

CURRICULUM VITAE

DATE: May, 2019

NAME: Laurence A. Nafie

ACADEMIC POSITION: Emeritus Distinguished Professor

ADDRESS: Department of Chemistry
1-014 Center for Science and Technology
Syracuse University
Syracuse, New York 13244-4100

WEB ADDRESS: <http://thecollege.syr.edu/people/faculty/pages/chem/Nafie-Laurence.html>

EDUCATION:

Ph.D. Chemical Physics, University of Oregon (1973)
M.S. Physics, University of Oregon (1969)
B. Chem. Chemistry, University of Minnesota (1967)

MEMBERSHIP IN PROFESSIONAL AND LEARNED SOCIETIES:

American Association for the Advancement of Science
American Chemical Society
American Physical Society
Coblentz Society
Society for Applied Spectroscopy

ACADEMIC POSITIONS:

2010- present Emeritus Distinguished Professor of Chemistry
2010, June Guest Professor, Chinese Academy of Sciences, Dalian, China
2000-2010 Distinguished Professor of Chemistry
1993-1994 Associate Dean for Academic and Fiscal Planning, College of Arts and
 Sciences, Syracuse University
1984-2000 Chair, Department of Chemistry, Syracuse University
1982-1984 Vice Chair, Department of Chemistry, Syracuse University
1982-2000 Professor of Chemistry, Syracuse University
1979-1982 Associate Professor of Chemistry, Syracuse University
1975-1979 Assistant Professor of Chemistry, Syracuse University
1973-1975 Postdoctoral Associate, University of Southern California

OTHER EMPLOYMENT:

1969 - 1971 Science and Engineering Assistant, Nuclear Effects Laboratory,
 Edgewood Arsenal, Maryland (Member, United States Army)
1968 Summer Research Assistant, Lawrence Radiation Laboratory, Livermore, California

AWARDS, HONORS, and PROFESSIONAL OFFICES:

Chirality Medal Winner, awarded by the Societa Chimica Italiana, 2019
SAS Senior Certified Spectroscopist, September 2016
Gold Medal Award of the New York Section of the Society for Applied Spectroscopy, 2014
Co-Chair, *Fourth International Conference on Vibrational Optical Activity (VOA-4)*, 2014
Pittsburgh Spectroscopy Award of the Spectroscopic Society of Pittsburgh, 2013
Honorary Member of the Coblentz Society, 2012
Editor-in-Chief, *Journal of Raman Spectroscopy*, 2010 to present
Fellow of the Society for Applied Spectroscopy, 2008
Distinguished Service Award of the Society of Applied Spectroscopy, 2007
Editorial Board, *Chirality* 2007 to present
Co-Chair, *Third International Conference on Advanced Vibrational Spectroscopy (ICAVS-3)*, 2005.
Editorial Board, *Applied Spectroscopy*, 2004 to 2016
President, Society of Applied Spectroscopy, 2003
Meggers Award for the best paper published in *Applied Spectroscopy* in 2000, October 2001
Bomem Michelson Award for Outstanding Achievements in Molecular Spectroscopy, March 2001
Parliamentarian and Executive Committee Member, Society of Applied Spectroscopy, 1999-2001
Editorial Board and Reviewing Editor, *Biopolymers*, 1999 to 2010
Editorial Board Member, *Enantiomer*, 1998 to 2002
Chancellor's Citation for Exceptional Academic Achievement, Syracuse University, February 1998
Co-Founder and Chief Research Officer, BioTools, Inc., 1996-present
Founding Editor, *Biospectroscopy*, A journal published by John Wiley and Sons, 1994 to 2003
Associate Dean for Academic and Fiscal Planning, College of Arts and Sciences, Syr., N.Y., 1994-1995
President, Coblentz Society, 1993-1995
Dean's Alumni Achievement Award, College of Arts and Sciences, University of Oregon, May 1991.
Advisory Committee, National Center for Biomedical Infrared Spectroscopy, Battelle Columbus Laboratories 1983-1989
Coblentz Society Governing Board Member, 1984 - 1988
Coblentz Award for Outstanding Contributions to Molecular Spectroscopy for a scientist under the age of 35 years, 1981
Alfred P. Sloan Foundation Fellow, 1978 - 1982
National Defense Education Act Fellowship, 1967 - 1969, 1971 - 1972
James Wright Hunt Scholarship, 1966 - 1967

