk and Surface Plasmon Charge Location in Small Aluminum Spheres", IBM Research Report, RC 8349 (#36313) (1980).

EXXON

(1) M. M. J. Treacy and J. J. Steger, "Influence of Crystallite Size on Catalytic Performance of One Dimensional Zeolites", CR.24BU.83, (1983).

(2) A. J. Jacobson, J. T. Lewandowski, M. M. J. Treacy and J. W. Johnson, "Synthesis, Characterization and Reactions of the Layered Perovskites $K[Ca_2Na_{n-3}Nb_nO_{3n+1}]$, n = 3 to 7", CR.8BT.85, (1985).

(3) M. M. J. Treacy and A.K. Ghosh, "Z Contrast Study of Pt Agglomeration as a Deactivation Mechanism of K-Zeolite L Catalyst", CR.17BF.85, (1985).

(4) A. K. Ghosh, M. M. J. Treacy and J. J. Steger, "Pt Agglomeration in KL Zeolite With Time on Oil", CR.69BF.85, (1985).

(5) J. Y. Koo, M. M. J. Treacy and J. C. Scanlon, "Lattice Imaging and Analytical Electron Microscopy Study of Pt Particles in Spent Pt-KL Zeolite Catalyst", CR.4BF-X.85, (1985).

(6) J. Y. Koo and M. M. J. Treacy, "Electron Microscopy Characterization of Pt/KL Zeolite Catalysts", CR.41BF.86, (1985).

(7) M. M. J. Treacy and J. Y. Koo, "Microanalysis of K-Zeolite L by Energy Dispersive X-Ray Spectroscopy in the Transmission Electron Microscope", CR.22BF.85, (1985).

(8) M. M. J. Treacy and S. B. Rice, "The Measurement of Particle Sizes in the STEM Using High-Angle Annular Detector Image Intensities", CR.44BF.86, (1986).

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(10) J. M. Newsam and M. M. J. Treacy, "Proceedings of the Fifth Exxon Zeolite Symposium", CR.69BF.86.

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