Russell R. Chianelli

Areas of Expertise: Energy Storage and Conversion Materials, Transition Metal Chalcogenide Chemistry and Physics, Crystal Growth, Biological Mineralization and Calcification, Solid State Chemistry and Physics of Carbonates and Phosphates, Structure Function Relations in Catalytic Materials, Bioremediation, Environmental Catalysis, Phytoremediation, Environmental Statistics, Metal Environmental Contaminants and Chemistry and Physics of Airborne Particulates, biodiesel from algae and others.

Education:

• Ph.D. in Chemistry, 1974 Polytechnic Institute of Brooklyn
• B.S. Chemistry, 1970 Polytechnic Institute of Brooklyn

Professional Experience:

• 2001 –present: Professor and Director of the Materials Research and Technology Institute (MRTI)
• 1996 to 2001: Professor and Chairman of the Chemistry Department, University of Texas at El Paso, El Paso, Texas
• 1973 - 1995: Senior Research Associate, Exxon Research and Engineering Co., Corporate Research Laboratories Annandale, NJ 08807

Awards:

1970 -Sigma Xi Award for Best Undergraduate Thesis.
1997 - Lifetime achievement award from the "Academia Mexicana de Materiales" "Por su valiosa contribución al desarrollo de la Ciencia de los Materiales en México."
1999 - UTEP - Award for outstanding achievement in developing the University Seminar Program.
2004 - UTEP – Award for Outstanding Research.
2006 – UTEP – UT System Chancellor's Entrepreneurship and Innovation Award
2009 " Southwest Catalysis Club" achievement Award.

University of Texas at El Paso Career:

- **1996-2000 Chairman of the Chemistry Department, Professor of Chemistry, Professor of Materials Science and Engineering and Professor of Environmental Science and Engineering.**

- **2001 to present Director of the Materials Research and Technology Institute (MRTI).** This Institute started in January 2001 to administer two DOE grants. The first is called the Materials Corridor Initiative (MCI) and the second is called the UTEP/Stanford "Gateway" program designed to train "border" students in the use of synchrotron techniques. MCI involves collaboration between southwestern universities and Mexican institutions. This grant currently was very successful at $1,000,000/year. **MRTI** has also become a business incubator raising more that $7,000,000 in private funding and currently involved in several commercializations.

Exxon Research and Engineering Career:

- **1992-1994 Section Head of Environmental Sciences:** Headed an effort to build a new section centered on fundamental and applied sciences relating to environmental problems of interest to Exxon.

- **1989-1992 Section Head of Catalytic and Biological Sciences:** Headed a section of approximately fifty people including the topics listed below as well as research in the areas of microbiology of hydrocarbon degraders, combustion processes, biological fuels processing, chemistry and physics of C_{60} materials and others.

- **1978-1989 Group Leader of the Catalytic Materials Group:** Headed a group of approximately twenty people investigating the fundamental properties of transition metal sulfide catalytic materials. This group consisted of chemists, physicists and a theoretician who formed an interdisciplinary team addressing fundamental and applied aspects of catalytic materials important to removal of sulfur, nitrogen and other pollutants from hydrocarbon fuels and feedstocks.

Special Assignments:

- **Exxon Bioremediation Research Task Force Leader 1989-1991:** Following the grounding of the Exxon Valdez on March 24, 1989, appointed Bioremediation Task Force Leader. Directed the research, which led to the successful application of bioremediation techniques in the cleanup of Prince William Sound in Alaska. In this capacity developed a broad interaction with the EPA and other environmental agencies.

- **Exxon Program Leader for Site Remediation 1992-1993.** Led a science and technology effort to extend bioremediation techniques learned in the Exxon Valdez clean up to contaminated land sites. This involved building a science program, which coupled laboratory experiments to environmental field experiments. The effort designed combined microbiology, chemistry, engineering, environmental statistics and analysis. Several successful commercial field tests based on the results of this program were carried out and the scientific understanding of bioremediation was substantially improved. Commercial application now in progress.

- 1995 conducted a worldwide study of surface exploration techniques for discovery of petroleum resources. This study included remote sensing techniques and microbial sensing techniques.

Professional Affiliations: American Chemical Society, Sigma Xi, New York Academy of Science, and Materials Research Society.

Journals Regularly Reviewed: Journal of Catalysis, Journal of Physical Chemistry, Fuels, Journal of Inorganic Chemistry, Materials Research Bulletin, Inorganic Synthesis, Journal of the American Chemical Society, Journal of Applied Catalysis, Science, Physics Today and others.

Outside Thesis Examiner: Brown University Chemistry Department, University of Strasbourg Chemistry Department, Lehigh University Department of Chemical Engineering.

Chairman and Co-chairman of Many National and International Symposia:

• Appointed to the Editorial Board of Catalysis Reviews, 1984.

• Appointed to the Editorial Board of Catalysis Letters, 1987.

• MRS Activities: Reflecting my strong interest in interdisciplinary research, I have been active in the Materials Research Society for many years.

• Co-chairman with G. Hubler and G. Olsen of the Spring, 1987 MRS Meeting in Anaheim, California.

• Served as a member of the Program Committee, Long Range Planning, and Publicity Committee, Publication Committee and others for the Materials Research Society.

• Currently Chair of the MRS Long Range Planning Committee

• Vice-President of Materials Research Society, 1989.

• President of Materials Research Society, 1990.

• Past President of the Materials Research Society, 1991.

• Materials Research Society Counselor, 1992-1994.

• Chair: MRS Long Range Planning Committee, 1992- 1994.

• Co-Chair: 4th International Materials Research Conference, Cancun, Mexico (1995).

• Current member of the MRS Bulletin editorial board.

• Omics Group Conference Board - 2013-2015.

Review Panels and Committees:

• Served on NASA site visit teams involved in evaluating materials research in space, 1986-1987.

• Member of Strategic Planning Team, NASA's Office of Commercial Programs, 1988.

• Appointed member of SSRL materials proposal review panel, 1987. Currently chair of the Materials subpanel, which has responsibility for maintaining the scientific quality of research in materials, performed at the Stanford Radiation Laboratory. Acting

Chair of Proposal Review Panel 1993. Chair of Proposal Review Panel until 2008.

• Served on several DOE panels including one, which is currently writing a report to guide future research in heterogeneous catalysis in the area of fuels refining and production. Also currently serving as a member of DOE experimental program to stimulate competitive research (EPSCoR) 1992-1993.

• USEPA/Israel Bioremediation Workshop, Nachsholim, Israel, November 10-15,1992.

• Panel on Material Science in Mexico, Ixtapa, Mexico, January 6-9,1993. In this context I have been following a long-standing interest in fostering regional scientific cooperation in North America. A recent success of my efforts here has been to institute a regional meeting called "Materials Issues in Art and Archeology" to be held in Cancun, Mexico in 1994. This meeting is a collaboration between the Government of Mexico and the Getty Conservation Institute.

• ACS Symposium on Bioremediation and Bioprocessing, Denver, April 1-2,1993.

• ACS Symposium on Hydroprocessing and Hydrotreating, Washington, 1994.

• Review of U.S. R&D Status and Trends in Nanoparticles, Nanostructured Materials, and Nanodevices, A WTEC Workshop Sponsored by NSF, ONR, NIST, AFOSR, NIH, NASA MAY 8-9, 1997.

• Member and Founder of CANUSMEX (Canadian-U.S.-Mexico) Organization to Coordinate Energy Research interaction in the "New Middle East" Canadian-U.S.-Mexico) - Current 2015.

