I. **BIOGRAPHICAL DATA**

A. Terrill S. Clayton Date of Birth: January 16, 1973

B. **Education**

BS in Biology, Chemistry Minor, University of Wisconsin-Madison (1996).

BS in Chemistry, University of Wisconsin–Milwaukee (2003).

MS in Organic Chemistry, University of Wisconsin-Milwaukee (2005).

PhD, Organic Chemistry, University of Wisconsin-Milwaukee, 2011 with Professor James M. Cook; Thesis Title: I. Unified pharmacophore protein models of the benzodiazepine receptor subtypes. II. Subtype selective ligands for α5 GABA(A) /BZ receptors (2011).

Executive Education: Key Executives Program, Harvard Business School, Boston, MA (2012).

C. **Positions Held**

Management Training Program, Quad/Graphics, Milwaukee, WI (1997-1999).

Chemist, Chemical Research\Technology, Hartford, WI (1999-2005).

Chemist, Hestia Laboratories, New Berlin, WI (2001).

Graduate Student, University of Wisconsin, Milwaukee, WI (2003-2010).

R&D Manager, Chemical Research\Technology, Hartford, WI (2005-2010).

Chemical Engineer, CTI, Colorado Springs, CO (2010-2011).

Vice President R&D, CTI, Colorado Springs, CO (2011-2015).

Adjoint Professor, University of Colorado, Colorado Springs, CO (2012-2015).

Adjunct Professor, University of Wisconsin, Milwaukee, WI (2012-Present).

Editorial Board, Current Research in Chemical Sciences, Lahore, Pakistan (2013-2015).

Director, Electronics for Imaging, Manchester, NH (2015-2023).

Expert Witness & Litigation, Chromatic Technologies, Colorado Springs, CO (2015).

Product Development Consultant, Sensor Products, NJ (2017-Present).

Strategic Advisor, Living Ink Technologies, Aurora, CO (2017-Present).

Product Development Consultant, US Polymers-Accurez, St. Louis, MO (2017-2022).

Consultant & Expert Witness, Flint Group, Flint, MI (2018-2019).

Startup Advisor, MIT Cambridge, MA (2019-2020).

Partner & Consultant, Summit Analytical, Gilford, NH (2020- Present).

D. **Special Honors and Awards**

Phi Eta Sigma (1992).

Air Products Innovator Award (1999).

Chancellor's Graduate Student Fellowship Award (2000).

Chancellor's Fellowship Award (2003).

Trevisan-Fueger UWM Chemistry Award (2003).

McFarland Award (2003).

Outstanding Analytical Chemistry (2003).

Graduate School Fellowship Nominee (2004).

Featured on cover of *Current Medicinal Chemistry* (2007).

Quad/Graphics Innovation Council Member (2008-2010).

Top Innovation Award by MillerCoors, *Cold-Activated Tabs*, (2013)

II. GRANTS, CONTRACTS AND RESEARCH AWARDS

A. External Funds

National Institutes of Health, "Ligands that Modulate Memory," $146,000, 2000-2002 (with Dr. Helmstetter, Psychology); 40% to Chemistry.

NIH SBIR (subcontract) "Attenuation of Memory Impairment Using BDZR Ligands," $48,756 (DC+IC) 2003-2005.

National Institute of Mental Health, "Selective Anxiolytics *via* BzR Subtype Specific Ligands," $1,687,717, 2000-2006.

National Institute of Health, NIMH, "Selective Anxiolytics *via* BzR Subtype Specific Ligands," $221,000, 12/1/03-11/30/06.

Searle Laboratories, "Process Development Chemistry," Donation of Equipment, $80,000, 2000-2005. $130,000 more, 2004-2008.

National Institutes of Health (NIAAA), (IUPUI/U of Maryland, subcontract with Harry June) "$GABA_A$ Receptor Subunits in Alcohol Reinforcement," $330,000, 2002-2008.

Bristol Myers Squibb, Unrestricted Funds for Medicinal Chemistry, $95,000, 2004 – 2008.

Bristol Myers Squibb (WISIS License Agreement) $280,000, 2006 – 2008.

UW-Milwaukee, Research Growth Initiative, "Novel GABA(A) Ligands for Treating Alzheimers-related Cognitive Deficits," $215,257. 2006 – 2008.

