

# Biography

## Christopher W. Macosko

Professor of Chemical Engineering and Materials Science  
University of Minnesota

### Education:

1966	B.S.	(Ch.E.)	Carnegie-Mellon University
1967	M.Sc.	(Ch.E.)	Imperial College, London
1970	Ph.D.	(Ch.E.)	Princeton University

### Professional Experience:

1968-1970	Plastics Processing Group, Western Electric Engineering Research Center, Princeton, New Jersey
1970-74	Assistant Professor, University of Minnesota
1971	(Summer) Abrasives Laboratory, 3M Company, St. Paul, Minnesota
1974-79	Associate Professor, University of Minnesota
1978-79	Visiting Professor of Chemical Engineering, Princeton University
1979-present	Professor, University of Minnesota
1983	Visiting Professor of Macromolecular Science, Case Western Reserve University
1985-86	Visiting Professor and CNRS Fellow, Universite Louis Pasteur, Strasbourg, France
1990	Visiting Scientist, BASF, Polymer Physics Lab
1992-93	Visiting Professor and NSF Fellow, Tokyo Institute of Technology
1997	Visiting Professor and NATO Fellow, Freiburg University
1999-present	Director of I PRIME (Industrial Partnership for Research in Interfacial and Materials Engineering)
2000	Visiting Professor of Chemical Engineering, University of California, Berkeley
2001	Visiting Professor of Chemical Engineering, Katholieke Universiteit Lueven, Belgium

### Professional Affiliations:

American Chemical Society—Polymer Division, Polymeric Materials Division; American Institute of Chemical Engineers; American Physical Society—High Polymer Division; British Rheology Society; Polymer Processing Society; Society of Plastics Engineers; Society of Rheology; Co-developer—Rheometrics Mechanical Spectrometer; Consultant—TA Instruments, Inc. (1970-present), 3M Company, Du Pont, and Dow Chemical

### Professional Service:

Editorial Board: *Polymer*, *Polymer Engineering and Science*  
University Senate: Member—1986-89, 2001-present; Student Affairs Committee—1991-1993, 1998-1999  
AIChE Materials Engineering and Science Division: Board Member—1986-1995; Chairman—1994  
University of Minnesota Christian Faculty-Staff Network: Organizing Committee—1985-present.  
Maclaurin Institute: Board Chairman—1995-2000  
Society of Rheology: Annual Meeting, Chair of Local Arrangements—2002

### Awards:

*Best Paper Award*, Thermoset Division, Society of Plastics Engineers, Annual Technical Conference—1972—1981.  
*Minnesota Young Engineer of 1977*, Society of Professional Engineers, State of Minnesota.  
*International Research Award*, Society of Plastics Engineers—1986.  
*Best Research Paper*, Society of Plastics Industry, Composites Conference, Cincinnati—1987.  
*Charles M.A. Stine Award* in Materials Engineering and Sciences, AIChE—1988.  
*Best Paper*, Society of the Plastics Industry, Inc, Polyurethanes Conference—1994.  
*Silver Medal* for published work, The Institute of Materials, London—1995.  
*Plenary Lecture*, Society of Plastics Engineers—1995.  
*E. B. Nilson Award* for Christian Leadership at Secular Universities—1995.  
*Turner Alfrey Visiting Professor*, Michigan Macromolecular Institute—1995.  
*Fellow* of the Society of Plastics Engineers—1997.  
*Pall Award* for Applied Polymer Research—1997.  
*Best Fundamental Paper*, Society of Plastics Industry Polyurethanes (Annual Technical Conference)—1998.  
*International Award*, Society of Plastics Engineers—1999.  
*John Templeton Foundation Award*, Science and Religion Course Program—2000  
*Best Paper*, Society of Plastics Engineers (Thermoplastic Foams Division)—2000, 2002  
*National Academy of Engineering*—2001

**Teaching:**

rheology, polymer chemistry, polymer properties, polymer processing, polymerization reactor engineering, chemical engineering unit operations, fluid mechanics, mass and energy balances, process design

**Publications:**

340 journal papers, four patents, two books.