• Catalysis Journal Editorial Board - Current 2015.

• MRS Bulletin Editorial Board - Current 2015.

Invited and Plenary Lectures

1. Chemical, Structural and Electrochemical Studies of Crystalline an Amorphous Layered Transition Metal Sulfides, Bell Laboratories, August 3, 1979.

2. Preparation and Properties of Amorphous and Poorly Crystalline Transition Metal Sulfides, Surface Science and Catalysis Seminar, December 5, 1979, Berkeley, California.

3. Catalysis by Transition Metal Sulfides, Symposium on Molecular Processes at Solid Surfaces, **ACS**, Atlanta, March, 1981.

4. Electronic Structure of Hydrodesulfurization Catalysts, Symposium on Chemical Physics in Catalysis, **ACS**, Atlanta, March 1981.

5. Modern Characterization Tools for Catalysts, Symposium on Materials Science Related to Energy, **AVS**, Linden, NJ, March, 1981.

6. Properties of Amorphous Transition Metal Sulfides, 10th International Conference on Amorphous and Liquid Semiconductors, Grenoble, France, July 2- 8,1981.

7. Metal Sulfide Catalysis, Advances in Catalytic Chemistry II: Heinz Heinemann Symposium, May18-21, 1982, Salt Lake City, Utah.

8. Metal Sulfide Catalysis, Caltech Catalysis Conference (Industrial Affiliates Meeting), March 5,1982.

9. **NATO** Conference on Heterogeneous Catalysis: Catalysis by Transition Metal Sulfides, September 20 - October 1, 1982.

10. Gordon Research Conference, Catalysis by Transition Metal Sulfides, June 27-30, 1983.

11. Catalysis by Transition Metal Sulfides Royal Society of Chemistry, Residential School of Heterogeneous Catalysis, Cambridge, July 25-28, 1983.

12. Heterogeneous Catalysis by Transition Metal Sulfides, Symposium on the Role of Solid State Chemistry, Petroleum Division of the **ACS,** August, 1983.

13. Heterogeneous Catalysis by Transition Metal Sulfides, January 11-13, 1984, 2nd Berkeley Catalysis and Surface Science Conference.

14. Heterogeneous Catalysis by Transition Metal Sulfides, May 21, 1984, **ACS**, Newark, NJ.

15. Amorphous and Poorly Crystalline Transition Metal Sulfides, Schlumberger-Doll Research, April 9,1984.

16. Catalysis by Transition Metal Sulfides a Fundamental Study, Fall **AIChE** Meeting, November10-15, 1985.

17. Fundamental Studies of TMS HDS Catalysts, California Catalysis Society Meeting, April 4-5, 1985.

18. Layered Transition Metal Sulfides, Symposium on Layered Materials, Spring **ACS** Meeting, April 14-18,1985.

19. Tenth North American Meeting of the Catalysis Society, Fundamental Studies of TMS HDS Catalysts, April, 1986.

2O. Philadelphia Catalysis Society Meeting, Fundamental Studies of TMS HDS Catalysts, April 1986.

21. Roermond Conference on Catalysis, July 27-August 1,1986, Roermond, Netherlands.

22. International Workshop on Heterogeneous Catalysis, Structure/Function Relations in TMS HDS Catalysts, September 1988, Morelos, Mexico.

23. Symposium on Metal Catalyzed Reactions of Heteroatom Containing Molecules: 196th National **ACS** Meeting, Los Angeles, California, and September 1988.

24. Structure/Function Relations in TMS Catalysts, National **AIChE** Meeting, Washington, D. C., December 1988.

25. 11th North American Meeting of Catalysis Society, Structure/Function Relations in TMS Catalysis, Dearborn, Michigan, May, 1989.

26. Structure/Function Relations in Transition Metal Sulfide in Transition Metal Sulfide Catalysts: The Importance of MoS_2 Edge Planes, Southwest Catalysis Society Meeting, April 7, 1989, Houston, Texas.

27. Role of Anisotropy in MoS_2 Hydrotreating Catalysts and Fundamental Studies of TMS Catalysts, **ACS** Garvin Medal Symposium, April 11, 1989, Dallas, Texas.

28. Chicago Catalysis Society, Feb.12, 1990, Chicago, Illinois.

29. Structure/Function Relations in TMS Catalysts, Petroleum Division, National **ACS** Meeting, April 22-27, 1990, Boston, Massachusetts.

3O. Fundamental Studies of TMS Catalysts, National **ACS** Meeting, April 22-27, 1990, Boston, Massachusetts.

31. 2nd International Conference of Heterogeneous Catalysis, U.N.A.M. Oct 29-Enseñda, Mexico 1990.

32. 10th International Conference on Solid Compounds of Transition Elements May 21-25, 1991.

33. Bioremediation Lectures - A series of bioremediation lectures were delivered between March 30, 1990 - May 31, 1991 at various institutions and universities.

34. Optimization of Hydrotreating Reaction by Controlling the Rim-edge sites ratio of TMS Catalysts, M. Daage, R. R. Chianelli, Chemical Research Meeting, Buck Hill Inn, April - May 1990.

35. 10th International Conference on Solid Compounds of Transition Elements May 21-25, 1991.

36. Bioremediation Lectures - A series of bioremediation lectures based on the Alaskan and Prall's Island Spill was delivered at various institutions and Universities between May 31, 1991 and March 30,1992.

37. "Fundamental Studies of TMS Catalytic Materials" 10th International Conference on Solid Compounds of Transition Elements, May 21-25, 1991, Munster.

38. "Bioremediation Helping Natures Microbial Scavengers" University of Florida "Frontiers of Science" series, October 16,1991, Gainesville, Florida.

39. "Amorphous and Poorly Crystalline TMS", Physics Department, Harvard University, November 1, 1991.

40. "Bioremediation Helping Nature Microbial Scavengers " Friday night discourse the Royal Institution of Great Britain, February 21, 1992.

41. "Basics of Natural Bioremediation" CONCAWE May18-21, 1992, Hamburg Germany.

42. "Fundamentals of TMS Catalytic Materials" 12th Canadian Symposium on Catalysis, Banff, Alberta, May 25-28, 1992.

43. "Fundamentals of TMS Catalytic Materials" High Temperature Gordon Research Conference July 20-24,1992.

44. "Basics of Natural Bioremediation of Hydrocarbons in Surface Water and the Effect of Enhancement by Nutrients, Fertilizers, and/or selected strains of microorganisms, CONCAWE, Hamburg, May 8-21, 1992.

45. "Environmental Materials", Congresso Nacional en Ciencia de Materials, Cancun, Mexico, September 21-25, 1992.

46. "Bioremediation Helping Nature's Microbial Scavengers" Januachem 92, October 25-30,1992, Genoa, Italy.

47. "Recent Studies in the Fundamental Properties of TMS Catalytic Materials, 3rd International Materials Research Meeting, August 30-September3, 1993, Tokyo, Japan.

48. Cursos Internationales: Caracterizacion de Materiales Avanzados y Problemas Ambientales y la Ciencia de Materiales. CYTED, Tegucigalpa, Honduras, Sept. 5-10, 994.

49 "Nutrient Enhanced Bioremediation: from Laboratory to Alaskan Beaches, to Refineries", in *Proceedings of the OECD Workshop on Biotechnology for Water Use and Conservation*, Cocoyoc, Mexico, October 20-23, 1996.