National Institutes of Health (Johns Hopkins University subcontract, Dr. Elise Weerts), "Preclinical Assessment of Medications for Alcohol Abuse," $66,000. 2007 – 2009.

Catalyst Grant, Lynde and Harry Bradley Foundation, "Synthesis of Beta Carbolines to Treat Alcohol Abuse," $60,908 (7/1/08 – 6/30/09 –extended to December 31, 2009.

National Institutes of Health (University of Maryland subcontract, Dr. Harry June), NIAAA "Alcoholism and Anxiety: Novel Benzodiazepine Treatments," $60,000 (2009-2010).

Research Growth Initiative, "New GABAergic Drugs to Treat Epilepsy Devoid of Sedative Ataxic and Amnesic Side Effects Which Do Not Develop Tolerance," ($130, 944).

National Institutes of Health (Harvard Medical School subcontract, Dr. James Rowlett, P. I.), "Novel GABA – A Modulators as Cognitive Enhancers," ($700,000) (UWM-share), July, 2010 – June, 2015.

National Institutes of Mental Health, "Design and Synthesis of Anxioselective Anxiolytics," ($2,343,234), 2006-2013.

NIAAA (Harvard Medical School subcontract, Dr. Donna Platt) "GABA(A) Receptor Subtype Mechanisms in Non Human Primate Models of Alcohol Abuse," ($183,750), 2006 – 2017. .

MiTAG (UW-Milwaukee), Synthesis of Subtype Selective GABAergic Agents to Treat Schizophrenia, ($95,000), 2007-2013.

National Institutes of Health (Johns Hopkins University subcontract, Dr. Nancy Ator), "GABA(A)-Alpha 5

Cognitive Enhancers: Pharmacology and Neuropsychology in Macaques," ($300,000), 2007 – 2012.

Confidential, "Covert Tagging with Polymeric Organic Raman Phototags," ($50,000), 2013.

NSF SBIR Phase I, "Engineering Novel Pigmented Cyanobacteria for the use in the ink, printing and colorant industries," (225,000), 2018.

National Science Foundation Small Business Innovation Research grant, *Engineering Novel Pigmented Cyanobacteria forthe use in the ink, printing and colorant industries, (2021).*

PRESENT

NSF SBIR Phase II: Engineering novel pigmented cyanobacteria for the use in the ink, printing and colorant industries," $750,000.00, 2018-2020.

PENDING

NSR SBIR/STTR Phase I: Preparing Colorants from Pollution. Currently In preparation.

NSR SBIR Phase I: Novel water based polymers for use on polyvinyl carbonate substrates. In preparation.

B. **Internal Funds**:

Graduate School Bridging Funds for Anxiolytics, ($50,000), 2005,(*under James M. Cook, P.I.*)

MiTag grant ($85,000), 2007-2008 (*w/ James M. Cook, P.I.*).

Quad/Graphics, "CRT International Plant Startup in Poland", ($12,000,000), 2008-2010.

Research Growth Initiative ($215, 000), 2006-2008.

Catalyst Grant ($60,000), 2008-2009.

III. **RESEARCH**

A. **Scholarly Publications**

1. "An Updated Unified Pharmacophore Model of the Benzodiazepine Binding Site on γ – Aminobutyric $Acid_A$ Receptors: Correlation with Comparative Models," T. Clayton, J. Chen, M. Ernst, L.Richter, B.A. Cromer, C.J. Morton, H.Ng, C. Cook – Kaczorowski, F.J. Helmstetter, R. Furtmüeller, G. Ecker, M.W. Parker, W. Sieghart and J.M. Cook, *Curr. Med. Chem.*, **14**, 2755-2775 (2007).

2. "Are $GABA_A$ Receptors Containing α5 Subunits Contributing to the Sedative Properties of α5 Agonists?" M. Savic, S. Huang, R. Furtmueller, T. Clayton, S. Huck, D. Obradovic, N. Ugresic, W. Sieghart, D. Bokonjic and J. M. Cook, *Neuropsychopharmacology*, **33,** 332-339 (2008).

3. "PWZ-029, a Compound with Moderate Inverse Agonist Functional Selectivity at $GABA_A$ Receptors Containing Alpha 5 Subunits, Improves Passive, but not Active, Avoidance Learning in Rats," M. Savic, T. Clayton. R. Furtmueller, I. Gaurilovic, J. Samardzic, S. Savic, W.Sieghart and J.M. Cook, *Brain Res.*, **1208**, 150-159 (2008).

