

# Malcolm D. E. Forbes - Curriculum Vitae

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## Education

Ph.D., Chemistry, The University of Chicago, June, 1988

M.S., Chemistry, The University of Chicago, March, 1986

B.S., Chemistry, University of Illinois at Chicago, August, 1983

## Professional History

Professor of Chemistry	University of North Carolina at Chapel Hill	July 1999-present
Associate Professor	University of North Carolina at Chapel Hill	July 1995 to July 1999
Assistant Professor	University of North Carolina at Chapel Hill	July 1990 to June 1995
NSF Postdoctoral Research Fellow	Division of Chemistry and Chemical Engineering California Institute of Technology	October 1988 to June 1990
Research Assistant	Department of Chemistry The University of Chicago	June 1984 to June 1988

## Recent Honors and Awards

Japan Society for the Promotion of Science Foreign Fellowship Award, 1998-1999  
National Science Foundation Young Investigator Award, 1993-1998  
Dupont Junior Faculty Development Award, 1994  
John Charles Morrow Junior Faculty Development Award, 1994  
IBM Junior Faculty Development Award, 1991  
National Science Foundation Postdoctoral Fellow, 1988-1990  
Bernard Smaller Prize for Research in Magnetic Resonance, The University of Chicago, 1988

## Professional Affiliations

American Chemical Society  
Inter-American Photochemical Society  
American Association for the Advancement of Science  
International Electron Paramagnetic Resonance Society

## Alpha Chi Sigma Chemistry Fraternity

### **Recent Chemistry Courses Taught**

Seminar in Organic Chemistry: Fall 1999

Introductory Organic Chemistry I (Chemistry 61): Spring 1998, Spring 1999, Fall 1999

Introductory Organic Chemistry II (Chemistry 62): Spring 1997

Honors Organic Chemistry I (Chemistry 65H): Fall 1995, Fall 1997

Organic Reaction Mechanisms (Chemistry 175): Fall 1996

Organic Spectroscopy (Chemistry 167): Spring 1995, Spring 1996, Spring 2000

### **Recent Departmental Service**

Publicity Director, Chemistry Department, 1995-present

Editor, Chemistry Department Newsletter, 1995-present

Rice Lecturer Selection Committee, 1995-present

### **Recent University Service**

Chemical Representative for Undergraduate Admissions Committee, 1998-present

2<sup>nd</sup> UNC Representative/Contact for the Council for Chemical Research, 1995-present

Carolina Renaissance Days Speaker, 1997-present

Freshman Camp Advisor, 1997-present

Project Uplift Participant, 1993-present

Carolina Close-Up Speaker, 1995-present

Morehead Scholars Luncheon Host, 1996-present

Faculty Advisor, Alpha Kappa Delta Phi Sorority, 1995-present

Faculty Advisor, ACS Student Affiliates, 1996-present

Faculty Co-Advisor, Alpha Chi Sigma Chemistry Fraternity, 1996-present

University Liaison to Dupont and the Rohm and Haas Company, 1995-1996

Advisory Board, UNC Mathematics and Science Education Network, 1995-present

UNC Representative at Exhibition at the U.S. Capitol for the Coalition for National Science Funding, April 1997

### **Recent Regional and National Service**

Editorial Advisory Board, Accounts of Chemical Research, 1997-2000

NRC Advisory Board on COBASE Program for U.S.-Russian Science Collaboration, 1998-2000

NSF Consortium for High Field Time-Resolved EPR, 1996-present

Secretary, Inter-American Photochemical Society, 1994-1996

Alternate Councilor, North Carolina Local Section of the American Chemical Society, 1993-present

Referee of proposals for: NSF, NIH, COBASE, International Science Foundation, Third World Science Foundation

Referee of manuscripts for the following scientific journals: Journal of the American Chemical Society, Journal of Physical Chemistry, Accounts of Chemical Research, Chemical Reviews, Macromolecules, Analytical Chemistry, Environmental Chemistry, Journal of Chemical Physics, Chemical Physics Letters, Journal of Magnetic Resonance.

