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Education

Ph. D. Organic/Polymer/Materials Chemistry, Department of Chemistry, University of Southern California. 1999. Advisor: Larry R. Dalton.

With a milestone achievement in electro-optic material research, Science News, Vol 157, No. 15, p231, April 8, 2000. C&EN News, vol. 78, pp.12-3, 2000. LA Times, April 7,

- x Molecular engineering of second-order NLO chromophores for organic electro-optic (OEO) devices.
- x Conversion of Lignin into chemicals via hydrothermal treatment.

Research Funding:

2014.9.1 – 2017.8.31

- 2) The invention of a novel EO polymer CX2 and, for the first time in the EO polymer history, the simultaneous realization of all the major device -critical properties, i.e. low loss, high thermal stability and good poling efficiency in EO modulators made from CX2.
Appl. Phys. Lett. 2005, 87, paper 061112.
News release of Pacific Wave Communications, Ltd. Los Angeles, California, "Major breakthrough in high speed 10 Gbps and 40 Gbps optical modulator technology." Business Wire, Los Angeles, June 18, 2001.
SPIE Photonics West Conference 4991, paper 40. 25-31 January 2003, San Jose.
- 3) Invention of the method to solve photostability of polymer EO devices, and its first demonstration in CLD1/APC electro-optic modulators.
US Patent, 6,616,865 B1, Sept. 9, 2003.
IEEE Journal on Selected Topics in Quantum Electronics, September/October 2001, 7 (5).
- 4) The first demonstration of EO polymer micro ring resonators in 2002.
"Polymer micro-ring filters and modulators." Payam Rabiei, W. H. Steier, Cheng Zhang, Larry R. Dalton. J. Lightwave Technology, Oct. 2002.
- 5) Invention of CLD (Cheng – Larry Dalton) series of second -order nonlinear optical chromophores in years 1998- 2000.
Dalton, Larry R.; Zhang, C.; et al. "Sterically stabilized second-order nonlinear optical chromophores and devices incorporating the same." U.S. 6,361,717 B1, March 26, 2002.
The current state-of-the-art second order NLO chromophores are still CLDs.
- 6) Joint invention of the Opto -Chip in 1999. CLD chromophores made possible the demonstration of the first sub1 volt electrooptic modulators (opto-chips).
Science, April 7, 2000. 288, 119- 122. "opto-chips shatter records for bandwidth and low voltage," L. Geppart, IEEE Spectrum, vol. 37, pp. 28-9 (2000); "Plastic opto-chips offer promise of greater communication bandwidths," R. K. Ackerman, Signal, vol. 54, pp. 21-5 (2000); "Rotund molecules key to high-speed telecommunications," R. Dagani, C&EN News, vol. 78, pp.12-3 (2000); "Polymers speed electro-optic conversion," K. J. McNaughton, The Industrial Physicist, vol. 6, pp. 14 (2000); "Information acceleration," MacNeil, U.S. News & World Report, vol. 128, pp. 44 (2000); "Chromophores bulk up for sub 1-volt modulators," Paula Noaker Powell, Laser Focus World, vol. 36, pp. 38-40 (2000).]
- 7) The first realization of low optical loss (1.2 dB/cm at 1.55 μm) in high - π E chromophore - doped polymer in 1999 -2000.
Chemistry of Materials, 2001, 13(9), 3043-50. Applied Physics Letters. 2000, 76 (24), 3525-7.

On the news:

Patents

1. Ring-protected organic chromophores for optoelectronic applications. Cheng Zhang and Qiquan Qiao. IP disclosure filed in June, 2013.
2. C. Zhang, H. R. Fetterman, W. Steier, J. Michael. "Sterically stabilized second-order nonlinear optical chromophores with improved stability and devices incorporating the same," US Patent, 6,616,865 B1, Sept. 9, 2003.
3. Dalton, Larry R.; Zhang, C.; Wang, C.; Fetterman, H. R.; Wang, F.; Steier, W.; Harper, A. W.; Ren, A. S.; Michael, J.. "Sterically stabilized second-order nonlinear optical chromophores and devices incorporating the same." U.S. 6,361,717 B1, March 26, 2002.
4. C. Zhang, H. R. Fetterman, W. Steier, J. Michael. "Sterically stabilized polyene-bridged second-order nonlinear optical chromophores and devices incorporating the same." U.S. Patent 6,348,992, February 19, 2002.
5. C. Zhang, H. R. Fetterman, W. Steier, J. Michael. "Polymers containing polyene-bridged second-order nonlinear optical chromophores and devices incorporating the same." 2000. 6,652,779 November 25, 2003.