ACADEMIC SPECIALIZATION:

Topics: Physical Chemistry, Chemical Physics, Bio-Analytical Chemistry, Vibrational Spectroscopy, Molecular Optical Activity, Chirality of Biological Molecules, Quantum Chemistry, Electron Transition Current Density, Characterization of Chiral Pharmaceutical Molecules

GRANTS:

- "Vibrational Optical Activity", Research Corporation, 1975 to 1978, \$15,000.
- "Vibrational Optical Activity", Petroleum Research Fund of the American Chemical Society, 1976 to 1979, \$9,000.
- "Vibrational Optical Activity in Proteins and Related Molecules", National Science Foundation, 1976 to 1979, \$88,400.
- "Mid-Infrared Vibrational Circular Dichroism", Senate Research Committee, Syracuse University, 1978, \$3,500.

- "Vibrational Optical Activity", National Institutes of Health, 1978 to 1981, \$177,900.
- Fellowship for Research from the Alfred P. Sloan Foundation, 1978 to 1982, \$19,800.
- "Vibrational Circular Dichroism Spectroscopy", National Science Foundation, 1980 to 1983, \$248,000.
- "Vibrational Optical Activity in Peptide Molecules", National Institutes of Health, 1981 to 1984, \$294,756.
- "Vibrational Circular Dichroism Spectroscopy", National Science Foundation, 1983 to 1986, \$272,500.
- "Vibrational Optical Activity in Peptide Molecules", National Institutes of Health, 1984 to 1989, \$611,355 direct costs.
- "Vibrational Circular Dichroism Spectroscopy", National Science Foundation, 1986 to 1989, \$334,000.
- "Vibrational Optical Activity in Biological Molecules," National Institutes of Health, 1989-1994, \$539,574 direct costs and approximately \$775,000 total costs.
- "Vibrational Optical Activity in Biomolecules" National Institutes of Health, 1994-2000,
- \$ 637,261 direct costs, and \$851,215 total costs.
- "Near-Infrared VCD of Chiral Pharmaceuticals" National Institutes of Health, 2001-2005,
- \$1,027,873 total costs.
- "Small Achiral Ligands as Vibrational Circular Dichroism Probes of Active Sites in Metalloproteins", National Science Foundation (NSF), 2001-2004, \$309,500 total costs.
- "Elaboration of VCD method to study of metal-ion induced structural polymorphism of DNA and its polypurine-polypyrimidine sequence", CRDF, 2002-2004, \$6,000 total costs.
- "Miniature Vibrational Circular Dichroism Spectrometer for Detection of Amino Acids and Chirality", Jet Propulsion Lab NASA (JPL), 2002-2005, ~\$100,000 total costs.
- "Detection of Chirality in Amino Acids Using Fourier-Transform Vibrational Circular Dichroism", National Aeronautics and Space Administration (NASA), faculty/graduate student fellowship grant, 2003-2006, \$72,000 total costs.
- BioTools Inc., 2000-2010, \$20,000, Phase one w/R.W. Johnson Pharmaceutical (plus lab equipment and computer donated). Phase two 2001-2002, \$40,000. Phase three 2002-2003, \$40,000. Phase four 2003-2004, \$20,000, 2004-2005, \$30,000. Total \$150,000.
- Small Business Technology Transfer (STTR) Grant "Near-Infrared Surface-Enhanced Raman Optical Activity from Metal Nanoshells" Air Force Office of Scientific Research (AFOSR), Syracuse University and BioTools, Inc., Phase I, \$100,000, 2005-2006.
- Air Force Office of Sponsored Research - Multiple University Research Initiative (AFOSR/MURI Negative Index Materials (NIMS)) "Three-Dimensional Approaches to Assembling Negative Index Metamaterials" \$5,040,000 for five years to the University of Michigan, Syracuse University budget approximately \$500,000 for five years, May 1, 2006 to April 30, 2011. (sub-project PI)
- Small Business Technology Transfer (STTR) Grant "Near-Infrared Surface-Enhanced Raman Optical Activity from Metal Nanoshells" Air Force Office of Scientific Research (AFOSR), BioTools, Inc. and Rice University, Phase II, \$750,000, 2007-2009 (named consultant).
- Small Business Innovation (SBIR) Grant "Vibrational CD Microscopy for Characterizing Supramolecular Bio-Chirality" from the National Science Foundation, Phase I (2010), \$100,000, and Phase II, 2011-2013 (\$500,000)