4. "Selective Influence on Contextual Memory: Physiochemical Properties Associated with Selectivity of Benzodiazepine Ligands at GABA(A) Receptors Containing the α5 Subunit," D. Harris, T. Clayton, J. Cook, R.Halliwell, P. Sahbaie, W. Sieghart, R. Furtmueller, and T. DeLorey, *J. Med. Chem.*, **51**, 3788-3803 (2008).

5. "A Study of the Structure-activity Relationship of $GABA_A$-benzodiazepine Receptor Bivalent Ligands by Conformational Analysis with Low Temperature NMR and X-ray Analysis," Han, D.; Forsterling, H.; Li, X.; Deschamps, J.; Parrish, D.; Cao, H.; Rallapalli, S.; Clayton, T.; Teng, Y.; Majumder, S.; Sankar, S.; Roth, B.; Sieghart, W.; Furtmuller, R.; Rowlett, J.; Weed, M.; Cook, J., *Bioorg. and Med. Chem.*, **16**, 8853-8862 (2008).

6. "Glutamatergic and GABAergic Modulations of Ultrasonic Vocalizations During Maternal Separation Distress in Mouse Pups," Takahashi, A.; Yap, J.J.; Bohager, D.Z.; Faccidomo, S.; Clayton, T.; Cook, J.M.; Miczek, K.A., *Psychopharmacol.* (Berlin, Ger.) , 204, 61-71 (2009).

7. "The Differential Role of α1 and α5 – Containing GABA(A) Receptors in Mediating Diazepam Effects on Spontaneous Locomotor Activity and Water-Maze Learning and Memory in Rats", M. Savic, M. Milinkovic, S. Rallapalli, T. Clayton Sr., S. Joksimovic, M. Van Linn, J. M. Cook, *Neuropsychopharmacology*, **12**, 1179-1193 (2009).

8. "Novel Positive Allosteric Modulators of GABA(A) Receptors: Do Subtle Differences in Activity at Alpha 1 Plus Alpha 5 Versus Alpha 2 Plus Alpha 3 Subunits Account for Dissimilarities in Behavioral Effects in Rats", M Savic, S. Majumder, S.Huang, R. Edwankar, R. Furtmuller, S. Joksimovic, T. Clayton, J. Ramerstovfer, M. Milinkovk, B. Roth, W. Sieghart, J. M. Cook, *Progress in Neuro-Psychopharmacology and Behavioral Psychiatry*, **34,** 376-386 (2010).

9. "Synthesis, Pharmacological Studies and Molecular Modeling of Some Tetracyclic 1,3 – Diazepinium Chlorides," J, -A. Grant, T. Bonnick, M. Gossell- Williams, T. Clayton, J. M. Cook, Yvette Jackson, *Biorg. Med. Chem.*, **18**, 909-921 (2010).

10. "Design, Synthesis and Subtype Selectivity Effects of 3,6-Disubstituted Beta Carbolines at Bz/GABA(A)ergic Receptors. SAR and Studies Directed Toward Agents for Treatment of Alcohol Abuse," Yin, W., Majumder, S., Clayton, T., Petrou, S., VanLinn, M., Ma, C., June, H.L., Cromer, B.A., Roth, B.L., Luddens, H., Cook, J.M. *Bioorg and Med. Chem*., **21**, 7548-7564 (2010).

11. "Part I. Unified pharmacophore protein models of the benzodiazepine receptor subtypes. Part II. Subtype selective ligands for alpha5 Gaba(A) /BZ receptors," Clayton, T. *Dissertation*, University of Wiscosin-Milwaukee, Milwaukee, WI. (2011).

12. "Modulation of the Reinforcing Effects of Ethanol in Rhesus Monkeys by α5 GABA (A) Receptor-Selective Ligands," Rüedi-Bettschen, D.; Rowlett, J. K.; Rallapalli, S.; Clayton, T.; Cook, J. M.; Platt, D. M., *Alcohol Clinical and Experimental Research*, **37**, (4), 624-634, (2013).

13. "Allosteric Modulation of GABA (A) Receptors Compared to Non-GABAergic Compounds: Effects on Visuo Spatial Memory in Rhesus Monkeys", P. Soto, N. Ator, S. Rallapalli, P. Biawat, T. Clayton, C. Brayton, J. Cook, M. Weed., *Neuropsychopharmacology*, **38**, 2315-2325 (2013).