# Publications and Lectures

## Publications

1. "Spin-Polarized Electron Paramagnetic Resonance Spectra of Radical Pairs in Micelles. Observation of Electron Spin-Spin Interactions," Gerhard L. Closs, Malcolm D.E. Forbes and J.R. Norris, Jr., *J. Phys. Chem.* *91*, 3592-99, (1987).
2. "Observation of Medium Chain Length Polymethylene Biradicals in Liquid Solutions by Time Resolved EPR Spectroscopy," Gerhard L. Closs and Malcolm D.E. Forbes, *J. Am. Chem. Soc.* *109*, 6185-87, (1987).
3. "EPR Study of Polymethylene Biradicals," Gerhard L. Closs and Malcolm D. E. Forbes, in *Kinetics and Spectroscopy of Carbenes and Biradicals*, M. Platz, ed., Plenum (New York), 1990, pp. 51-75.
4. "Real Time Measurements of Interfacial Charge Transfer Rates at Silicon/Liquid Junctions", Malcolm D.E. Forbes and Nathan S. Lewis, *J. Amer. Chem. Soc.* *112*, 3682-83, (1990).
5. "EPR Spectroscopy of Electron Spin Polarized Biradicals in Liquid Solutions. Technique, Spectral Simulation, Scope and Limitations," Gerhard L. Closs and Malcolm D. E. Forbes, *J. Phys. Chem.* *95*, 1924-33, (1991).
6. "Spin and Reaction Dynamics in Flexible Polymethylene Biradicals as Studied by EPR, NMR, Optical Spectroscopy and Magnetic Field Effects. Measurements and Mechanisms of Scalar Electron Spin-Spin Coupling," Gerhard L. Closs, Malcolm D.E. Forbes and Piotr Piotrowiak, *J. Am. Chem. Soc.* *114*, 3285-94, (1992).
7. "Simple Modification of Varian E-Line Microwave Bridges for Fast Time-Resolved EPR Spectroscopy," Malcolm D.E. Forbes, John Peterson, and Christopher S. Breivogel, *Rev. Sci. Instrum.* *66*, 2662-65, (1991).
8. "Time Resolved Electron Paramagnetic Resonance Spectroscopy of Organic Free Radicals Anchored to SiO<sub>2</sub> Surfaces," Malcolm D.E. Forbes, Katerina E. Dukes, Tanya L. Myers, Heather D. Maynard, Christopher S. Breivogel, and Heather B. Jaspán, *J. Phys. Chem.* *95*, 10547-49, (1991).
9. "Biradicals and Spin-Correlated Radical Pairs Anchored to SiO<sub>2</sub> Surfaces: Probing Diffusion at the Solid/Solution Interface," Malcolm D.E. Forbes, Tanya L. Myers, Katerina E. Dukes, and Heather D. Maynard, *J. Am. Chem. Soc.* *114*, 353-54, (1992).
10. "Time Resolved Electron Paramagnetic Resonance Spectroscopy in the Q-Band Microwave Region," Malcolm D.E. Forbes, *J. Phys. Chem.* *96*, 7836-39, (1992).
11. "Solvent-Free Cyclization of Linear Dienes Using Olefin Metathesis and the Thorpe-Ingold Effect", Malcolm D.E. Forbes, Jasson T. Patton, Tanya L. Myers, Heather D. Maynard, Dennis W. Smith, Gregory R. Schulz, and Kenneth B. Wagener, *J. Am. Chem. Soc.* *114*, 10978-80, (1992).
12. "The Solution EPR Spectra of Reactive 1,5- and 1,6- Biradicals," Malcolm D.E. Forbes, *J. Am. Chem. Soc.* *115*, 1613-15, (1993).
13. "The Temperature Dependence of the Exchange Coupling in Polymethylene Biradicals. Conclusions

Regarding the Mechanism of the Coupling," Malcolm D.E. Forbes, Gerhard L. Closs, Paloma Calle, and Pennathur Gautam, *J. Phys. Chem.* 97, 3384-89, (1993).

14. "The Effect of Localized Unsaturation on the Scalar Exchange Coupling in Flexible Biradicals," Malcolm D.E. Forbes, *J. Phys. Chem.* 97, 3390-95, (1993).

15. "The Effect of System Spacers on Exchange Couplings and End to End Encounter Rates in Flexible Biradicals," Malcolm D.E. Forbes, *J. Phys. Chem.* 97, 3396-3400, (1993).

16. "A Fast 35 GHz Time Resolved EPR Apparatus," Malcolm D.E. Forbes, *Rev. Sci. Instrum.* 64, 397-402, (1993).

17. "Quantitative EPR Measurement of Long Distance Electronic Interactions in Two Geometric Isomers of an Unsaturated Biradical," Malcolm D.E. Forbes and Kanku Bhagat, *J. Am. Chem. Soc.* 115, 3382-83, (1993).