PUBLICATIONS:

1. "Polarized Laser Raman Studies on Biological Polymers" by B. Fanconi, B. Tomlinson, L.A. Nafie, W. Small and W.L. Peticolas, *J. Chem. Phys.* **51**, 3993-4005 (1969).
2. "Inelastic Light Scattering from Biological and Synthetic Polymers" by W.L. Peticolas, B. Fanconi, B. Tomlinson, L.A. Nafie and W. Small, *Annal. N.Y. Acad. Sci.* **168**, 564-588 (1970).
3. "Quantum Theory of Intensities of Molecular Vibrational Spectra" by W.L. Peticolas, L.A. Nafie, P. Stein and B. Fanconi, *J. Chem. Phys.* **52**, 1576-1584 (1970).
4. "Angular Dependence of Raman Scattering Intensity" by L.A. Nafie, P. Stein, B. Fanconi and W.L. Peticolas, *J. Chem. Phys.* **52**, 1584-1588 (1970).
- 4a. "Reply to Comments by Freund" by L. Nafie, P. Stein, B. Fanconi, and W.L. Peticolas, *The Journal of Chemical Physics*, Vol. **53**, 2990-2991 (1970).
5. "Time Ordered Diagrams for the Resonant Raman Effect from Molecular Vibrations" by L.A. Nafie, P. Stein and W.L. Peticolas, *Chem. Phys. Lett.* **12**, 131-136 (1971).
6. "Reorientation and Vibrational Relaxation as Line Broadening Factors in Vibrational Spectroscopy" by L.A. Nafie and W.L. Peticolas, *J. Chem. Phys.* **57**, 3145-3155 (1972).
7. "Origin of the Intensity of the Resonant Raman Bands of Differing Polarization in Heme-Proteins" by L.A. Nafie, M. Pezolet and W.L. Peticolas, *Chem. Phys. Lett.* **20**, 563-568 (1973).
8. "Complete Polarization Measurements for Non-Symmetric Raman Tensors: Symmetry Assignments of Ferrocyclochrom c Vibrations" by M. Pezolet, L.A. Nafie and W.L. Peticolas, *J. Raman Spectrosc.* **1**, 455-464 (1973).
9. "A 10.6 Micron Modulated Light Ellipsometer" by S.D. Allen, A.I. Braunstein, J.C. Cheng and L.A. Nafie, in *Optical Properties of Highly Transparent Solids*, S.S. Mitra and B. Bendow, Eds., Plenum, New York, 1975, pp. 503-514.
10. "Vibrational Circular Dichroism of 2,2,2-Trifluoro-1-phenylethanol" by L.A. Nafie, J.C. Cheng and P.J. Stephens, *J. Am. Chem. Soc.* **97**, 3842 (1975).
11. "Polarization Scrambling Using a Photoelastic Modulator: Application to Circular Dichroism Measurement" by J.C. Cheng, L.A. Nafie and P.J. Stephens, *J. Opt. Soc. Amer.* **65**, 1031-1035 (1975).
12. "Vibrational Circular Dichroism" by L.A. Nafie, T.A. Keiderling and P.J. Stephens, *J. Am. Chem. Soc.* **98**, 2715-2723 (1976).
13. "Photoelastic Modulator for the 0.55-13 μm Range" by J.C. Cheng, L.A. Nafie, S.D. Allen and A.I. Braunstein, *Appl. Optics* **15**, 1960-1965 (1976).
14. "Observation of the Raman Anti-Resonance Effect in Synthetic Metal (II) Porphyrin Analogues" by L.A. Nafie, R.W. Pastor, J.C. Dabrowiak and W.H. Woodruff in *Proceedings of the Fifth International*

Conference on Raman Spectroscopy, E. Schmid et al., Eds., H. Schulz, Freiburg, 1976, pp. 330-331.