14. "Updated Pharmacophore for the Alpha 5 GABA(A) Benzodiazepine Receptor Model", Clayton, T., Poe, M., Rallapalli, R., Biawat, P., Savic, M., Rowlett, J., Cook, J.M., *manuscript in preparation.*

15. "A Protein Homology Model and Key Residues Identified in the Allosteric GABA(A) Benzodiazepine Receptor", Clayton, T., *manuscript in preparation.*

16. Clayton, T.; Poe, M.; Rallapalli, S.; Biawat, P.; Savic, M.; Rowlett, J.; Gallos, G.; Emala, C.; Kaczorowski, C.; Stafford, D.; Arnold, L.; Cook, J. **Prime Archives in Chemistry.** 2020. *Vide Leaf Publishing. (Book Chapter)*

B. **Conference Proceedings and Abstracts** - these are listed below under E.

C. **Patents**

1. "GABAergic Agents to Treat Memory Deficits (A)," Cook, James M.; Han, D.; and Clayton, T.; Provisional patent filed June 30, 2005. Published in 2006. Patent No. PCT/US 2006018721; US Patent No. 7,595,395;

issued July 24, 2009.

2. "GABAergic Agents to Treat Memory Deficits (B)," Cook, J.M., Clayton, T., Teng Johnson, Y., Rallapalli, S., Han, D., Provisional patent filed August 31, 2009. Published May 27, 2010. Publication number US20100130479 A1.
3. "GABAergic Receptor Subtype Selective Ligands and Their Uses," J.M. Cook, T. Clayton, H. Jain, Y. Teng, J. Yang, S. Rallapalli, Filed a provisional patent on May 4, 2008.
4. "Printing Using Color Changeable Material," Barndt, J.A.; Barton, R.H.; Clayton, T.S.; Rose, M.J.; Volz, P.G. WO 2009/094063 A1. Published July 30, 2009.
5. "Ablative Printing," Graushar, W.T; Barndt, J.A.; Barton, R.H.; Clayton, T.S..; US 2009/0128860 A1; Published May 21, 2009.
6. "Device, Method, and Composition for Reducing the Incidence of Tobacco Smoking," Roth, B.; Clayton, T. U.S. Pat. 7,766,018; August 03, 2010.
7. "Gabaergic Receptor Subtype Selective Ligands and their Uses," Cook, J. M., S. Rallapalli, T. Clayton, H. Jain, J. Yang, Teng, Y., provisional patent filed on April 28, 2011. Application No. 6147899.
8. "System and Method for Adding Data to a Printed Publication," Graushar, W., Barndt, J., Barton, R., Clayton, T. Filed on November 20, 2008. US Pat. No. 8,120,81. Patent issued February 21, 2012.
9. "GABAergic Receptor Subtype Selective Ligands and their uses, "Cook, J. M., Clayton, T., Jain, H.D., Rallapalli, S. K., Johnson, Y. T.,Yang, J.,Poe, M.M., Namjoshi, O. A., Wang, Z. Patent publication no US 2012/0295892 A1, Published November 22nd, 2012.
10. "Scented Thermochromic Ink," Clayton, T., Owen, T., filed May 14, 2012, WO2012158611A1and US 20120315412 A1.
11. "Thermochromic Level Indicator." Clayton, T., Owen, T., U.S. Patent Application Serial No. 61/663,089, filed on June 22, 2012.
12. "Variable Printing of Thermochromic Codes," Clayton, T., PCT/US2012/051941, filed August 22, 2012.
13. "Stabilizing Additives for Thermochromic Pigments," Owen, T., Clayton, T., Tomovich, V., Roberts, C., Siske, B., U.S. Provisional Patent Application No. 61/747,004, filed on December 28, 2012.
14. "Reversible Thermochromic and Photochromic Ink Pens and Markers," Clayton, T.; Owen, T., U.S. Patent Application Serial No. 61/605,714 on March 01, 2012 and U.S. Patent Application Serial No. 13/782,611 and PCT/US13/20814, filed January 9, 2013.
15. "Thermochromic Coloring Pad," Clayton, T.; Owen, T., U.S. Patent Application Serial No. 13/752,056, filed on January 28, 2013.
16. "Pressure Sensitive Coating for Image Forming," Clayton, T., Owen, T., U.S. Patent Application Serial No. 61/732,120 on November 30, 2012 and U.S. Patent Application Serial No. 61/584,398 on January 9, 2012, and U.S. Patent Application No. 13/737,728 and PCT/US13/28555, filed March 1, 2013.
17. "Small Scale Microencapsulated Pigments and Uses Thereof," Clayton, T. U.S. Patent Application No. 13/843,492, filed on March 15, 2013.
18. "Thermal Treatment to Improve Performance of Thermally Damaged Thermochromic Systems," Clayton, T., Owen, T., U.S. Patent Application No. 61/832,039, filed on June 6, 2013.
19. "Water-Activated Thermochromic Materials," Clayton, T., Owen, T., U.S. Patent Application No. 61/836,563, filed on June 18, 2013.
20. "Yellow Thermochromic Dyes and Ink Composition," Clayton, T., Owen, T., Small, L., Wang, R., Du, Y., Abraha, M., U.S. Patent Application No. 61/842,165, filed on July 2nd, 2013.
21. "Radiation Curable Ink Compositions," Cong, L., Clayton, T., U.S. Patent 9,540,531 B2. Patent issued January 10, 2017.