18. "Macrocyclic Syntheses: Cyclic Ketones, Keto-alkenes, Diketones and Dienes of Ring Size C<sub>21</sub> to C<sub>26</sub>," Malcolm D.E. Forbes and Yi Dang, *Org. Prep. Proc. Intl.* 25, 309-314, (1993).

19. "Acyclic Diene Metathesis (ADMET) Polymerization: The Synthesis of Unsaturated Polyketones," Kenneth B. Wagener, Jasson T. Patton, Malcolm D.E. Forbes, Tanya L. Myers, and Heather D. Maynard, *Polym. Intl.* 32, 411-415, (1993).

20. "CIDEP Studies of Carotenoid Radical Cations," Anthony S. Jeevarajan, Mohammed Khaled, Malcolm D.E. Forbes, and Lowell D. Kispert, *Zeitschr. Phys. Chem.* 182, 51-61, (1993).

21. "Time Resolved Electron Paramagnetic Resonance Spectroscopy in the Q-Band Microwave Region. 2. Magnetic Field Effects on CIDEP in Radicals, Biradicals, and Spin-Correlated Radical Pairs," Malcolm D.E. Forbes, *Zeitschr. Phys. Chem.* 182, 63-76 (1993).

22. "Time-Resolved EPR Spectroscopy of Short Biradicals (1,3- to 1,8-) in Solution. The Inter-Connecting Roles of the External Magnetic Field, the Dipolar Coupling, the Exchange Interaction and Molecular Motion in the Spin Polarization and Relaxation Mechanisms," Malcolm D.E. Forbes and Shiyamalie R. Ruberu, *J. Phys. Chem.* 97, 13223-13233, (1993).

23. "Photodegradation of Alternating p-tButylstyrenyl and exo-Norbornyl-CO Copolymers Studied by Multiple Frequency Time-Resolved EPR Spectroscopy," Malcolm D.E. Forbes, James C. Barborak, Katerina E. Dukes, and Shiyamalie R. Ruberu, *Macromolecules* 27, 1020-1026, (1994).

24. "Dynamics of Spin-Polarized Radical Pairs at the Solid/Solution Interface", Malcolm D.E. Forbes, Shiyamalie R. Ruberu and Katerina E. Dukes, *J. Am. Chem. Soc.* 116, 7299-7307, (1994).

25. "Low Temperature Disappearance of Spin Correlation in Flexible 1,n-Biradicals (N = 22, 24, 26)", Malcolm D. E. Forbes and Gregory R. Schulz, *J. Am. Chem. Soc.* 116, 10174-77, (1994).

26. "Dynamic Effects in Spin-Correlated Radical Pair Theory: J Modulation and a New Look at the Phenomenon of Alternating Line Widths in the EPR Spectra of Flexible Biradicals", Nikolai I. Avdievich and Malcolm D. E. Forbes, *J. Phys. Chem.* 99, 9660-67, (1995).