15. "Resonance Raman Studies of Macrocyclic Complexes II. Anti-Resonance and Selective Intensity Enhancement in Synthetic Metal (II) Porphyrin Analogues" by L.A. Nafie, R.W. Pastor, J.C. Dabrowiak and W.H. Woodruff, *J. Am. Chem. Soc.* **98**, 8007-8014 (1976).
16. "Calculation of Excitation Profiles from the Vibronic Theory for Raman Scattering" by B.B. Johnson, L.A. Nafie and W.L. Peticolas, *Chem. Phys.* **19**, 303-311 (1977).
17. "Near-Infrared Magnetic Circular Dichroism of Cytochrome c" by J. Rawlings, P.J. Stephens, L.A. Nafie and M. Kamen, *Biochemistry* **16**, 1725-1729 (1977).
18. "Accessibility of Manganese Oxidation States. Control by Pentaazo Macrocyclic Ligands" by J.C. Dabrowiak, L.A. Nafie, P.S. Bryan and A.T. Torkelson, *Inorg. Chem.* **16**, 540-544 (1977).
19. "Vibrational Circular Dichroism Theory: A Localized Molecular Orbital Model" by L.A. Nafie and T.H. Walnut, *Chem. Phys. Lett.* **49**, 441-446 (1977).
20. "Infrared Absorption and the Born-Oppenheimer Approximation I. Vibrational Intensity Expressions" by T.H. Walnut and L.A. Nafie, *J. Chem. Phys.* **67**, 1491-1500 (1977).
21. "Infrared Absorption and the Born-Oppenheimer Approximation II. Vibrational Circular Dichroism" by T.H. Walnut and L.A. Nafie, *J. Chem. Phys.* **67**, 1501-1510 (1977).
22. "Vibrational Circular Dichroism in Amino Acids and Peptides. 1. Alanine" by M. Diem, P.J. Gotkin, J.M. Kupfer, A.G. Tindall and L.A. Nafie, *J. Am. Chem. Soc.* **99**, 8103-8104 (1977).
23. "Analysis of the Gas Phase Infrared Spectrum of Bromochlorofluoromethane: Calculated and Observed Band Contours and Intensities" by M. Diem, L.A. Nafie and D.F. Burow, *J. Molec. Spectrosc.* **71**, 446-457 (1978).
24. "Vibrational Circular Dichroism in Amino Acids and Peptides. 2. Simple Alanyl Peptides" by M. Diem, P.J. Gotkin, J.M. Kupfer and L.A. Nafie, *J. Am. Chem. Soc.* **100**, 5644-5650 (1978).
25. "Theory of High Frequency Differential Interferometry: Application to Infrared Circular and Linear Dichroism via Fourier Transform Spectroscopy" by L.A. Nafie and M. Diem, *Appl. Spectrosc.* **33**, 130-135 (1979).
26. "Fourier Transform Infrared Vibrational Circular Dichroism" by L.A. Nafie, M. Diem and D.W. Vidrine, *J. Am. Chem. Soc.* **101**, 496-498 (1979).
27. "Optical Activity in Vibrational Transitions: Vibrational Circular Dichroism and Raman Optical Activity" by L.A. Nafie and M. Diem, *Acc. Chem. Res.* **12**, 296-302 (1979).
28. "The Atom Dipole Interaction Model of Raman Optical Activity: Reformulation and Comparison to the Two-Group Model" by P.L. Prasad and L.A. Nafie, *J. Chem. Phys.* **70**, 5582-5588 (1979).
29. "Raman Optical Activity. Spectral Simulation of the Conformer Dependent C-Cl Stretching Vibrations