22. "Gabaergic Receptor Subtype Selective Ligands and Their Uses," Cook, J., Clayton, T. et al. U.S. Patent 9,597,342. Patent issued March 21, 2017.
23. "Thermochromic Efficiency Indicator," Edson, P., Owen, T., Clayton, T., U.S. Patent 10,113,920. Patent issued October 30, 2018.
24. "Spot Gloss and Gloss Control in an Inkjet Printing System," Cong, L., Clayton, T., U.S. Patent 10,730,318 B2. Patent issued Aug. 4, 2020.

D. **Non-refereed Publications** (including major in house reports): Progress reports were written to NIH as part of grants.

E. **Papers Presented at Professional Meetings**

1. "Synthesis of Optically Active Subtype Selective BZR Ligands," S. Huang, T. Clayton, M. Dai, R. Edwankar, C. Sawant, J. M. Cook, Abstracts of Papers, 232nd ACS National Meeting, San Francisco, CA, Sept. 10-14, 2006, MEDI-502.
2. "The SAR Study of Benzodiazepine Receptor Bivalent Ligands by Low Temperature NMR Spectroscopy and X-Ray Analysis," S. Huang, T. Clayton, M. Dai, W. Yin, J. Ma, R. Edwankar, C. Sawant, M. Van Linn, Y. Teng, M. Johnson, H. F. Forsterling, and J. M. Cook, Abstracts, 37th Great Lakes Regional Meeting of the American Chemical Society, Milwaukee, WI, May 31 – June 2, 2006, GLRM-155.
3. "Modulation of Alcohol-heightened Aggression in Mice by α-5-Containing GABA(A) Receptors," S. Faccidomo, J. G. Maggin, S. Melief, T. Clayton, J. M. Cook, K. A. Miczek, Society for Neuroscience, October, 2006, Atlanta, GA.
4. "Synthesis, Pharmacological Studies, and Molecular Modeling of Novel 1,3-Diazipinium Chlorides," J. A. Grant, Y. A. Jackson, M. Gossel-Williams, T. Clayton, J. M. Cook, Latest Trends in Organic Synthesis, Brock University, St.Catherines, Ontario, CA, 2006.
5. "Synthesis of Subtype Selective Ligands for Alpha -5 Containing GABA (A) / Bz Receptors to Treat Memory Deficits," T. Clayton, M.Ernst, L. Richter, S. Sankar, T. Delorey, W. Sieghart, R. Furtmüeller, G. Ecker, and J.M. Cook, 233rd ACS National Meeting, March 25-29, 2007, Chicago, Ill., MED - 299.
6. "Design and Synthesis of Stereoenantiomeric Benzodiazepine Receptor Ligands," S.Huang, M. Savic, R. Furtmueller, A.Duke, T.Clayton, W. Sieghart, J.K. Rowlett and J.M. Cook, 233rd ACS National Meeting, March 25-29, 2007 Chicago, Ill., MED – 302.
7. "GABA-A/alpha 5 Receptor Mechanisms in the Discriminative Stimulus Effects of GABA-A Modulators" D. Platt, M. Van Linn, T. Clayton, J.M. Cook, J. Rowlett, 69th Annual Meeting of the College on Problems of Drug Dependence, June 16-21, Hilton, Quebec, Canada, Poster Session III (2007).
8. "Serendipity Rediscovered - An Oxymoron or Rational Drug Design: Studies on Subtype Selective BzR/GABAergic Ligands," J.M. Cook, H. June, E. Weerts, M.L. Van Linn, D. Platt, T. DeLorey, M. Savic, T. Clayton, Abstracts of Papers, 234th ACS National Meeting, Boston, MA, United States, August 19-23, 2007 (**Plenary Lecture**.)
9. "Ry-023, a Selective Inverse Agonist at the Benzodiazepine Binding Site on the GABA-A α5 Receptor, Improves Performance in a Delayed-Match-to-Sample Task in Rhesus Monkeys," M. Weed, T. Clayton, J.M. Cook, 46th American College of Neuropsychopharmacology, December 9-13, Boca Raton, FL, Abst. #158 (2007).
10. "Role of GABA(A) Receptor Subtypes in Benzodiazepine Self-administration by Rhesus Monkeys", B. Fischer, D. Platt, M. Van Linn, S. Rallapalli, T. Clayton, J. M. Cook and J. K. Rowlett, *71st Annual Meeting of the College on the Problems of Drug Dependence, June 20-25, Reno, NV*, **2009**.