50. “Environmental Chemistry Research along the Mexico/U.S. Border, the Environmental Challenges”, “Science and Technology in the Nafta Framework”, AAAS Annual Meeting, Baltimore, 1996.

51. (Invited) Cursos Internationales: Caracterizacion de Materiales Avanzados y Problemas Ambientales y la Ciencia de Materiales. CYTED, Tegucigalpa, Honduras, Sept. 5-10, 1996.

52. (Invited) Nutrient Enhanced Bioremediation: from Laboratory to Alaskan Beaches, to Refineries, OECD Workshop on Biotechnology for Water Use and Conservation, Cocoyoc, Mexico, October 20-23,1996.

53. The Structure and Potential Role of Atmospheric Nanoparticles in Photocatalytic and Thermal Production of Atmospheric Pollutants, Chianelli, R. R. and Yácaman, M. J., *Proceedings of the WERC/HSRC meeting*, April 23-25, 1997, Albuquerque, N.M.

54. (Invited Plenary Lecture) Fundamental Studies of Transition Metal Sulfide Catalytic Materials, North American Catalysis Meeting, May 18-27, 1997.

55. (Invited Plenary Lecture) Present and Future Research in Materials Science and its Industrial Impact, Workshop on Materials Science and Technology, Feb 18-19, Queretaro, Mexico 1997.

56. (Invited Plenary Lecture) Fundamental Studies of Transition Metal Sulfide Catalytic Materials, Symposium honoring John Sinfelt, ACS meeting September 10, 1997, Las Vegas Nevada.

57. (Invited Plenary Lecture) Present and Future Research in Materials Science and its Industrial Impact, Workshop on Materials Science and Technology, Feb 18-19, Queretaro, Mexico 1997.

58. Synthesis and Fundamental Properties of Nanocrystals, Sheets, and Fullerenes Based on Layered Transition Metal Chalcogenides, R. R. Chianelli, S. P. Kelty, P. D.

Persans, and M. J. Yacaman, VI Congreso Iberamericano de Quimica Inorganica, April 20-25(1997) Puebla, Mexico.

59. Bending and Folding in Transition Metal Chalcogenides, Invited Workshop on "R&D Status and Trends in Nanoparticles, Nanostructured Materials, and Devices in the United States, May 8-9, 1997

60. The Structure and Potential Role of Atmospheric Nanoparticles, M.J. Yacaman and R.R.Chianelli, 12th Annual Conference on Hazardous Waste Research, May 19-22, 1997, Kansas City, Missouri.

61. (Invited Plenary Lecture) Synchrotron Studies of Maya Blue Pigments, Polette, L.A., Ugarte, N., Ortega, M., and Chianelli, R.R. Chianelli, *ICEM,* symposium FF, ICEM14, Cancun, Mexico, 1998.

62. Sulfide Supported Transition Metal Carbides, G. Berhault and R. R. Chianelli, 16th Meeting of the North American Catalysis Society, May 30 to June 4, Boston, 1999.

63. N. Ugarte. L Polette and R.R. Chianelli, Maya Blue: An Ancient Material for the Future, Symposium Materials Science in Art and Archeology ACS 55th Regional Meeting October 21-23, 1999, El Paso, Texas.

64. R.R. Chianelli, M. J. Yacaman, F. Aldalpe and J. Arenas, The Structure and Potential Role of Atmospheric Nanoparticles in Photocatalytic and Thermal Production of Atmospheric Pollutants ACS 55th Regional Meeting October 21-23, 1999, El Paso, Texas.

65. R.R.Chianelli, *The Role of Carbon in Catalysis by Transition Metal Sulfide Catalysts*, UNAM Meeting, Ensenada, Mexico, January 24, 2001.

66. “The Forgotten Role of Carbon in Transition Metal Sulfide Catalytic Materials” Second International Symposium on the Molecular Aspect of Catalysis by Sulfides, Porquerolles, France, May 14-18, 2001.

67. “The Forgotten Role of Carbon in Transition Metal Sulfide Catalytic Materials” Second International Symposium on the Molecular Aspect of Catalysis by Sulfides, XVII Symposio Iberamericano de Catalisis, Porlamar, Isla de Margarita, Venezuela, September, 19, 2002.

68. “HRTEM, Synchrotron, and Simulation Techniques Applied to Activity and Selectivity Correlations in Hydrodesulphurization Catalysts”; Russell R. Chianelli, Myriam Perez De la Rosa, Gilles Berhault Miguel José Yácaman Apurva Mehta Sergio Fuentes. VI Congreso Nacional de la Asociación Mexicana de Microscopía y Reunión Nacional de Microanálisi, CIMAV, Chihuahua, Mexcio, October 3, 2002.

69. Advanced Synchrotron and Simulation Techniques Applied to Problems in Catalytic Materials Science; Russell R. Chianelli SSRL User’s Meeting, Workshop: Opportunities

in Catalysis Research Using Synchrotron Radiation, Stanford Synchrotron Radiation Laboratory, Palo Alto, California, October 7-9, 2002.

70. The Materials Corridor Initiative (MCI) - Transition Metal Sulfide Catalytic Materials Azul Maya - A Complex Hybrid Material, Russell R. Chianelli – INSTITUTO MEXICANODE INGENIEROS QUIMICOS, A.C., Friday, October 23, 2002,Juarez – Mexico.

71. "HRTEM, Synchrotron, and Simulation Techniques Applied to Activity and Selectivity Correlation in Hydrodesulfurization Catalysts", Myriam Perez De la Rosa, Gilles Berhault, Miguel José Yácaman, Apurva Mehta, Sergio Fuentes, Russell R. Chianelli, *18th North American Catalysis Society Meeting*, June 1-6, 2003, Fiesta Americana Grand Coral Beach, Cancún, México.

72. " Advanced Synchrotron and Simulation Techniques Applied to Problems in Materials Science: Fuel Cells, Catalysts and Maya Blue", Russell R. Chianelli and Lori A. Polette, Symposium 22, Synchrotron Radiation in Materials Research, XII International Materials Research Congress 2003, AUGUST 17 – 21, 2003 MARRIOT CASA MAGNA, Cancún, México.

73. " Advanced Synchrotron and Simulation Techniques Applied to Problems in Materials Science: Fuel Cells, Catalysts and Maya Blue", Russell R. Chianelli, ASTATPHYS2003, August 14-17, 2003, Puerto Vallarta, Cancún, México**.**

74. "HRTEM, Synchrotron, and Simulation Techniques Applied to Activity and Selectivity Correlation in Hydrodesulfurization Catalysts". Russell R. Chianelli, Gilles Berhault, Miguel José Yácaman, Apurva Mehta, Sergio Fuentes, Gabriel Alonso, and Myriam De la Rosa. Catalysts and Processes for Environmentally-Cleaner Gasoline and Diesel Fuels, DIVISION OF FUEL CHEMISTRY, 226th ACS National Meeting, New York, NY, September 7-11, 2003.

75. Conversion of Heavy Petroleum Products: Options for the Future
Russ Chianelli, Sandia, October 25, 2005 Albuquerque, NM.

76. Mayan Pigments: Russell Chianelli, Binational Sustainability Laboratory, November 18, 2005, Santa Theresa, New Mexico.

77. Periodic Trends Transition Metal Sulfide Catalysis: Intuition and Theory
R. R. Chianelli, University of Texas at El Paso, Research Advances in Rational Design of Catalysts and Sorbents 14-16 December 2005,IFP-Lyon, France.