**C.W. Macosko Publications**

8/25/2003

**Books and Book Chapters**

1. Reaction injection molding, J.M. Castro and C.W. Macosko, in *Encyclopedia of Materials Science and Engineering*, M.B. Bever, ed., Pergamon Press, Oxford, p. 4085 (1986).
2. *RIM, Fundamentals of Reaction Injection Molding*, Hanser, New York (1989).
3. *Rheology: Principles, Measurements and Applications*, Wiley/VCH, Poughkeepsie, NY (1994).
4. Polyurethane flexible foam formation, L. Artavia and C.W. Macosko. Chapter 2 in *Low Density Cellular Plastics, Physical Basis of Behavior*, N.C. Hilyard and A. Cunningham, eds., Chapman and Hall, London (1994).
5. Fluid Mechanics Measurements in Non-Newtonian Fluids, C. W. Macosko. Chapter 9 in *Fluid Mechanics Measurements*, Second Edition, R.J. Goldstein, ed., Hemisphere, New York (1996).
6. Block copolymers and compatibilization: reactively formed, C.W. Macosko, H.K. Jeon, and J.S. Schulze. *Encyclopedia of Materials: Science and Technology*, Elsevier (2001), 683-688.  
<http://www.elsevier.com/inca/publications/store/6/2/0/6/8/1/index.htm>

**Patents (also listed with articles):**

7. Force measuring apparatus, J.M. Starita and C.W. Macosko U.S. Patent 3,693,425 (1972).
8. Reaction injection molding machine C.W. Macosko and L.J. Lee U.S. Patent 4,189,070 (1980).
9. RIM mixhead with high pressure recycle C.W. Macosko and D.B. McIntyre U.S. Patent No. 4,473,531 (1984).
10. Process of and apparatus for extruding a reactive polymer mixture C.W. Macosko, T.G. Charbonneaux, and K.J. Mikkelsen, U.S. Patent No. 4,990,293 (1991).
11. Electrochemical process for the production of conducting polymer fibers (S. Li, C.W. Macosko H.S. White, U.S. Patent 5,423,956 (1995).

**Articles and Preprints**

12. Latex particle size analysis. I. Flow ultramicroscopy, J.A. Davidson, C.W. Macosko and E.A. Collins, *J. Coll. Interface Sci.* **1967**, *25*, 381-388.
13. Kinetic constants from molecular weight distributions, C.W. Macosko and K.E. Weale, *Polym. Prepr.* **1969**, *10*, 562-568.
14. New rheometer is put to the test, C.W. Macosko and J.M. Starita, *Soc. Plast. Eng. Tech. Pap. (ANTEC)* **1971**, *17*, 595; and *Soc. Plast. Eng. Journ.* **1971**, *27*, 38-42.
15. Tensile yield energy in glassy polymers, C.W. Macosko and G.J. Brand, *Soc. Plast. Eng. Tech. Pap. (ANTEC)* **1972**, *18*, 424; and *Polym. Eng. Sci.* **1972**, *12*, 444-449.
16. Force measuring apparatus, J.M. Starita and C.W. Macosko, U.S. Patent 3,693,425, **1972**.
17. Rheology of network forming systems, C.W. Macosko and F.G. Mussatti, *Soc. Plast. Eng. Tech. Pap. (ANTEC)* **1972**, *18*, 73; *Polym. Eng. Sci.* **1973**, *13*, 236-240; *Rheol. Acta* **1973**, *12*, 189.
18. Applications of rheology to rubber crosslinking, C.W. Macosko and F.G. Mussatti, *Polym. Prepr.* **1973**, *14*, 103-108.
19. Flow caused by an air-lubricated edge moving over viscoelastic liquid, R.L. Cerro, C.W. Macosko and L.E. Scriven, *Nature: Phys. Sci.* **1973**, *241*, 146-147.
20. The rheology of two-blow molding polyethylenes, C.W. Macosko and J.M. Lorntson, *Soc. Plast. Eng. Tech. Pap. (ANTEC)* **1973**, *19*, 461-467.
21. Analysis of the normal stress extruder, P.A. Good, A.J. Schwartz and C.W. Macosko, *AIChE J.* **1974**, *20*, 67-74.
22. Mechanical equilibrium for eccentric rotating disks, W.M. Davis and C.W. Macosko, *AIChE J.* **1974**, *20*, 600-602.