27. "Site-Selective Photochemistry in an Alternating 2-Norbornyl-CO Copolymer: Importance of Stereoelectronic Effects", Malcolm D. E. Forbes, Shiyamalie R. Ruberu, Dana Nachtigallova, Kenneth D. Jordan, and James C. Barborak, *J. Am. Chem. Soc.* **117**, 3946-51, (1995).
28. "Time-Resolved Electron Paramagnetic Resonance Spectroscopy as a Structural and Mechanistic Tool in Organic Chemistry", Malcolm D. E. Forbes, *The Spectrum*, **8**, 1, 3-8, (1995).
29. "Role of Excited Singlet State in the Photooxidation of Carotenoids: A Time-Resolved Q-Band EPR Study", Antony S. Jeevarajan, Lowell D. Kispert, Nikolai I. Avdievich, and Malcolm D. E. Forbes, *J. Phys. Chem.*, **100**, 669-671, (1996).
30. "Strong Modulation of the Exchange Interaction in a Spin-Polarized, Aryl Ether-Linked 1,14-Biradical", Nikolai I. Avdievich and Malcolm D. E. Forbes, *J. Phys. Chem.*, **100**, 1993-1995, (1996).
31. "Photoionization of N,N,N',N'-Tetramethylphenylenediamine Studied by Q-Band Time-Resolved EPR Spectroscopy. Separation of Singlet and Triplet Ionization Channels", Nikolai I. Avdievich, Antony S. Jeevarajan, and Malcolm D. E. Forbes, *J. Phys. Chem.*, **100**, 5334-5342, (1996).
32. "Useful Model Systems for the Study of SRN1 Chemistry in the Synthesis of Poly(arylene ether ketone)s", Katerina E. Dukes, Malcolm D. E. Forbes, Antony S. Jeevarajan, Anna M. Belu, Joseph M. DeSimone, Richard W. Linton, and Valerie V. Sheares, *Macromolecules*, **29**, 3081-3089, (1996).
33. "In Search of Through-Solvent Electronic Coupling in Flexible Biradicals", Malcolm D. E. Forbes, Jonathan D. Ball, and Nikolai I. Avdievich, *J. Am. Chem. Soc.*, **118**, 4707-4708, (1996).
34. "Unusual Dynamics of Micellized Radical Pairs Generated from Photochemically Active Amphiphiles", Malcolm D. E. Forbes, Gregory R. Schulz, and Nikolai I. Avdievich, *J. Am. Chem. Soc.*, **118**, 10652-10653, (1996).
35. "Micelles Formed from Photochemically Active Amphiphiles: Structural Characterization by Small-Angle Neutron Scattering," Gregory R. Schulz, Delia Chillura Martino, Roberto Triolo, and Malcolm D. E. Forbes, *J. Mol. Struct.*, **383**, 191-196, (1996).
36. "Chain Dynamics Cause the Disappearance of Spin-Correlated Radical Pair Polarization in Flexible Biradicals", Malcolm D. E. Forbes, Nikolai I. Avdievich, Gregory R. Schulz, and Jonathan D. Ball, *J. Phys. Chem.*, **100**, 13887-13891, (1996).
37. "Time-Resolved (CW) Electron Paramagnetic Resonance Spectroscopy. An Overview of the Technique and its Use in Organic Photochemistry", Malcolm D. E. Forbes, *Photochem. Photobiol.*, **65**, 73-81 (1997).
38. "Time-Resolved EPR Study of a 1,9- Flexible Biradical Dissolved in Liquid Carbon Dioxide. Observation of a New Spin Relaxation Phenomenon: Alternating Intensities in Spin-Correlated Radical Pair Spectra", Nikolai I. Avdievich, Katerina E. Dukes, Malcolm D. E. Forbes and Joseph M. DeSimone, *J. Phys. Chem. A*, **101**, 617-621, (1997).
39. "Flow System and 9.5 GHz Microwave Resonators for Time-Resolved and Steady-State Electron Paramagnetic Resonance Spectroscopy in Compressed and Supercritical Fluids", Katerina E. Dukes, Elizabeth J. Harbron, Malcolm D. E. Forbes, and Joseph M. DeSimone, *Rev. Sci. Instruments*, **68**, 2505-2510, (1997).