78. Sulfide Catalysts: New Science and Ancient Reactions, Russell R. Chianelli, Santa Fe Institute, Santa Fe, New Mexico, June 1, 2006.

79. Organic/Inorganic Hybrid Materials: Novel Pigments, Catalysts and More,
3rd International Symposium on Hybridized Materials with Super-Functions *Monterrey Dec. 4, 2006,*Russell R. Chianelli, Brenda Torres, Alejandra Ramirez, Karina Castillo, Felicia Manciu University of Texas at El Paso.

80. Fundamental Studies of Sulfide Catalytic Materials, Russell Chianelli, ACCELERGY Corp. Shanghai, China, January 9, 2007.

81. Simulation and Synchrotron Techniques Applied to Problems in Materials Science: Catalysts and Azul Maya Pigments, Russell R. Chianelli Accelrys Science Forum - Houston, TX, November 13, 2007.

82. Organic/Inorganic Hybrid Materials: Novel Pigments, Catalysts and More, University of Denmark, March 13, 2008.

83. Organic/Inorganic Hybrid Materials: Novel Pigments, Catalysts and More, University of Puerto Rico, April 2, 2008.

84. Organic/Inorganic Hybrid Materials: Novel Pigments, Catalysts and More, University of Virginia, November 13, 2008.

85. "Conversion of Heavy Petroleum Products: Options for the Future", MRS Spring Meeting San Francisco, April 14 , 2009.

86. "Conventional vs. Sustainable Transportation Fuels for the Future", UABC Facultad de Ciencias QuímicasTijuana, Mexico, June 1, 2009.

87. "Transition Metal Sulfide Catalytic Materials100 years of Science and Application", XI Congreso de Catálisis – Programa, Ensenada, Mexico, June 3, 2009.

88. Chianelli, R. R. (April 14, 2009). Conversion of Heavy Petroleum Products: Options for the Future. MRS Spring Meeting San Francisco.

89. Behault, G., Chianelli, R. R., (August 17, 2009). Transition Metal Sulfide Catalytic Materials100 years of Science and Application. 238thACS National Meeting, Washington D.C.

90. "Conventional vs. Sustainable Transportation Fuels for the Future" R. R. Chianelli, ACS/MRS Symposium Materials for Energy, El Paso, Texas, November 4, 2009.

91. "*Structure of Hybrid Organic/Inorganic Surface Compounds", Russell R. Chianelli,* ACS/MRS Symposium, USA/Mexico/Japan Materials Consortium, El Paso, Texas, November 5, 2009.

92. R. R. Chianelli "Transition Metal Sulfide Catalytic Materials100 years of Science and Application", Texas A & M University, April 9, 2010.

93. R. R. Chianelli, "AZUL MAYA, An Ancient Hybrid Organic/Inorganic Material", Art Institute of Chicago/Northwestern University Seminar series in Conservation Science: "Nanotechnology for research and art conservation, October 28, 2010, Chicago.

94. Chianelli, R. R. “Azul Maya An Ancient Hybrid Organic/Inorganic Material” 8th Seminars of Advanced Studies on Molecular Design and Bioinformatics Universidad de La Habana, Havana, July 10 to 15, 2011

95. R. R. Chianelli, MRS World Materials Summit, Energy Fuels Panel, Oct 9-12, 2011.

96. R. R. Chianelli, “Transition Metal Sulfide Catalytic Materials” 100 Years of Application and Science”, The 6th Sino – U.S. Joint Conference on Chemical Engineering, November 8, 2011, Beijing China.

97. R. R. Chianelli, “Catalysts and the New Map of U.S. Energy Production”, LAMAR University, December 2, 2013.

98. R. R. Chianelli, “Transition Metal Sulfide Catalytic Materials for Hydroprocessing”, F. T. Synthesis and Other Applications, Worchester Polytechnic Institute, Wednesday February 6, 2013.

99. R. R. Chianelli, “Asphaltenes Too Valuable to Burn”, TMS – 2013, San Antonio, March 6, 2013.

100. R. R. Chianelli**,** “Novel Transition Metal Sulphide Catalytic Materials for Hydroprocessing, F. T. Synthesis and other Applications”, XXII Materials Research Congress, Cancun, Mexico, August 12, 2013.

101. R. R. Chianelli, “Gulf Oil Spill Déjà Vu: Oil Spill Cleanups, Past and Present, ”El Paso Community College, Transmountain, September 10, 2013.

102. R. R. Chianelli, “Novel Transition Metal Sulphide Catalytic Materials for Hydroprocessing, F. T. Synthesis and other Applications”, University of Texas at San Antonio, October 4, 2013.

103. R. R. Chianelli, “Transition metal sulfide catalytic materials for hydroprocessing, F. T. synthesis and other applications”, World Congress on Petrochemistry and Chemical Engineering, San Antonio, Texas, November 19, 2013.

104. R. R. Chianelli, “Transition metal sulfide catalytic materials for hydroprocessing, F. T. synthesis and other applications”, University of Texas Pan American, May 13, 2014.

105. R. R. Chianelli**,** “Catalytic Materials from Theory and Synthesis to Commercialization”, XXIII Materials Research Congress, Cancun, Mexico, August 17, 2014.

106. R. R. Chianelli, “Novel methods for upgrading heavy petroleum products” World Congress on Petrochemistry and Chemical Engineering, Las Vegas, Nevada, October 27, 2014.

107. R. R. Chianelli, "Understanding Novel Transition Metal Sulfide Catalytic Materials for Hydroprocessing, F. T. Synthesis and Other Applications". XIV Mexican Catalysis Congress, Valle de Bravo, Edo de Mexico, April 21, 2015.

108. R. R. Chianelli, "Catalytic Materials from Theory and Synthesis to Commercialization", UNAM Catalyst Colloquium “Catalysts in the 21st Century Trends Challenges and Opportunities”, Mexico City, April 16-17,2015.

109. R. R. Chianelli "Advances in Understanding and Commercialization of the Transition Metal Sulfide (TMS) Catalytic Materials", XXIIV Materials Research Congress, Cancun, Mexico, August 17, 2015.

U. S. Patents

Patent# Date Issued Title and Authors

1. **3,987,590** 10/26/76 Methods of Fabricating Thermonuclear Fuel Elements, R. R. Chianelli.

2. **4,144,384** 03/13/79 Cells Having Cathodes with Vanadium-Chalcogen Containing Compounds - A. J. Jacobson, R. R. Chianelli, M. S. Whittingham.

3. **4,166,160** 08/28/79 Cells Having Cathodes Derived from Ammonium Molybdenum Chalcogen Compounds - R. R. Chianelli, A. J. Jacobson, M. S. Whittingham.

4. **4,208,394** 06/17/80 Commercial Production of Transition Metal Sulfides from their Halides - R. R. Chianelli.

5. **4,243,624** 01/06/81 Method of making Cathodes Derived from Ammonium Metal-Chalcogen Compounds - A. J. Jacobson, R. R. Chianelli, And M. S. Whittingham.

6. **4,279,737** 07/21/81 Hydrodesulfurization over Catalysts Comprising Chalcogenides of Group VIII Prepared by Low Temperature Precipitation from Nonaqueous Solution - R. R. Chianelli, T. A. Pecoraro.

7. **4,288,422** 09/08/81 Method of Preparing Chalocogenides of Group VII Prepared by Low Temperature Precipitation from Nonaqueous Solution, the Products Produced by said Method and their Use as Catalysts - R. R. Chianelli, T. A. Pecoraro.