10. Frontier orbital and morphology engineering of conjugated polymers and block copolymers for potential high efficiency photovoltaics. Sun, Sam-Shajing; Zhang, Cheng; Li, Rui; Nguyen, Thuong; David, Tanya; Brooks, Jaleesa. *Solar Energy Materials & Solar Cells* 2012, 97, 150-156.
11. Ultrafast optical studies of ordered poly(3-thienylene-vinylene) films. E. Olejnik, B. Pandit, T. Basel, E. Lafalce, C.-X. Sheng, C. Zhang, X. Jiang, and Z. V. Vardeny. *Physical Review B* 85, 235201 (2012)
12. "Photophysics and morphology of poly (3-dodecylthienylenevinylene)-[6,6]-phenyl-C61-butyric acid methyl ester composite." E. Lafalce, P. Togliola, C. Zhang and X. Jiang. *Applied Physics Letters* 2012, 100, 213306.
13. "Regioregularity and Solar Cell Device Performance of Poly(3-dodecylthienylenevinylene)." Jianyuan Sun, Cheng Zhang,* Swaminathan Venkatesan, Rui Li, Sam-Shajing Sun, and Qiquan Qiao J. *Polym Sci. B: Polymer Physics* 2012, 50, 917–922.
14. "Synthesis and Characterization of New Sulfone-Derivatized Phenylenevinylene-Based Conjugated

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29. "Synthesis and Characterization of a New Acceptor (n-Type) Fluorinated and Terminal-Functionalized Polythiophene." Shanneth Thomas, Cheng Zhang , Sam-Shajing Sun. Journal of Polymer Science: Part A: Polymer Chemistry, 2005, Vol. 43, 4280–4287.
30. "Side-chain electro-optic polymer modulator with wide thermal stability ranging from -46 [degree]C to 95 [degree]C for fiber-optic gyroscope applications." Seong-Ku Kim, Yu-Chueh Hung, Byoung-Joon Seo, K. Geary, W. Yuan, B. Bortnik, H. R. Fetterman, C. Wang, W. H. Steier, and C. Zhang. Appl. Phys. Lett. 2005, 87, 061112.
31. "Metal-Defined Passive Polymer Optical Waveguides Operating at both 1.31 and 1.55 Pm Wavelengths." Kim, Seongku; Geary, K.; Yuan, W.; Fetterman, H. R.; Zhang, C.; Wang, C.; Steier, W. H.; Park, G.-C.; Kang, S.-J.; Oh, I.; Jung, W.-J. Journal of Nonlinear Optical Physics & Materials 2005, 14(3), 391-397.
32. "Electro-optic phase modulator using metal-defined polymer optical waveguide." Seong-Ku Kim, W. Yuan, K. Geary, Yu-Chueh Hung, and H. R. Fetterman, Dong-Gun Lee, C. Zhang, C. Wang and W. H. Steier, G.-C. Park, S.-J. Kang, and I. Oh. Appl. Phys. Lett. 2005, 87, 011107.
33. "Combined electromagnetic and photoreaction modeling of CLD-1 photobleaching in polymer microring resonators." Yanyi Huang, Joyce K. S. Poon, Wei Liang, and Amnon Yariv (CalTech),; Cheng Zhang , Larry R. Dalton. Appl. Phys. Lett. 2005, 87(7), 071108/1-071108/3.
34. "Stress- L Q G X F H G S R O \ P H U Z D Y H J X L G H V R S H U D W L Q J D W E R W K D Q
SeongKu; Geary, K.; Yuan, W.; Fetterman, H. R.; Lee, D.-G.; Zhang, C.; Wang, C.; Steier, W. H.; Park, G.-C.; Gang, S.-J.; et al. Electronics Letters 2004, 40(14), 866-868.
35. "Push-pull electro-optic polymer modulators based on photo-bleaching induced waveguides and dual-driving electrodes." Kim, Seongku; Geary, K.; Fetterman, H. R.; Zhang, C.; Wang, C.; Steier, W. H. Journal of Nonlinear Optical Physics & Materials 2004, 13(3 & 4), 405-410.
36. "Low loss photo-bleaching induced electro-optic polymer modulator in a guest-host system." Kim, SeongKu; Geary, K.; Yuan, W.; Fetterman, H. R.; Zhang, C.; Wang, C.; Steier, W. H. Appl. Phys. Lett. 2005, 87, 011107.