11. "GABA-A Receptor Subtype Mechanisms in the Discriminative Stimulus Effects of Ethanol in Monkeys", D. Platt, M. Van Linn, S. Rallapalli, T.Clayton and J. M. Cook, *71st Annual Meeting of the College on the Problems on Drug Dependence, June 20-25, Reno, NV,* **2009**.

12. "PWZ-029, An Inverse Agonist Selective for α5 Subunit Containing GABA(A) Receptors, Enhances Performance on an Executive Function Task in Monkeys", J. K. Rowlett, C. A. Moran, T. Clayton, S. Rallapalli, B. Roth and J. M. Cook, *European Behavioral Pharmacology Society*, September 4-7, 2009, Rome, Italy.

13. "Acute Dependence in Squirrel Monkeys Following Zolpidem Administration: Role of α1 GABA (A) Receptors," L. Teixeira, B. Fischer, M. VanLinn, O. Namjoshi, W. Yin, T. Clayton, J. Cook, J. Rowlett, Society for Neuroscience Meeting, November 13-17, 2010, San Diego, CA.

14. "Evaluation of α1 GABA (A) Receptor Mechanisms in the Reinforcing Effects of Alcohol in Rhesus Monkeys," M. Szafir, M. VanLinn, O. Namjoshi, W. Yin, T. Clayton, J. Cook, D. M. Platt, Society of Neuroscience Meeting, November 13-17, 2010, San Diego, CA.

F. **Invited Lectures Presented at Universities, Industry, etc.**

1. "Computational Chemistry Methods: SAR, Pharmacophores & Protein Docking," Clayton, T.; University of Wisconsin-Milwaukee, Milwaukee, WI, March 2, 2010.

2. "Synthesis of Subtype Selective ligands for α5 Containing GABA(A) Receptors," Clayton, T., University of Colorado-Colorado Springs, Colorado Springs, CO. October 29, 2013.

3. "Synthesis of Novel Leuco Dyes and Smart Materials," Clayton, T.; United States Air Force Academy, Department of Chemistry, Colorado Springs, CO. November 5, 2013.

4. "Computational Chemistry Methods, SAR, Pharmacophores & Protein Docking," Clayton, T.; Sigma Xi Meeting, University of Colorado, Colorado Springs, CO, November 6, 2013.