40. "Study of Consecutive Biradicals from 2-Hydroxy-2,12-dimethylcyclododecanone by TR-CIDNP, TREPR, and Laser Flash Photolysis", Olga B. Morozova, Alexandra V. Yurkovskaya, Yuri P. Tsentalovich, Renad Z. Sagdeev, Tina Wu, and Malcolm D. E. Forbes, *J. Phys. Chem. A*, *101*, 8803-8808 (1997).
41. "Influence of Molecular Structure on the Rate of Intersystem Crossing in Flexible Biradicals", Yuri P. Tsentalovich, Olga B. Morozova, Nikolai I. Avdievich, Gennady S. Ananchenko, Alexandra V. Yurkovskaya, Jonathan D. Ball, and Malcolm D. E. Forbes, *J. Phys. Chem. A*, *101*, 8809-8816 (1997).
42. "Gateway Reactions to Diverse, Poly-functional Monolayer-Protected Gold Clusters", Allen C. Templeton, Michael J. Hostetler, Emily K. Warmoth, Shaowei Chen, Chris M. Hartshorn, Vijay M. Krishnamurthy, Malcolm D.E. Forbes, and Royce W. Murray, *J. Am. Chem. Soc.*, *120*, 4845-4849, (1998).
43. "Time-Resolved EPR Studies in Organic Photochemistry", Christine M. R. Clancy, Valery F. Tarasov, and Malcolm D. E. Forbes, *Specialist Reports of the Royal Society of Chemistry, EPR Series*, *16*, 50-78, (1998).
44. "Chemically-Induced Nuclear and Electron Polarization (CIDNP and CIDEP)", Elizabeth J. Harbron and Malcolm D. E. Forbes, *Encyclopedia of Chemical Physics and Physical Chemistry*, Chapter B1.17, Institute of Physics Publishing, in press, (62 manuscript pages).
45. "Time-Resolved Electron Paramagnetic Resonance Study of Photoionization of Tyrosine Anion in Aqueous Solution", Christine M. R. Clancy and Malcolm D. E. Forbes, *Photochem. Photobiol.*, *69*, 16-21, (1999).
46. "Theoretical and Experimental Stimulated Nuclear Polarization Investigation of Consecutive Biradicals", N.V. Lebedeva, E.G. Bagryanskaya, I.V. Koptuyug, R.Z. Sagdeeva, M.D.E. Forbes, *Chem. Phys. Letters*, *308*, 295-302 (1999).
47. "Time-Resolved Electron Spin Resonance of Spin Correlated Micelle Confined Radical Pairs: Shape of the Anti-phase Structure", Christine M.R. Clancy and Malcolm D.E. Forbes, *Spectrochimica Acta Part A*, *56*, 245-263 (2000).
48. "Energy Transfer Studied Using Spin Polarized Free Radicals. Effect of Substrate Structure and a Comparison Between Micellar Confinement and Free Solution", Vanessa P. McCaffrey and Malcolm D.E. Forbes, *Tetrahedron*, (2000).
49. "Stereochemistry and Pseudo-Symmetries in Main Chain Polymeric Free Radicals", Elizabeth J. Harbron, Vanessa P. McCaffrey, Ruixin Xu and Malcolm D. E. Forbes, *J. Am. Chem. Soc.*, submitted.
50. "Mechanism for Formation of the Lightstruck Flavor in Beer Revealed by Time-Resolved Electron Paramagnetic Resonance", Colin S. Burns, Arne Heyerick, Denis De Keukeleire, and Malcolm D. E. Forbes, *J. Am. Chem. Soc.*, submitted
51. "Transient Peptide Biradicals Produced by Photoinduced Electron Transfer. Evidence for Very Large Exchange Interactions", Colin S. Burns and Malcolm D. E. Forbes, *J. Am. Chem. Soc.*, submitted.
52. "Time-Resolved Electron Paramagnetic Resonance of "Lazy" Radical Pairs", Valery F. Tarasov, Nikolai I. Avdievich, and Malcolm D. E. Forbes, *J. Phys. Chem A*, submitted.

53. "Temperature Effects in TREPR Spectra of Micelle-Confined Spin Correlated Radical Pairs", Valery F. Tarasov, Nikolai I. Avdievich, and Malcolm D. E. Forbes, *J. Phys. Chem A*, submitted.

### Recent and Upcoming Lectures

1. "Connections Between Different Kinds of Electron Donor-Acceptor Interactions", University of Notre Dame, March 19, 1998.
2. "Spin and Reaction Dynamics of Correlated Radical Pairs. Comparison of Flexible Alkane Chain Biradicals and Micelle-Bound Radicals", Symposium on Molecular and Supramolecular Photochemistry, 216th National ACS Meeting, Boston, MA, August 25, 1998.
3. "Games You Can Play With Free Radicals", Randolph-Macon College, November 4, 1998.
4. "Spin, Reaction and Molecular Dynamics of Correlated Radical Pairs and Biradicals", Michigan State University, February 18, 1999.
5. "Photodegradation of Acrylates: A Time-Resolved EPR Study", Symposium on Free Radicals in Condensed Phases, 217th National ACS Meeting, Anaheim, CA, March, 1999.
6. "Photodegradation of Acrylates: A Time-Resolved EPR Study", Tohoku University, Sendai, Japan, May 1999.
7. "Spin and Reaction Dynamics of Correlated Radical Pairs", University of Florence, Florence, Italy, June 1999.
8. "Photochemistry and Free Radicals from Paint and Beer", Radicals in the Rockies, Telluide, CO, July 1999.
9. "Spin and Reaction Dynamics of Correlated Radical Pairs", 6th International Symposium on Spin and Magnetic Field Effects in Chemistry and Related Phenomena", Emetten, Switzerland, August 1999.
10. "Photodegradation of Acrylates: A Time-Resolved EPR Study", International Photochemistry Conference, Duke University, August 1999.
11. "Spin and Reaction Dynamics of Correlated Radical Pairs", 6th Latin American Encounter of Photochemistry and Photobiology (ELAFOT-6), Teresopolis, Rio de Janeiro, Brazil, September 1999.
12. "Spin and Reaction Dynamics of Correlated Radical Pairs", 6th Annual Sendai EPR Symposium, Sendai, Japan, November 1999.
13. "Photochemistry and Free Radicals from Paint and Beer", Purdue University, April 2000.