47. "Integration of Electro-Optic Polymer Modulators with Low-Loss Fluorinated Polymer Waveguides." Seh-Won Ahn, William H. Steier and Yin-Hao Kuo, Min-Cheol Oh and Hyung-Jong Lee, Cheng Zhang, and Harold R. Fetterman. *Optics letters*, 2002, 27(23), 2109-2111.
48. "Polymer micro-ring filters and modulators." Payam Rabiei, W. H. Steier, Cheng Zhang, Larry R. Dalton. *J. Lightwave Technology*, Oct. 2002.
49. "Low-Loss Interconnection Between Electrooptic and Passive Polymer Waveguides with a Vertical Taper." Min-Cheol Oh, Cheng Zhang, Hyung-Jong Lee, William H. Steier, Harold R. Fetterman. *IEEE Photonics Technology Letters*, 2002, 14(8), 1121-1123.
50. "Polymer micro-ring modulators with 1 THz FSR." Payam Rabiei, W. H. Steier, Cheng Zhang, Chuanguang Wang, H. J. Lee. *Trends in Optics and Photonics (2002)*, 73(Technical Digest - Conference on Lasers and Electro-Optics, 2002), CPDB8/1-CPDB8/3.
51. "Multiple Output Photonic RF Phase Shifter Using a Novel Polymer Technology", Jeehoon Han, H. Erlig, D. Chang, M. Oh, H. Zhang, C. Zhang, W. Steier, and H. Fetterman, *IEEE Photonics Technology Letters*, vol.14, (no.4), April 2002, p.531-3.
52. "Recent Advances in Electrooptic Polymer Modulators Incorporating Highly Nonlinear Chromophore." Min-Cheol Oh, Hua Zhang, Cheng Zhang, Hernan Erlig, Yian Chang, Boris Tsap, Dan Chang, Attila Szep, William H. Steier, Harold R. Fetterman, and Larry R. Dalton, *Invited Paper on IEEE Journal on Selected Topics in Quantum Electronics*, September/October 2001, 7 (5).
53. "Polymeric Waveguide Prism-Based Electro-Optic Beam Deflector," Lin Sun, Jin-Ha Kim, Chiou-Hung Jang, Dechang An, XueJun Lu, Qingjun Zhou, John M. Taboada, Ray T. Chen, Jeffrey J. Maki, Suning Tang, Hua Zhang, William H. Steier, Cheng Zhang, Larry R. Dalton, *Optical Engineering*, 2001, 40(7) 1217-1222 (July 2001).
54. "Push-Pull Electro-Optic Polymer Modulators with Low Half-Wave Voltage and Low Loss at Both 1310 nm and 1550 nm." Hua Zhang, Min-Cheol Oh, Attila Szep, William H. Steier, Cheng Zhang, Larry R. Dalton, Hernan Erlig, Daniel H. Chang, Yian Chang, Harold R. Fetterman. *Applied Physics Letters* 2001, 78 (20), 3136-8.
55. "Low V_{π} EO Modulators from CLD-1: Chromophore Design and Synthesis, Material Processing and Characterization," Cheng Zhang, Larry R. Dalton, Min-Cheol Oh, Hua Zhang, William H. Steier, *Chemistry of Materials*, 2001, 13(9), 3043-50.
56. "Urethane-Urea copolymers Containing Siloxane Linkages: Enhanced Temporal Stability and Low Optical Loss for Second-Order Nonlinear Optical Applications," C. Wang, C. Zhang, C. Zhou, M. Chen, L. R. Dalton, G. Sun, H. Zhang, and W. H. Steier, *Macromolecules* 2001, 34(7), 2359-2363.
57. "Electric Poling and Relaxation of Thermoset Polyurethane Second-Order Nonlinear Optical Materials: the Role of Cross-Linking and Monomer Rigidity," Cheng Zhang, Chuanguang Wang, Jinglin Yang, Larry R. Dalton, Guilin Sun, Hua Zhang, William H. Steier. *Macromolecules* 2001, 34 (2), 235-243.
58. "Progress toward Device-Quality Second-Order Nonlinear Optical Materials: 4. A Tri-Linkable High μ -beta NLO Chromophore in Cross-Linked Polyurethane - A Guest-Host Approach to Larger Electro-Optic Coefficients." Cheng Zhang, Chuanguang Wang, Larry R. Dalton, Guilin Sun, Hua Zhang, William H. Steier. *Macromolecules* 2001, 34, 253-261.
59. "Resonant and nonresonant hyper-Rayleigh scattering of charge-transfer chromophores," C. H. Wang, J. N. Woodford, C. Zhang, L. R. Dalton, *J. Applied Physics*, April, 2001, 89(8), 4209-17.
60. "Formylation of Diethyl 2-Thienylmethylphosphonate for One-Pot Synthesis of Aminothienostilbenecarboxaldehyde," Cheng Zhang, Aaron W. Harper, Larry R. Dalton. *Synthetic Communications*, 2001, 31(9), 1361-1365.
61. "Low (Sub-1 Volt) halfwave voltage electrooptic polymer modulators achieved by controlling chromophore shape." Shi, Y.; Zhang, C.; Zhang, H.; Bechtel, J. H.; Dalton, L. R.; Robinson, B. H. and Steier, W. H. *Science*, 2000. 288, 119-122.
62. "A Facile Synthesis of 5-N,N-Bis(2-hydroxyethyl)amino-2-Thiophenecarboxaldehyde." Cheng Zhang, Aaron W. Harper, Darrell S. Spels, Larry R. Dalton. *Synthetic Communications*, 2000, 30(8).
63. "Importance of Intermolecular Interactions on the Nonlinear Optical Properties of Poled Polymers." I. Liakatas, C. Cai, M. Bösch, M. Jäger, Ch. Bosshard, and P. Günter (Switzerland), Cheng Zhang, Larry R. Dalton (USC). *Applied Physics Letters*, March 13th, 2000, 76(11), 1368-1370.
64. "Synthesis and Characterization of Main-Chain NLO Oligomers and Polymer Which Contain 4-Dialkylamino-4'-(alkylsulfonyl)azobenzene Chromophores," Diyun Huang, Cheng Zhang, Larry R. Dalton, William P. Weber. *Journal of Polymer Science Part A*, 2000, 38, 546-559.
65. "Sequential Synthesis of Main-Chain NLO Oligomers which Contain 4-Dialkylamino-4'-(alkylsulfonyl)azobenzene Chromophores," D. Huang, C. Zhang, L. R. Dalton, and W. P. Weber, *Designed Monomers and Polymers*, 2000, 3(1), 95-111.