IV. **RESEARCH IN PROGRESS**

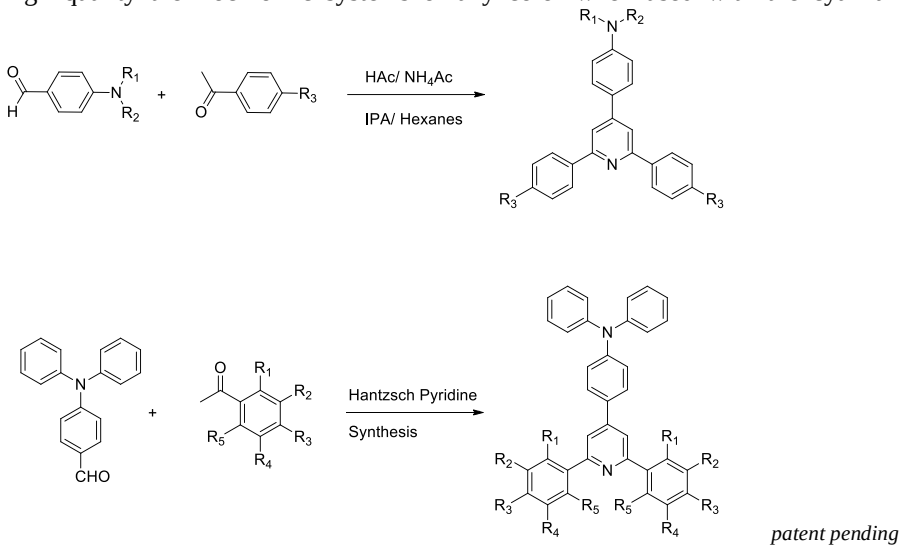
Major areas of interest at the present time include Smart Materials Chemistry, Synthetic Organic Chemistry, and Medicinal Chemistry. More specifically, Dr. Clayton is interested in the synthesis of novel molecules with therapeutic value or which can interact to surprise, alert or protect consumers and the preparation of inks, coatings, packaging, or consumer products containing 'Smart Materials'. Research of this type has led into the triarylpyridine, oxazine, lactone, fluoran, quinazoline, pyran, naphthopyran, spiropyran, and spirooxazine fields. Much of our research effort has been concerned with the synthesis of small molecules, preparation of microencapsulated smart materials, and utilization in commercial coatings for packaging as well as finished goods themselves. Dr. Clayton's work has broad application and is being used commercially world-wide.

Smart Materials

The use of 'Smart Materials' can make ordinary objects interactive. Dr. Clayton's laboratory has developed covert materials which are machine readable and overt materials which will interact with light, heat, and pressure. Further, his expertise in microencapsulation allows for the preparation of highly stable microencapsulated systems designed for harsh environments. He develops bench scale chemistries and scales them to pilot and full production scale-up. His team operates a synthetic kilo-scale laboratory, a pilot applications lab, and a full production facility. The microencapsulated smart materials have wide application in consumer packaged goods (CPG), pharmaceutical packaging, and brand protection. Additionaly, Dr. Clayton has built a network of custom chemical manufactures, toxicologists and certified testing laboratories, and contract manufacturing partners to ensure all commercial and regulatory concerns are properly addressed as part of his product development pipeline and commercial launch process. Dr. Clayton's work may be more broadly known for the temperature sensitive blue mountains on the Coors Light can that stops unsuspecting consumers from buying warm beer. The blue mountains were recently referenced in the popular country song, "Pontoon."

In addition to fighting thirst, his laboratory develops technologies that are focused on helping children learn, keeping people safe and identifying counterfeit products. Current research efforts are detailed below:

1. To prepare commercially viable yellow thermochromic systems. There has been significant need for potent yellow chromophore leuco dyes with application in microencapsulated systems. It has been found that triaryl pyridines (Figure 1) develop a strong yellow color as compared to other yellow leuco dye scaffolds. Our laboratory has developed more than 50 triaryl pyridine analogs with wide rangeing solubility, color density, λ_{max} profiles, and varying kinetic profiles and is based on Hantzsch pyridine synthesis. Currently CTI has developed the most potent yellow leuco chromophores in the world. These proprietary compounds not only allow the availability of strong yellow thermochromic systems but allow for the preparation of high quality thermochromic systems of any color when used with the cyan and magenta leuco dyes.



patent pending

Figure 1. Highly stable fluorescent yellow leuco dyes.