8. **4,299,892** 11/10/81 Amorphous and Sheet Dichalocogenides of Group IVB, VB, Molybdenum and Tungsten - M. B. Dines, R. R. Chianelli.

9. **4,308,171** 12/29/81 Method of Preparing Di and Polychalcogenides of Group VIIB by Low Temperature Precipitation from Nonaqueous Solution and Small Crystallite Size Stoichiometric Layered Dichalcogenides of Rhenium and Technetium - M. B. Dines, R. R. Chianelli and T. A. Pecoraro.

10. **4,323,480** 04/06/82 Method of Preparing Di and Polychalcogenides of Group VIIB, VB Molybdenum and Tungsten Transition Metals by Low Temperature Precipitation from Nonaqueous Solution and the Product Obtained by Said Method - M. B. Dines, R.R. Chianelli.

11. **4,368,115** 01/11/83 Catalysts Comprising Layered Chalcogenides of Group VIIB Prepared by a Low Temperature Nonaqueous Precipitation Technique - R. R. Chianelli and T. A. Pecoraro, M. B. Dines.

12. **4,390,515** 06/28/83 Method of Preparing Chalcogenides of Group VIIB by Low Temperature Precipitation from Nonaqueous Solution, the Products Produced by Said Method and their Use as Catalysts - R. R. Chianelli and T. A. Pecoraro.

13. **4,430,443** 02/07/84 Supported Carbon-Containing Molybdenum and Tungsten Sulfides Catalysts, Their Preparation and Use - R. L. Seiver, R. R. Chianelli.

14. **4,431,747** 02/14/84 Supported Carbon-Containing Molybdenum and Tungsten Sulfides Catalysts, Their Preparation and Use - R. L. Seiver, R. R. Chianelli.

15. **4,508,847** 04/02/85 Containing Molybdenum and Tungsten Sulfides Catalysts, Their Preparation and Use - R. R. Chianelli, T. A. Pecoraro.

16. **4,510,260** 04/09/85 Self-Promoted Molybdenum and Tungsten Sulfide Hydrotreating Catalysts Bis-Tetrathiometallate Precursors - E. I. Stiefel, W. H. Pan, R. R. Chianelli.

17. **4,528,089** 07/09/85 Hydrogenation Processes Using Carbon-Containing Molybdenum and Tungsten Sulfide Catalysts - T. A. Pecoraro, R. R. Chianelli.

18. **4,540,482** 09/10/85 Supported Carbon-Containing Molybdenum and Tungsten Sulfide Catalysts, Their Preparation and Use - R. L. Seiver, R. R. Chianelli.

19. **4,544,481** 10/01/85 Supported Carbon-Containing Molybdenum and Tungsten Sulfide Catalysts, Their Preparation and Use - R. L. Seiver, R. R. Chianelli.

20. **4,581,125** 04/08/86 Hydrotreating Using Self-Promoted Molybdenum and Tungsten Sulfide Catalysts Formed from Bis-tetrathiomolybdate Precursors - E. I. Stiefel, W. H. Pan, R. R. Chianelli.

21. **4,591,429** 05/27/86 Hydrotreating Process Employing Catalysts Comprising a Supported Mixture of a Sulfide of a Promoter Metal, Trivalent Chromium, Molybdenum and Tungsten - T. C. Ho, A. R. Young, R. R. Chianelli, A. J. Jacobson.

22. **4,504,183** 08/05/86 Catalytic Process for Hydroconversion of Solid Carbonaceous Materials - E. H. Edelson, E. I. Stiefel, R. R. Chianelli, C. L. Coyle.

23. **4,622,128** 11/11/86 Hydrotreating Catalysts Comprising Supported Mixtures of a Sulfide of Trivalent Chromium and Molybdenum or Tungsten - A.R. Young, T. C. Ho, A. J. Jacobson and R. R. Chianelli.

24. **4,626,339** 12/02/86 Supported Chromium-Molybdenum and Chromium Sulfide Catalysts - R.R. Chianelli, T. C. Ho, A. J. Jacobson, A. R. Young.

25. **4,632,747** 12/30/86 Process Employing Catalysts Comprising a Supported Mixed Metal Sulfide Iron Promoted Mo an W- - T. C. Ho, A. R. Young, A. J. Jacobson, R. R. Chianelli.

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30. **4,716,139** 12/29/87 Amorphous Sulfide Catalysts of Trivalent Cr and Promoter Metals and Method of Making Same - A. J. Jacobson, T. C. Ho, R. R. Chianelli, J. J. Steger, A. A. Montagna.

31. **4,721,558** 01/26/88 Hydrotreating Catalysts comprising Mixture of Sulfide of a Promoter Metal, Amorphous Sulfide of Trivalent Cr and Microcrystalline Mo and W - A. J. Jacobson, T. C. Ho, R.R. Chianelli, J. J. Steger.

32. **4,727,135** 02/23/88 Synthesis of Polyquinoline by the Catalytic Dehydrogenative Polymerization of Tetra-hydroquinoline - L. Y. Chiang and R. R. Chianelli.

33. **4,748,142** 05/31/88 Supported Chromium-molybdenum and Tungsten Sulfide Catalysts-R. R. Chianelli, T. C. Ho, A. J. Jacobson and A. R. Young.

34. **4,749,673** 06/07/88 Hydrotreating Catalysts Comprising Supported Mixtures of a Sulfide of Trivalent Chromium and Molybdenum or Tungsten - A.R. Young, T. C. Ho, A. J. Jacobson and R. R. Chianelli.

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37. **4,795,731** 01/03/89 Transition Metal Sulfide Promoted Molybdenum or Tungsten Sulfide Catalysts and Their Uses for Hydroprocessing - A. J. Jacobson, R. R. Chianelli and T. A. Pecoraro.

38. **4,801,570** 01/31/89 Process for Preparing a Supported Promoted Molybdenum and/or Tungsten Sulfide Hydroprocessing Catalyst - A. R. Young, T. C. Ho, A. J. Jacobson, and R. R. Chianelli.

39. **4,812,227** 03/14/89 Hydrotreating with Catalysts Comprising Mixtures of an Amorphous Sulfide or Trivalent Chromium and Microcrystallites of Molybdenum or Tungsten Sulfide - A. J. Jacobson, T. C. Ho, R. R. Chianelli, J. J. Steger, and A. A. Montagna.

40. **4,820,677** 04/11/89 Amorphous Iron Promoted Mo and W Sulfide Hydroprocessing Catalysts and Process for Their Preparation - A. J. Jacobson, R. R. Chianelli, T. C. Ho and T. A. Pecoraro.

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45. **4,962,077** 10/9/90 Transition Metal Tris-Dithiolene and Related Complexes As Precursors to Active Catalysts - T. R. Halbert, R. R. Chianelli, E. I. Stiefel and A. J. Jacobson.

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47. **4,981,949** 01/01/91 Method for Polymerizing Aromatic Heterocyclic Compounds - L. Y. Chiang, J. W. Swirczewski and R.R. Chianelli.

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5. "National Treasures, MRS Bulletin, November, 1990.