- in 1-Chloro-2-Methylbutane" by P.L. Prasad, L.A. Nafie and D.F. Burow, *J. Raman Spectrosc.* **8**, 255-258 (1979).
30. "Vibrational Circular Dichroism in Amino Acids and Peptides. 3. Solution and Solid Phase Spectra of Serine and Alanine" by M. Diem, E. Photos, H. Khouri and L.A. Nafie, *J. Am. Chem. Soc.* **101**, 6829-6837 (1979).
 31. "Vibrational Circular Dichroism in Peptides" by L.A. Nafie, P.L. Prasad, H. Khouri and E. Doorly, *Polymer Preprints* **20**(2), 85-89 (1979).
 32. "Differential Absorption at High Modulation Frequencies Using a Fourier Transform Infrared Spectrometer" by L.A. Nafie and D.W. Vidrine, *Proc. Soc. Photo. Inst. Eng.* **191**, 56-63 (1979).
 33. "Vibrational Optical Activity: Comparison of Theoretical and Experimental Results for (+)-(3R)-Methylcyclohexanone" by P.L. Polavarapu and L.A. Nafie, *J. Chem. Phys.* **73**, 1567-1575 (1980).
 34. "Vibrational Optical Activity in Para-Substituted 1-Methylcyclo-hex-1-enes" by P.L. Polavarapu, M. Diem and L.A. Nafie, *J. Am. Chem. Soc.* **102**, 5549-5453 (1980).
 35. "Experimental Observations and Theoretical Predictions of Raman Optical Activity" by P.L. Prasad and L.A. Nafie, in *Proceedings of the VIIIth International Conference on Raman Spectroscopy*, W.F. Murphy, Ed., North-Holland, New York, 1980, pp. 252-253.
 36. "Vibrational Optical Activity in Perturbed Degenerate Modes: Concepts and Model Calculations in 1-Substituted Haloethanes" by L.A. Nafie, P.L. Polavarapu and M. Diem, *J. Chem. Phys.* **73**, 3530-3540 (1980).
 37. "Infrared and Raman Vibrational Optical Activity" by L.A. Nafie in *Vibrational Spectra and Structure*, Vol. 10, J.R. Durig, Ed., Elsevier, Amsterdam, 1981, pp. 153-225.
 38. "Optical Activity Due to Isotopic Substitution. Vibrational Circular Dichroism and the Absolute Configuration of α -Deuterated Cyclohexanones" by P.L. Polavarapu, L.A. Nafie, S.A. Benner and T.H. Morton, *J. Am. Chem. Soc.* **103**, 5349-5354 (1981).
 39. "Localized Molecular Orbital Calculations of Vibrational Circular Dichroism. I. General Theoretical Formalism and CNDO Results for the Carbon Deuterium Stretching Vibration in Neopentyl-1-d-Chloride" by L.A. Nafie and P.L. Polavarapu, *J. Chem. Phys.* **75**, 2935-2944 (1981).
 40. "Localized Molecular Orbital Calculations of Vibrational Circular Dichroism. II. CNDO Formulation and Results for the Hydrogen Stretching Vibrations of (+)-(3R)-Methylcyclohexanone" by P.L. Polavarapu and L.A. Nafie, *J. Chem. Phys.* **75**, 2945-2951 (1981).
 41. "Fourier Transform Infrared Circular Dichroism: A Double Modulation Approach" by L.A. Nafie, E.D. Lipp and C.G. Zimba in *Proceedings of the 1981 International Conference on Fourier Transform Infrared Spectroscopy*, J. Sakal, Ed., SPIE Vol. 289, 1981, pp. 457-468.
 42. "A Unified Approach to the Determination of Infrared and Raman Vibrational Optical Activity