23. Dynamic mechanical measurements with the eccentric rotating disks flow, C.W. Macosko and W.M. Davis, *Rheol. Acta* **1974**, *13*, 814-829.
24. Application of the rheometrics mechanical spectrometer to rubber testing, C.W. Macosko and F.C. Weissert, in *Rubber and Related Products: New Methods for Testing and Analyzing*, ASTM STP 553, American Society for Testing Materials, Philadelphia, **1974**, 127-141.
25. Viscous dissipation in die flows, H.W. Cox and C.W. Macosko, *AIChE J.* **1974**, *20*, 785-795.
26. The effect of shear heating on capillary flow, H.W. Cox and C.W. Macosko, *Soc. Plast. Eng. Tech. Pap. (ANTEC)* **1974**, *20*, 27-32.
27. Time-dependent response in the flow between eccentric rotating disks, S.J. Willey, W.M. Davis, C.W. Macosko and C. Goldstein, *Trans. Soc. Rheol.* **1974**, *18*, 515-526.
28. Kinetic and viscosity relations for urethane network polymerizations, S.D. Lipshitz, F.G. Mussatti and C.W. Macosko, *Soc. Plast. Eng. Tech. Pap. (ANTEC)* **1975**, *21*, 239-241.
29. Comparison of cone and plate, bicone and parallel plates geometries for melt rheological measurements, E. Broyer and C.W. Macosko, *Soc. Plast. Eng. Tech. Pap. (ANTEC)* **1975**, *21*, 343-345.
30. Characterization of polymer melts, rubber and thermosets by mechanical spectroscopy, C.W. Macosko and J.M. Starita, *Coatings and Plastic Preprints* **1975**, *35*, 377-381.
31. The effect of network structure in the equation of rubber elasticity, E.M. Valles and C.W. Macosko, *Rubber Chem. & Tech.* **1976**, *49*, 1232-1237; portions in *ACS Organic Coatings and Plastics Preprints* **1975**, *35*, No. 2, 44.
32. A new derivation of average molecular weights of nonlinear polymers, C.W. Macosko and D.R. Miller, *Macromolecules* **1976**, *9*, 199-206; portions in *ACS Organic Coatings and Plastic Preprints* **1975**, No. 2, 38.
33. A new derivation of post gel properties of network polymers, D.R. Miller and C.W. Macosko, *Macromolecules* **1976**, *9*, 206-211; reprinted in *Rubber Chem. & Tech.* **1976**, *49*, 12.
34. Heat transfer and curing in polymer reaction molding, E. Broyer and C.W. Macosko, *AIChE J.* **1976**, *22*, 268-276.
35. Transient shear testing with the mechanical spectrometer, C.W. Macosko and D.J. Morse **1976**, *Proceedings of VII Int. Congress on Rheol.*, C. Klason and J. Kubat, eds., Gothenburg, 376.
36. Rheological changes during a urethane network polymerization, S.D. Lipshitz and C.W. Macosko, *Polym. Eng. Sci.* **1976**, *16*, 803-809.
37. Kinetics and energetics of a fast polyurethane cure, S.D. Lipshitz and C.W. Macosko, *J. Appl. Polym. Sci.* **1977**, *21*, 2029-2039.
38. A forced torsional oscillator for dynamic mechanical measurements, W.M. Davis and C.W. Macosko, *Polym. Eng. Sci.* **1977**, *17*, 32-37.
39. The effect of network structure in the equation of rubber elasticity. II. Further results, E.M. Valles and C.W. Macosko, in *Chemistry and Properties of Crosslinked Networks*, S.S. Labana, ed., Academic Press **1977**, 401-410.
40. Viscosity of elastomeric impression materials, T.W. Herfort, W.W. Gerberich, C.W. Macosko, and R.J. Goodkind, *J. Prosthet. Dent.* **1977**, *38*, 396-404.
41. Adhesives rheology, C.W. Macosko, *Adhes. Age* **1977**, *20*, 35-37.
42. Rheology of xanthan gum solutions, P.J. Whitcomb, C.W. Macosko, and B.J. Ek, in *Extracellular Microbial Polysaccharides*, P.A. Sandford and A. Laskin, eds., American Chemical Society, Washington, D.C., **1977**, 160-173.
43. Rheology of xanthan gum, P.J. Whitcomb and C.W. Macosko, *J. Rheol.* **1978**, *22*, 493-504.
44. Nonlinear dynamic mechanical moduli for polycarbonate and PMMA, W.M. Davis and C.W. Macosko, *J. Rheol.* **1978**, *22*, 53-71.
45. Average property relations for nonlinear polymerization with unequal reactivity, D.R. Miller and C.W. Macosko, *Macromolecules* **1978**, *11*, 656-668; portions in *Proceedings of VII Int. Congress on Rheol.* **1976**, C. Klason and J. Kubat, eds., Gothenburg, 568-662.
46. Steady shear rheological behavior of PVC plastisols, S.J. Willey and C.W. Macosko, *J. Rheol.* **1978**, *22*, 525-545.
47. Curing and heat transfer in polyurethane reaction molding, E. Broyer, C.W. Macosko, F.E. Critchfield, and L.F. Lawler, *Polym. Eng. Sci.* **1978**, *18*, 382-387.
48. Kinetics of fast (RIM) urethane polymerization, E.B. Richter and C.W. Macosko, *Polym. Eng. Sci.* **1978**, *18*, 1012-1018.
49. Tear strength of elastomeric impression materials, T.W. Herfort, W.W. Gerberich, C.W. Macosko, and R.J. Goodkind, *J. Prosthet. Dent.* **1978**, *39*, 59-62.