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Appendix I

YEAR: **2007-2008**
NAME: **Russell R. Chianelli**
RANK: **Professor**
DEPARTMENT: **Chemistry, MRTI**

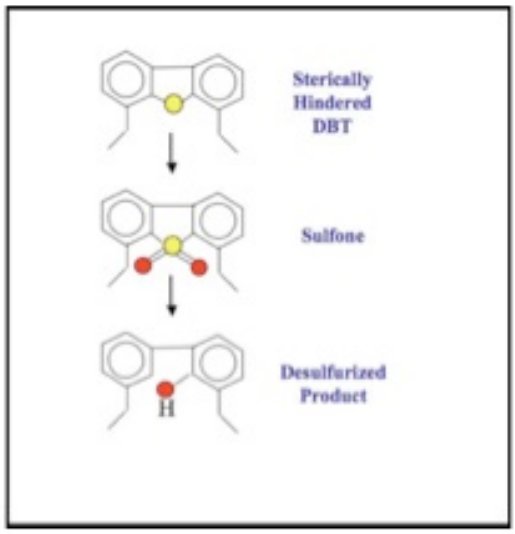
Comments: This period represents one of the most productive period of my career. Since 1974 I have published and average of 4-5 publications every year. In this period I published ~ 15 refereed publications. In addition I achieved an *H-index* of 36 and a citation per paper index of 28.29 . The *H-index (Hirsch)* is used by the National Academy of Science to measure impact of science by an individual researcher. Three U.S. patents issued that have been licensed and are proceeding to commercialization. In addition, progress has been made in extending the interdisciplinary research and teaching approach across colleges and depart

MRTI**: The process of turning UTEP science and technology continued in 2007-2008. Several new collaborations were instituted and Mayan Pigments Inc. received a $1,000,000 grant from the *Texas Emerging Technology Fund.* To further enhance the innovation process a second installment of a new course was given this Fall with professors Lush and Hoy: MGMT 5394 *Technology Entrepreneurship* combining science, engineering and business majors in entrepreneurial teams. A student business won a class composition judged by entrepreneurs and became eligible to compete in the *El Paso Angels Innovation Competition* to be held in the Spring. The winning team, *Eco-Oil*, prepared a business plan based on previous MRTI research in lipid oil production from algae.**
Science: This period saw significance advances in three key science areas:
Mayan Blue Pigments: The chemistry of this organic/inorganic complex goes far beyond Maya Blue that is an indigo/palygorskite complex material. We have discovered that many different molecules and solids form the organic/inorganic complex and exchange electron density creating many new

colors and materials. We are on the verge of having complete control over the optical spectra of these materials and have created a whole new class of materials. Our theoretical efforts to understand these "surface complexes has progressed nicely in 2008. We are now able to predict the color of a new organic/inorganic complex. Three theses were completed on this subject in 2008. Two are M.S. in Chemistry and on is a MA&SE PhD.

Environmental Catalytic Materials: Progress continued in understanding and developing practical environmental Transition Metal Catalytic (TMS) materials. The results have been summarized in an 2009 *Applied Catalysis* invited article entitled: "Unsupported Transition Metal Sulfide Catalysts: 100 years of Science and Application", We have studied tetrahydroquinoline intercalated MoS_2 as the first in a series of new materials that result from the learning described above. Commercialization of these materials commenced in 2007 through collaboration with ACCELERGY Corp.

Bio-inspired Desulfurization Chemistry: Previous work during the *Exxon Valdez* oil spill revealed that microorganism existing in sea water when starved of sulfur can remove sulfur from petroleum molecules as sulfate as indicated in the figure below:



We have reproduced this chemistry in detail at one atmosphere and below 200°C using novel catalytic chemistry. This breakthrough chemistry has the potential of revolutionizing petroleum refining. In 2009 patents will be developed and publications prepared.

Technology: The previously mentioned scientific breakthroughs are leading to strong industrial interest, development of intellectual property and commercial development with large potential payoffs for UTEP. Especially, new this year is the development of a novel process for separation of lipid oil from algae was developed in conjunction with Four Peaks Energy Corp. The discovery of this process promise to remove a major economic bottleneck in production of algal oils. These oils may be used to produce biodiesel or higher valued products such as lubricants and cosmetics. Appendix 1 is a copy of the new **MRTI Energy Plan: Opportunities in Liquid Fuels Production**

OTHER

Guided many thesis committees in Mexico as part of a continued effort to partner with Mexican scientists and engineers. A particular example is: CONACyT Awards 2000 - 2002 with Gabriel Alonso and CIMAV - catalytic materials - about $220,000**.** Award to be spent in Mexico as part of the continuing partnership.

Advisor to the Director of CIMAV (Centro de Investigacion de Materiales Advanzados) in Chihuahua.

Developed business incubator critical mass covering business development assistance, intellectual property assistance, SBIR development assistance and investor development assistance. This effort involves an interdisciplinary effort with the school of business. In 2004 two companies **Mayan Pigments Inc.** and **Refinery Science Crop.,** were formed as previously described and they joined the incubator. New companies are currently in the formation phase. These have raised approximately **$7,000,000** to date and provide funding and local jobs for students as they grow.

SERVICE CONTRIBUTION

I. COMMITTEE SERVICE

(2000- 2002) Dean of Engineering's Total Quality Management Advisory. Board
(2000 – 2002) Department of Physics Academic Search Committee.

(2000 – 2002) Department of Chemistry Inorganic Search Committee.
(2002 – 2005) Chairman Chemistry Department merit evaluation committee.
(2004 – 2005) Member of the Presidential Task Force on Research Development for the Future (Millennium Committee).
(2006 –2007) Member of the Dean of Engineering Search Committee
(2007 – current) Board of Directors Tigua Inc., a new start-up to assist the Tigua Nation.
(Current) IDR (Interdisciplinary Research Committee)
(Current) IPR (intellectual Property Committee)

II. SPECIAL DUTIES

Extensive interactions with Mexican Institutions to establish educational and research opportunities. These connections have led to many research and educational interactions. 1998 saw the founding of the Materials Council Corridor (MCC) and the Materials Corridor Initiative (MCI). The MCC consists of Academic, Industrial and National Laboratories on both sides of the border. Approximately 25 institutions joined. The MCI was funded by DOE in 2001 with an initial grant of $1,010,000. The MCI grant ended at the end of 2004 with approximately 21 projects of which 8 were declared ready for "deployment". Deployment is the DOE term for "pre commercialization". This is a remarkable track record for a commercialization grant. Two of the programs at UTEP have gone into a start-up as described elsewhere.

Materials Research and Technology Institute (MRTI): Continued funding of the MCI coupled with other initiatives has permitted the successful startup of MRTI. New focus areas such as a fuel cell initiative and the salt cedar are being developed to assist forefront efforts in materials research and education. In addition a new course has been instituted (MGMT 5394 **Technology Entrepreneurship**). This course combines science, engineering and business majors in entrepreneurial teams. At the end of the course the best team is chosen that will compete in the Texas student entrepreneurial contest. Further MRTI status and progress reported at the end of this document.

DOE funded "Gateway" Program: The SSRL (Stanford Synchrotron Radiation Laboratory)/UTEP "Gateway" program successfully completed its

six year and is renewed for it seventh and final year. The program has trained over 60 students and faculty in the use of synchrotron technique.

Chemistry Department: MRTI continued to provide support for research in the chemistry department. Also assistance was provided to members of the chemistry department in obtaining new grants through MRTI contacts. Mentoring and assistance to newer members of the department continued.

CONSULTING AND PUBLICATIONS OF A SERVICE NATURE

Chairman of Stanford Synchrotron Radiation Laboratories (SSRL) proposal review panel (PRP). The PRP oversees the scientific quality and user friendliness of the SSRL community in an advisory role to the director.