- Intensities Using Localized Molecular Orbitals" by L.A. Nafie and T.B. Freedman, *J. Chem. Phys.* **75**, 4847-4851 (1981).
- 42a. Book Review of Vibrational Spectra and Structure, Vol. 9, J.R. Durig, Ed. Elsevier Publishing Co., *J. Am. Chem. Soc.* **103**, 7699-7700 (1981).
43. "Double Modulation Fourier Transform Spectroscopy" by L.A. Nafie and D.W. Vidrine in *Fourier Transform Infrared Spectroscopy*, J.R. Ferraro and L.J. Basile, Eds., Academic Press, New York, Vol. 3, 1982, pp. 83-123.
- 43a. Book Review of *Fourier Transform Infrared Spectroscopy*, Vol. 1, J.R. Ferraro and L.J. Basile, Eds., Academic Press Inc., *J. Chem. Soc.* **104**, 3329-3336 (1982).
44. "Vibrational Circular Dichroism in Amino Acids and Peptides. 4. Vibrational Analysis, Assignments and Solution Phase Raman Spectra of Deuterated Isotopomers of Alanine" by M. Diem, P.L. Polavarapu, M. Oboodi and L.A. Nafie, *J. Am. Chem. Soc.* **104**, 3329-3336 (1982).
45. "Vibrational Circular Dichroism in Amino Acids and Peptides. 5. Carbon-Hydrogen Stretching VCD and Fixed Partial Charge Calculations for Deuterated Isotopomers of Alanine" by B.B. Lal, M. Diem, P.L. Polavarapu, M. Oboodi, T.B. Freedman and L.A. Nafie, *J. Am. Chem. Soc.* **104**, 3336-3342 (1982).
46. "Vibrational Circular Dichroism in Amino Acids and Peptides. 6. Localized Molecular Orbital Calculations of the Carbon-Hydrogen Stretching VCD in Deuterated Isotopomers of Alanine" by T.B. Freedman, M. Diem, P.L. Polavarapu and L.A. Nafie, *J. Am. Chem. Soc.* **104**, 3343-3349 (1982).
47. "The Emergence and Exploration of Vibrational Optical Activity" by L.A. Nafie, *Appl. Spectrosc.* **36**, 489-495 (1982).
48. "Polarization Demodulation: A New Approach to the Reduction of Polarization Artifacts from Vibrational Circular Dichroism Spectra" by E.D. Lipp, C.G. Zimba, L.A. Nafie and D.W. Vidrine, *Appl. Spectrosc.* **36**, 496-498 (1982).
49. "Molecular Orbital Formulations of Raman Optical Activity" by T.B. Freedman and L.A. Nafie in *Raman Spectroscopy: Linear and Nonlinear*, J. Lascombe and P.V. Huong, Eds., Wiley Heyden, New York, 1982, pp. 13-14.
50. "Spectroscopic Studies of Copper(II) Bound at the Native Copper Site or Substituted at the Native Zinc Site of Bovine Erythrocyte (Superoxide Dismutase) by M.W. Pantoliano, J.S. Valentine and L.A. Nafie, *J. Am. Chem. Soc.* **104**, 6310-6317 (1982).
51. "Vibrational Circular Dichroism in the Mid-Infrared Using Fourier Transform Spectroscopy" by E.D. Lipp, C.G. Zimba and L.A. Nafie, *Chem. Phys. Lett.* **90**, 1-5 (1982).
52. "Vibrational Circular Dichroism in Amino Acids and Peptides. 7. Amide Stretching Vibrations in Polypeptides" by B.B. Lal and L.A. Nafie, *Biopolymers* **21**, 2161-2183 (1982).
53. "Vibrational Optical Activity Calculations Using Infrared and Raman Atomic Polar Tensors" by T.B. Freedman and L.A. Nafie, *J. Chem. Phys.* **78**, 27-31 (1983).

- 53a. "Erratum: Vibrational optical activity calculations using infrared and Raman atomic polar tensors" by Teresa B. Freedman and Laurence A. Nafie, *J. Chem. Phys.* **97**(2), 1104 (1983).
54. "Experimental and Theoretical Advances in Vibrational Optical Activity" by L.A. Nafie in *Advances in Infrared and Raman Spectroscopy*, Vol. 11, R.J.H. Clark and R.E. Hester, Eds., Heyden, London, 1984, pp. 49-93.
55. "Vibronic Coupling Theory of Infrared Vibrational Intensities" by L.A. Nafie and T.B. Freedman, *J. Chem. Phys.* **78**, 7108-7116 (1983).
56. "Raman Spectral Studies of Bleomycin A₂ and Related Structural Fragments. A Probe of Bleomycin-DNA Interactions" by T.B. Freedman, F.S. Santillo, C.G. Zimba, L.A. Nafie and J.C. Dabrowiak, *J. Raman Spectrosc.* **14**, 266-270 (1983).
57. "Adiabatic Behavior Beyond the Born-Oppenheimer Approximation. Complete Adiabatic Wavefunctions and Vibrationally Induced Electronic Current Density" by L.A. Nafie, *J. Chem. Phys.* **79**, 4950-4957 (1983).
58. "Vibrational Circular Dichroism in Amino Acids and Peptides. 8. A Chirality Rule for the Methine C*H Stretching Mode" by L.A. Nafie, M.R. Oboodi and T.B. Freedman, *J. Am. Chem. Soc.* **105**, 7449-7450 (1983).
59. "An Alternative View on the Sign Convention of Raman Optical Activity" *Chem. Phys. Lett.* **102**, 287-288 (1983).
60. "Fourier Transform Vibrational Circular Dichroism: Improvements in Methodology and Mid-Infrared Spectral Results" by E.D. Lipp and L.A. Nafie, *Appl. Spectrosc.* **38**, 20-25 (1984).
61. "Molecular Orbital Approaches to the Calculation of Vibrational Circular Dichroism" by T.B. Freedman and L.A. Nafie, *J. Phys. Chem.* **88**, 496-500 (1984).
62. "Raman Optical Activity in the Skeletal Motions of (+)-(3R)-Methylcyclohexanone. Chiral Mixing of Inherently Achiral Vibrations" by T.B. Freedman, J. Kallmerten, C.G. Zimba, W.M. Zuk and L.A. Nafie, *J. Am. Chem. Soc.* **106**, 1244-1252 (1984).
63. "Application of Fourier Self-Deconvolution to Vibrational Circular Dichroism Spectra" by E.D. Lipp and L.A. Nafie, *Appl. Spectrosc.* **38**, 774-778 (1984).
64. "Fourier Transform Vibrational Circular Dichroism in the Carbonyl Region of Peptides and Polypeptides" by L.A. Nafie, E.D. Lipp, A. Farrel and G. Paterlini, *Polymer Preprints* **25**,(2), 145-146 (1984).
65. "Vibrational Circular Dichroism in Amino Acids and Peptides. 9. Carbon-Hydrogen Stretching Spectra of the Amino Acids and Selected Transition Metal Complexes" by M.R. Oboodi, B.B. Lal, D.A. Young, T.B. Freedman and L.A. Nafie, *J. Am. Chem. Soc.* **107**, 1547-1556 (1985).
66. "Vibrational Circular Dichroism in Amino Acids and Peptides. 10. Fourier Transform VCD and Fourier