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51. Design and characterization of a small reaction injection molding machine, L.J. Lee and C.W. Macosko, *Soc. Plast. Eng. Tech. Pap. (ANTEC)* **1978**, *24*, 151-154.
52. Automated dynamic mechanical spectra, C.W. Macosko, R.G. Garritano, and J.M. Starita, *Soc. Plast. Eng. Tech. Pap. (ANTEC)* **1978**, *24*, 2-4.
53. A lamellar model for analysis of liquid-liquid mixing, J.M. Ottino, W.E. Ranz, and C.W. Macosko, *Chem. Eng. Sci.* **1979**, *34*, 877-889.
54. Calculation of molecular parameters for stepwise polyfunctional polymerization, D.R. Miller, E.M. Valles, and C.W. Macosko, *Polym. Sci. Eng.* **1979**, *19*, 272-283.
55. Structure and viscosity of poly(dimethylsiloxanes) with random branches, E.M. Valles and C.W. Macosko, *Macromolecules* **1979**, *12*, 521-526.
56. Properties of networks formed by end linking of poly(dimethylsiloxane), E.M. Valles and C.W. Macosko, *Macromolecules* **1979**, *12*, 673-679.
57. Orthogonal stagnation flow, a framework for steady extensional flow experiments, H.H. Winter, C.W. Macosko, and K.E. Bennett, *Rheol. Acta* **1979**, *18*, 323-334.
58. Conversion and composition profiles in polyurethane reaction molding, M. Tirrell, L.J. Lee, and C.W. Macosko, *Polymerization Reactors and Processes*, ACS Symposium Series, 104, J.N. Henderson and T.C. Bouton, eds., American Chemical Society, Washington, D.C., **1979**, 150-179.
59. Impingement mixing in reaction injection molding, L.J. Lee, J.M. Ottino, W.E. Ranz, and C.W. Macosko, *Soc. Plast. Eng. Tech. Pap. (ANTEC)* **1979**, *25*, 439; *Polym. Eng. Sci.* **1980**, *20*, 868-874.
60. Reaction injection molding: filling of a rectangular mold, J.M. Castro, C.W. Macosko, F.E. Critchfield, E.C. Steinle, and L.P. Tackett, *Soc. Plast. Eng. Tech. Pap. (ANTEC)* **1979**, *25*, 444; *J. Elast. Plast.* **1980**, *12*, 3-17.
61. Reaction injection molding machine (C.W. Macosko and L.J. Lee) U.S. Patent 4,189,070 (**1980**).
62. Viscosity changes during isothermal and adiabatic urethane network polymerization, E.B. Richter and C.W. Macosko, *Polym. Eng. Sci.* **1980**, *20*, 921-924.
63. Substitution effects in property relations for stepwise polyfunctional polymerization, D.R. Miller and C.W. Macosko, *Macromolecules* **1980**, *13*, 1063-1069.
64. Recursive approach to copolymerization statistics, F. Lopez-Serrano, J.M. Castro, C.W. Macosko and M.V. Tirrell, *Polymer* **1980**, *21*, 263-273.
65. An efficiency parameter for batch mixing of viscous fluids, J.M. Ottino and C.W. Macosko, *Chem. Eng. Sci.* **1980**, *35*, 1454-1459.