Advisor to the Director of CIMAV (Centro de Investigacion de Materiales Advanzados) in Chihuahua.

PROFESSIONAL SERVICE ACTIVITY

Science Studio – Continued as co-host of KTEP's Science Studio. Science Studio the creation of Keith Pannell brings current science, health and environmental issues to the UTEP community.

V. Awards

1997 - Lifetime achievement award from the "Academia Mexicana de Materiales" "Por su valiosa contribución al desarrollo de la Ciencia de los Materiales en México."
1999 - UTEP - Award for outstanding achievement in developing the University Seminar Program.
2004 - UTEP – Award for Outstanding Research.
2006 – UTEP – UT System Chancellor's Entrepreneurship and Innovation Award

The Materials Research and Technology Institute
Status and Update 2006

Since MRTI was formed in 2001, it has made significant progress in achieving its initial objectives. These objectives and progress in achieving them are shown below:

• Fostering interdisciplinary research across the Colleges of Science and Engineering. **MRTI research initiatives include contributions from chemistry, physics, biology, geology, civil engineering, electrical engineering and metallurgical engineering.**

• Supporting the MAS&E, ES&E and Biology Ph.D. Programs: **Since its inception in 2001 MRTI has supported or assisted 27 Ph.D. students in their research programs with interdisciplinary focus.**

• Fostering the Development of Intellectual Property: **MRTI has encouraged and sought to develop intellectual property in all the programs supported or assisted by MRTI. This includes education efforts and assistance to the intellectual property committee.**

• Development of Industrial Partnerships: **MRTI has developed working relationships with corporations and assisted the corporations in developing industrial research projects. Examples include** Atofina Corp. **and** Vitro Corp.

• Development of Interdisciplinary Interactions with the College of Business: **MRTI has worked with the College of Business and Professor Frank Hoy in developing bonds between science, engineering and business. The purpose of this process has been to develop faster routes to commercialization of UTEP research and technology. Another example is the creation of a new graduate course entitled "Technology Entrepreneurship" that is being given for the first time this fall This effort is a combined effort between Science (Russ Chianelli), Engineering (Greg Lush) and Business (Frank Hoy). The course curriculum is attached as Appendix #1.**

• Commercialization of UTEP Research and Technology: **Three companies have been started based on UTEP research and technology as described further on**
• Creation of Economic Opportunities for UTEP Graduates: **The development of start-up companies in UTEP has created employment opportunities as described below. Particularly satisfying is the fact that a large portion of the jobs created is currently occupied by female Hispanics. Thus, UTEP is a pioneer in this field, which is currently casing great controversy in the academic community.**

In part these objectives include clearly demonstrating that our students and the technology that they develop at UTEP are second to none in the world.

APPENDIX 2

Opportunities in Liquid Fuel Production

The Materials Research Technology Institute
University of Texas El Paso

The Problem and Conceptual Solution

The global economy is powered by light, sweet crude oil — a natural resource that is getting more difficult to access, refine, sell, and use in an economically predictable and environmentally acceptable way. If the world continues to demand liquid fuels principally for transportation, innovative individuals and organizations will need to invent, develop, and adopt new technologies capable of producing, refining, and consuming this remarkable energy source in a way that not only satisfies global demand, but also minimizes or contains undesirable effluents.

The Materials Research Technology Institute

Professor Russ Chianelli, a former Exxon Labs scientist, founded the Materials Research and Technology Institute (MRTI) in 2001. He is recognized as a world leader in heterogeneous catalysis and is the inventor or co-inventor on 65 patents. Capitalizing on his 30 years of experience in energy science and engineering, Prof. Chianelli has built a diverse, talented group of 19 students, staff, and scientists who conduct interdisciplinary research and technology development in several areas applicable to liquid fuel production. To date, MRTI has produced seven patents (six licensed and several more proceeding), three startup companies, and a cadre of researchers — especially women — with the skills and confidence required to do cutting edge materials science and engineering.

In the energy area, MRTI conducts research amongst a network of peers who are not only subject matter specialists, but also close colleagues who bonded through successful and failed endeavors over the past 40 years. Current research subjects span from the practical to the exotic: improved extraction of light crudes from existing oil fields, more efficient refining of light crudes, conversion of heavy feeds at the wellhead or deep within underground reservoirs, and finally the selection, harvesting, and extraction of oils from hydrocarbon-producing organisms (e.g., algae, extremophiles) or inorganic hydrogen-carbon resources (e.g., CO_2, asphaltenes, CH_4-CO_2 reactions).

Extracting More Oil From Existing US Fields

In Washington DC, there has been much ado about opening new areas offshore and in Alaska to oil prospecting and drilling. Whatever the future outcome of this debate, a present opportunity looms in the background — the application of new technologies that can help extract the remaining 50% of oil within existing fields throughout North America.

Dr. Arthur Thompson, a former Exxon Corporate Research Labs scientist who is part of MRTI's network, has developed one such technology although it has yet to be put into common practice. Field tested successfully by Exxon Production Research Company, this novel approach directly detects hydrocarbon pools through conversions between electromagnetic and seismic energy. Once detected, this approach can then be used to map oil reservoirs with the precision required to guide oil drilling and extraction.

Refining Petroleum More Efficiently

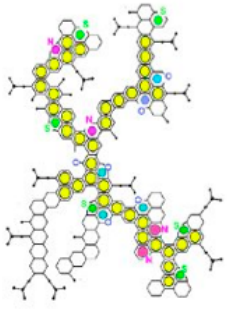
Just as no new oil fields have gone on-line in the United States over the past several years, nor have any new US refineries entered into service. Until additional refinery capacity is built, more can be done to increase the throughput, efficiency, and profitability of existing refineries. The potential for improved refinery output and increased profit margins is quite substantial. In 2005, Exxon-Mobil reported that their energy savings initiative at their refineries resulted in an annual $1 billion savings out of a total $6 Billion annual energy cost for their refinery operations.

MRTI and its network of specialists have the knowledge and experience to show refineries how to adopt a variety of technologies to improve their operations, including modern instrumentation, thermoelectric sensing devices, and acoustic sensors for monitoring the internal workings of reactors and nozzles. In addition, Prof. Chianelli has developed new catalysts for hydrodesulfurization that enable aging hydro-treaters in old refineries to meet current environmental requirements for liquid hydrocarbon

products. Accelergy Corporation, led by another Exxon Labs alum in MRTI's network, has successfully field tested these catalysts.

Converting Heavy Petroleum

North America has more than enough oil to meet US, Canadian, and Mexican energy demand for the next 1000 years. The problem is that these light crudes are locked up in heavy feeds, oil shales, bitumen, and tar sands. Whether these vast reserves can be tapped depends largely on new extraction and refining technologies that are able to produce light, low sulfur crude in an environmentally acceptable manner.



Asphaltene Molecule

Already, demand for heavy crudes is increasing as lighter crudes become more costly. Compared with light petroleum products, heavy crude contains a larger fraction of asphaltenes and are hydrogen deficient. Asphaltenes are complex mixtures of polyaromatic molecules containing most of the metals, sulfur, and nitrogen within crude oil. These molecules are difficult to convert to lighter fractions and the metals within these molecules foul catalysts. In addition, asphaltenes adversely affect viscosity, resulting in clogging during production, refining, and transport.