66.

1. Synthesis and photodegradation study of diCN-PPV. Logan Sanow, Jianyuan Sun, Cheng Zhang. MWRM ACS November 12-15, 2014, U. Missouri-Columbia.
2. Bond Cleavage and Condensation in Lignin Solvolysis and Hydrogenolysis, Dan Liu, Eric Nagel, and Cheng Zhang, Frontiers in Biorefining, Conference organized by Institute of Agriculture, University of Tennessee, October 22-24, 2014, King and Prince Beach & Golf Resort, St. Simons Island, Georgia, USA.
3. Shape engineering to promote head-tail interactions of electro-optic chromophores, Cheng Zhang, Lianjie Zhang, Stephanie J. Benight, Benjamin C. Olbricht, Lewis E. Johnson, Bruce H. Robinson, Robert A. Norwood, Larry R. Dalton. SPIE optics and photonics 2013, San Diego. Paper 8827-4.
4. Bioinspired self-assembly for organic electro-optics (Invited Paper), Cheng Zhang, Thuong H. Nguyen, Emily M. Heckman, SPIE optics and photonics 2010 (San Diego), Nanobiosystem conference, paper 7765-20.
5. The effects of gamma-ray irradiation on organic materials of different conjugation lengths. (Invited Paper) SPIE Optics + Photonics 2009, Conference 7467: Nanophotonics and Macrophotonics for Space Environments III, Paper 7467-6, Aug 3, 2009.
6. "C12-PTV with controlled regioregularity for photovoltaic application." Cheng Zhang, Eric Annih, Rui Li, Sam-Shajing Sun. Proceeding of PIE, Vol 7213 (Photovoltaic and Display Materials), Paper 7213-8. Jan 2009, San Jose.
7. A Low Energy Gap and Fully Regioregular Poly(3-Dodecyl-2,5-thienylenevinylene) for Photovoltaics. Cheng Zhang, Taína D. Cleveland, Shahin Maaref, Eric Annih, and Sam-Shajing Sun. SPIE 2008, Section "Organic Photovoltaics IX (OP113)", paper 7052-33.
8. Development of PPV-Based Block Copolymers for Photovoltaics. Cheng Zhang, S. Choi, J. Haliburton, Sam Sun, A. Ledbetter, and Carl Bonner. MRS, March 24-28, 2008, San Francisco.
9. "Development of Conjugated Block Copolymers and Low Eg polymers" the Air Force Program Review meeting "2008 Polymer Chemistry" at Baltimore, May 5-9, 2008.
10. "Mono-

20. "Thermally Stable Polyene-Based NLO Chromophore and Its Poly

Graduate Research

- 1994.9-1998.12 Advisor: Prof. Larry R. Dalton, Chemistry Department, U. of Southern California.
Ph.D. Thesis: "Novel Phenylpolyene-Bridged Second-Order Nonlinear Optical Chromophores and New thermally Stable Polyurethanes for Electro-Optic Applications."
- 1991.9-1993.6 Ph. D. Candidate, the State Key Laboratory of Molecular Reaction Dynamics, Dalian Institute of Chemical Physics, Chinese Academy of Sciences, China.
Advisor: Prof. Guohe Sha. Laser spectroscopy, Molecular reaction dynamics, Nonlinear optics.