66. Steady planar extension with lubricated dyes, C.W. Macosko, M.A. Ocansey, and H.H. Winter, *J. Non-Newtonian Fluid Mech.* **1982**, *11*, 301-315; *Proc. VIII Internatl. Congress Rheol.*, G.Astarita, G.Marrucci, and L.Nicolais, eds. Plenum Press, New York, **1980**.
67. Kinetics and conversion monitoring in a RIM thermoplastic polyurethane system, E.C. Steinle, F.E. Critchfield, J.M. Castro, and C.W. Macosko, *J. Appl. Polym. Sci.* **1980**, *25*, 2317-2329.
68. Morphological characterization of reaction injection moulded (RIM) polyester-based polyurethanes, I.D. Fridman, E.L. Thomas, L.J. Lee, and C.W. Macosko, *Polymer* **1980**, *21*, 393-402.
69. Kinetics and rheology of typical polyurethane reaction injection molding systems, J.M. Castro and C.W. Macosko, *Soc. Plast. Eng. Tech. Pap. (ANTEC)* **1980**, *26*, 434-438.
70. Premature gelling in RIM, J.M. Castro, C.W. Macosko, L.P. Tackett, E.C. Steinle, and F.E. Critchfield, *Soc. Plast. Eng. Tech. Pap. (ANTEC)* **1980**, *26*, 423-427.
71. Onset of phase separation in segmented urethane polymerization, J.M. Castro, F. Lopez-Serrano, R.E. Camargo, C.W. Macosko, and M. Tirrell, *J. Appl. Polym. Sci.* **1981**, *26*, 2067-2076.
72. Extensional rheometry of several blow molding polyethylenes, V.S. Au-Yeung and C.W. Macosko, *Proc. VIII Int. Congress Rheol.* G.Astarita, G.Marrucci, and L.Nicolais, eds. Plenum Press, New York, **1980**, *3*, 717-722; *Modern Plast.* **1981**, *58*, No. 4, 84.
73. Extensional flow of linear and star-branched hydrogenated polybutadiene with narrow molecular weight distribution, V.S. Au-Yeung, C.W. Macosko, and V.R. Raju, *J. Rheol.* **1981**, *25*, 445-452.
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75. Modulus of three and four functional poly(dimethylsiloxane) networks, C.W. Macosko and G.S. Benjamin, *Pure Appl. Chem.* **1981**, 53, 1505-1518.
76. Stress-strain behavior of randomly crosslinked polydimethylsiloxane networks, M. Gottlieb, C.W. Macosko, and T.C. Lepsch, *J. Polym. Sci. Polym. Phys. Ed.* **1981**, 19, 1603-1617.
77. Lubricated squeezing flow: a new biaxial extensional rheometer, Sh. Chatraei, C.W. Macosko, and H.H. Winter, *J. Rheol.* **1981**, 25, 433-443.
78. A framework for description of mechanical mixing of fluids, J.M. Ottino, W.E. Ranz, and C.W. Macosko, *AIChE J.* **1981**, 27, 565-577.
79. Stress relaxation and dynamic viscoelastic properties of end-linked poly(dimethylsiloxane) networks containing unattached poly(dimethylsiloxane), S. Granick, S. Pedersen, G.W. Nelb, J.D. Ferry, and C.W. Macosko, *J. Polym. Sci. Polym. Phys. Ed.* **1981**, 19, 1745-1757.