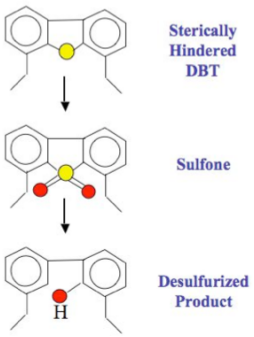
Currently, heavy crudes are converted into transportation fuels through the use of two general processes: coking (pyrolysis) and hydro-processing. Coking rejects carbon as coke while hydrogen is transferred to the product fuel. Hydro processing adds hydrogen to the asphaltene fraction. Refining with these two methods becomes increasingly expensive as the asphaltene content increases due principally to catalyst deactivation.

The researchers at MRTI have developed more robust catalysts that improve the effectiveness of both of these heavy crude refining processes. This team of three has emerged as a world leader in understanding asphaltene structure and conversion. Future research on the asphaltene molecule will explore the development of new materials from the asphaltene molecule that could be used to create new polymers, electrodes, and energy converters.

Even with more robust catalysts, the two well-established processes for heavy feed conversion are difficult to incorporate into the current refinery environment; transportation costs associated with heavy crudes are higher and refineries pay heavy crude producers a significantly lower price for their product. If heavy crude producers could upgrade their product at the wellhead, the resulting light crude could be put into existing pipeline networks and earn the full commodity price from refineries.

A research group at MRTI has come up with novel upgrading processes that could work in this way and is presently developing these approaches for field-testing. One of the concepts were inspired by Prof. Chianelli's bioremediation method that was successfully applied to clean up the Exxon Valdez oil spill. This approach featured the nutriation of indigenous hydrocarbon degrading organisms that converted spilled oil to CO_2, H_2O,

and more of themselves. The hydrocarbon degrading organisms thrived within a symbiotic consortium of organisms with many different functions and abilities. Amazingly, some of these organisms removed sulfur at ambient temperatures from hindered molecules such as substituted DBT (dibenzothiophene).



The MRTI research team has reproduced this sulfur removal reaction in the laboratory below 200 degrees C at atmospheric pressure. The first potential application of this technology is likely diesel desulfurization. Beyond this first application, this technology could be developed further for application at the wellhead for heavy feeds, significantly reducing cost and increasing the efficiency of sulfur removal.

While the sulfur removal process described above does not use organisms, we believe that sulfur-removing organisms will eventually be used directly at the wellhead. Tanks at the wellhead filled with hydrocarbon degrading organisms and heavy crude will be kept under optimal conditions. These organisms would remove the sulfur and upgrade the heavy crude in a process analogous to how wines are aged in wooden casks. Once mature, the upgraded crude would be fed into existing oil pipelines. Commercialization of this process at the wellhead would revolutionize heavy crude upgrading.

Going one step further, the ultimate dream is to make heavy petroleum reservoirs function as vast underground casks for heavy crude upgrading. While there are a variety of ways to do this, the conceptual approach would involve the inoculation of the reservoirs with appropriate organisms. One of the most simple, direct approaches would be the injection of anaerobic organisms commonly found in coal and shale beds that would produce methane. Enhanced with nutrients and moisture, this approach could yield massive methane farms where the CH_4 could be processed into liquid

transportation fuels. This approach would have the added advantage of minimizing expensive and environmentally destructive mining operations.

Advanced Fuel Chemistry Concepts

From a regulatory and consequently economic standpoint, all of the enumerated ideas are likely incomplete without methods to utilize CO_2 effluent for fuel production. This can be done biologically through the consumption of CO_2 by hydrocarbon-producing organisms
such as algae and extremophiles or synthetically through thermochemical processing of hydrogen and carbon resources as well as novel CH_4-CO_2 reactions.

With literally hundreds of companies, labs, and university research groups in pursuit of
the ideal hydrocarbon producing organism, Prof. Chianelli and Dr. Kretschmer of MRTI have focused on novel ways to select, harvest, and separate lipid oils regardless of specific micro-organism species optimized for biofuel production. Laboratory experiments at MRTI of one approach have significantly improved current harvesting and separation methods. In the synthetic fuel arena, researchers at MRTI intend to apply their experience and expertise to the problem of significantly increasing the production rate and energy efficiency of new thermochemical processes for synthetic fuel engineering.

MRTI Network

With the notable exception of art, the individual rarely brings a breakthrough to full realization; it takes cohesive teams and social networks to not only achieve technological breakthroughs, but also bring breakthroughs to the mass market. From over 40 years of close working relationships, MRTI has built a unique network of colleagues and specialists that cover the full spectrum of technical topics that have been enumerated. The table below shows some of the salient members of this network:

Individuals	Organizations	Relevant Areas of Specialization	Additional Comments
	Becht Engineering Carmegen Engineering	Energy conservation, Refinery processes	
Rocco Fiato	Accelergy	Coal-to-liquid, gas-to-liquid, tar sand conversion	Active in the US and China, Former Exxon Corporate Research Lab scientist
Barry Marrs	Athena Biosciences	Cellulose to ethanol	Dr. Marrs is the CEO and founder of Athena, former Exxon Corporate Research Lab scientist
Arthur Thompson	Consultant	Oil Prospecting	Former Exxon Corporate Research Lab scientist, Nominated for Geoscience paper of the year
Ed Morse	Lehman Brothers	Strategic Planning, Oil and Refineries	
Ron Atlas	University of Louisville	Microbiology	Former Exxon Corporate Research Lab scientist
Allan Jacobson	University of Houston	Solid-state inorganic chemistry	Former Exxon Corporate Research Lab scientist
Long Chiang	University of Massachusetts Lowell	Solid-state organic chemistry	Former Exxon Corporate Research Lab scientist
Peter Lucchesi	International Technology Services	Energy R&D, Energy Investing	Founder and Former Director of Exxon Corporate Research Laboratory

MRTI Projects and Private Investors

When MRTI was founded in 2001, the institute set a series of specific and ambitious goals that are listed on its web site[1] and repeated here:

- Providing world research facilities and opportunities.
- Providing funding opportunities.
- Providing a stimulating interaction platform to vet creative ideas.
- Providing potential employment opportunities for research and business students.
- Providing national and international opportunities for presenting the work of students.
- Encouraging the development of intellectual property based on UTEP research.
- Developing "Start-Up" companies based on UTEP intellectual property.
- Assisting in developing "Start-Up" teams involving UTEP students, staff and faculty.
- Assisting in developing "Start-Up" funding.
- Developing-supporting UTEP research contracts.

[1] http://research.utep.edu/Default.aspx?tabid=29069

Seven years later, these goals have been realized for xx specific individuals, xx funded research projects, and xx startup companies. The new MRTI objective is to pursue these goals on a much larger scale. To do that, MRTI is actively seeking private investment in current and future research projects — particularly those in energy. This can be done through formal partnerships based on shared risk and reward.

Operating at the University of Texas at El Paso (UTEP), MRTI is part of the University of Texas (UT) system's larger efforts to have UT research and technology develop into commercial enterprises. The UT system has entered a variety of business arrangements with the private sector, including joint ventures, royalty sharing, and UT investment in startup companies with licenses of UT intellectual property (IP). While IP developed solely by UT faculty, staff, and students are the property of the State of Texas regardless of funding sources,[2] exclusive licenses can and have been granted to individuals and organizations that invest money in UT research projects.

[2] UTEP faculty, staff, and students who work with others outside of the UT system may also develop shared intellectual property that is prosecuted through joint ownership.