- Self-Deconvolution of the Amide I Region of Poly(γ -Benzyl-L-Glutamate)" by E.D. Lipp and L.A. Nafie, *Biopolymers* **24**, 799-812 (1985).
67. "Vibrational Circular Dichroism in Bis(acetylacetonato) (L-alaninato)cobalt(III). Isolated Occurrences of the Coupled Oscillator and Ring Current Intensity Mechanisms" by D.A. Young, E.D. Lipp and L.A. Nafie, *J. Am. Chem. Soc.* **107**, 6205-6213 (1985).
68. "Enhanced Vibrational Circular Dichroism via Vibrationally Generated Electronic Ring Currents" by T.B. Freedman, G.A. Balukjian and L.A. Nafie, *J. Am. Chem. Soc.* **107**, 6213-6222 (1985).
69. "Vibrational Circular Dichroism Spectroscopy and the Ring Current Intensity Mechanism" by L.A. Nafie and T.B. Freedman in *Proceedings of the International Conference on Circular Dichroism*, Bulgarian Academy of Sciences, Sofia, 1985, pp. 218-232.
70. "Fourier Transform Vibrational Circular Dichroism of Carbonyl Stretching Modes in N-Urethanyl- α -Amino Acids" by A.C. Chernovitz, T.B. Freedman and L.A. Nafie in *1985 Conference on Fourier and Computerized Infrared Spectroscopy*, J. Grasselli et al. eds. Proc. SPIE Vol., pp. 222-223 (1985).
71. "Fourier Transform Vibrational Circular Dichroism in the Amide I Band of Polypeptides" by M.G. Paterlini, T.B. Freedman and L.A. Nafie, in *1985 Conference on Fourier and Computerized Infrared Spectroscopy*, J. Grasselli et al. eds. Proc. SPIE Vol., pp. 274-275 (1985).
72. "The VCD Spectrum of 2-Methyl Oxetan" by R.A. Shaw, N. Ibrahim, L.A. Nafie, A. Rank and H. Wieser in *1985 Conference on Fourier and Computerized Infrared Spectroscopy*, J. Grasselli et al. eds. Proc. SPIE Vol., pp. 433-434 (1985).
73. "Ring Current Mechanism of Vibrational Circular Dichroism" by L.A. Nafie and T.B. Freedman, *J. Phys. Chem.* **90**, 763-767 (1986).
74. "Ring Current Enhanced Vibrational Circular Dichroism in the CH-Stretching Motion of the Sugars" by M.G. Paterlini, T.B. Freedman and L.A. Nafie, *J. Am. Chem. Soc.* **108**, 1389-1397 (1986).
75. "Molecular Orbital Calculations of Infrared Intensities Beyond the Born-Oppenheimer Approximation Using the Dipole Momentum Operator" by T.B. Freedman and L.A. Nafie, *Chem. Phys. Lett.* **126**, 441-446 (1986).
76. "Biologically Relevant Applications of Vibrational Circular Dichroism" by L.A. Nafie in *Spectroscopy in the Biomedical Sciences*, R.N. Gendreau, Ed., CRC Press, Boca Raton, Florida, 1986, pp. 141-150.
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