80. A viscometer for fast polymerizing systems, S.J. Perry, J.M. Castro, and C.W. Macosko, *J. Rheol.* **1985**, 29, 19-35; portions presented at AIChE Annual Meeting **1981**, Detroit.
81. Microemulsion rheology: Newtonian and non-Newtonian regimes, K.E. Bennett, H.T. Davis, C.W. Macosko, and L.E. Scriven, *Soc. Pet. Eng.*, San Antonio, TX, October **1981**, Paper No. 10061.
82. Rheology of randomly branched polydimethyl siloxanes, W.J. Hickey and C.W. Macosko, *Polym. Prepr.* **1981**, 22, 379-380.
83. A preliminary study of composite reaction injection molding, V.M. Gonzalez, J.M. Castro, and C.W. Macosko in *The Role of the Polymeric Matrix in the Processing and Structural Properties of Composite Materials (Proc. Jt. U.S.-Italy Symp. Compos. Mater.)*, Capri, **1981**, 189-205.
84. Laminar tube flow with a thermosetting polymerization, J.M. Castro, S.D. Lipshitz, and C.W. Macosko, *AIChE J.* **1982**, 28, 973.
85. Computer simulation of nip flow in roll coating, D.J. Coyle, C.W. Macosko, and L.E. Scriven in *Computer Applications in Applied Polymer Science*, T. Provder, ed. ACS Symposium Series 197, Washington, D.C., **1982**, 251-264.
86. The effect of instrument compliance on dynamic rheological measurements, M. Gottlieb and C.W. Macosko, *Rheol. Acta* **1982**, 21, 90-94.
87. The influence of impingement mixing on striation thickness distribution and properties in fast polyurethane polymerization, P. Kolodziej, C.W. Macosko, and W.E. Ranz, *Polym. Eng. Sci.* **1982**, 22, 388-392.
88. Solvation effects of dilatancy in concentrated PVC plastisols, S.J. Willey and C.W. Macosko, *J. Rheol.* **1982**, 26, 557-564.
89. Studies of mold filling and curing in the reaction injection molding process, J.M. Castro and C.W. Macosko, *AIChE J.* **1982**, 28, 250-260.
90. On the suppression-of-junction-fluctuations parameter in Flory's network theory, M. Gottlieb and C.W. Macosko, *Macromolecules* **1982**, 15, 535-537.
91. Viscosity and conductivity of microemulsion, K.E. Bennett, J.C. Hatfield, H.T. Davis, C.W. Macosko, and L.E. Scriven in *Microemulsions*, I.D. Robb, ed., Plenum Press, London, **1982**, 65-85.
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99. Insights into molding RIM materials, C.W. Macosko, *Plast. Eng.* **1983**, 39, 21-25.
100. Properties of mat reinforced reaction injection molded materials, V.M. Gonzalez and C.W. Macosko, *Polym. Compos.* **1983**, 4, 190-195.
101. An integral constitutive equation for mixed flows: Viscoelastic characterization, A.C. Papanastasiou, L.E. Scriven, and C.W. Macosko, *J. Rheol.* **1983**, 27, 387-410.
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