2. To produce chemically resistant microcapsules. Our laboratory has patented chemical and process techniques for the preparation of robust microcapsules. Microcapsules with enhanced solvent resistance, extended heat resistance, and significant enhancement of UV stability have been produced in our laboratory and are currently being tested in the harshest of manufacturing environments. We have now developed smart materials which can be successfully used in solvent based coil coating applications.
3. To prepare more UV stable thermochromic systems. Traditional dye based systems have relatively short UV stability. We have now prepared thermochromic systems with 4X improvement in UV light stability allowing for commercialization beyond one time use commercial applications opening new market opportunities.
4. To prepare commercially viable photochromic coatings. The use of photochromic materials has been limited due to the intrinsic instability (thermal and UV) of the compounds. Our lab has successfully demonstrated proof of concept photochromic systems which are heat stable and UV stable. Pilot scale up and commercial line trials are underway now and photochromic products will be available in 2014.
5. To prepare formaldehyde free microencapsulation processes. We have already driven residual formaldehyde levels down below *de minimis* concentrations (non-reportable by Prop 65) and we are currently developing the chemistry of formaldehyde free microencapsulation.
6. To synthesize neutral buoyancy highly Raman active taggants for covert identification. Our laboratory has developed patented machine readable invisible pigments for use in brand protection, pharmaceutical packaging authentification, and currency. Work is underway to build a library of highly potent analogs for commercialization. Our taggants are currently used by foreign countries and a grant has been awarded to fund further development.
7. To prepare cancer cell targeting gold nanoparticles. Our laboratory has patented cancer-targeting

compounds. Efforts are underway to tether our targeting analogs to gold nanoparticles in order to develop non-invasive cancer treatments.

8. To prepare microencapsulated systems with absolute particle size below 1μm. It has been demonstrated that there is significant benefits to commercial environments when coating formulations are prepared with reduced particle size microcapsules. Our laboratory has patented new processes and chemical techniques to prepare such microcapsules. Efforts are underway to scaleup the chemistry to full production scale.

Novel Imidazobenzodiazepines

Synthesis of chiral and nonchiral imidazobenzodiazepines allowed for enhancing selectivity to subtypes of the GABA(A) receptors and for further refinement of the Milwaukee based pharmacophore. From R and S analogs of pendant imidazobenzodiazepines (Figure 2), a new lipophilic pocket was found in the binding pocket of α5 benzodiazepine receptor GABA(A) subtype (L_4).

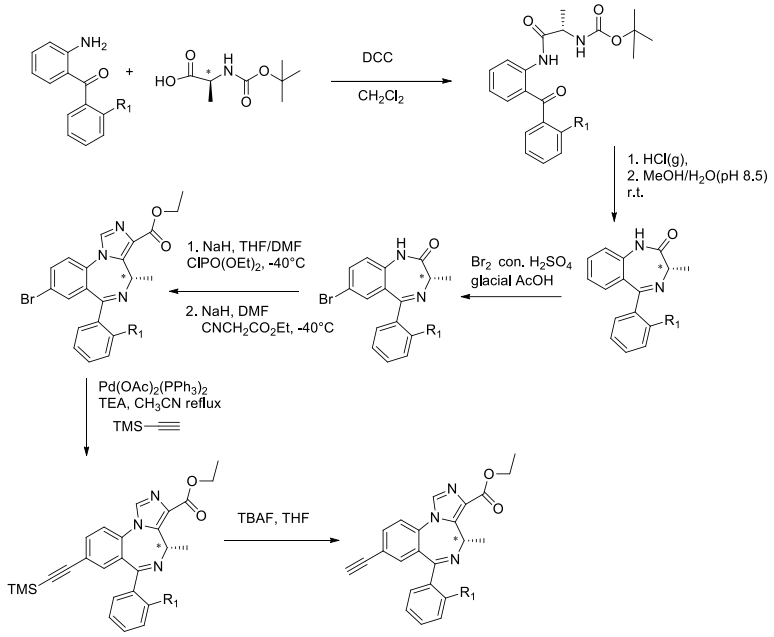


Figure 2. Imidazobenzodiazepine Synthesis

Pharmacophore Development

More than 650 agonists, antagonists and inverse agonists at the GABA(A) benzodiazepine binding site (Bz BS) which encompassed 16 structural families were used for generating the unified pharmacophore/receptor model. Although the relative affinities, efficacies and functional effects displayed by various ligands from the same structural class at the diazepam sensitive and diazepam-insensitive benzodiazepine binding sites were taken into account, the approximate locations of descriptors (hydrogen bond donor sites, hydrogen bond acceptor sites, lipophilic regions, and regions of steric repulsion) were based primarily on *in vitro* binding affinities. Ligands from different structural classes were then superposed on each other to satisfy the same descriptors, resulting in the unified pharmacophore model.

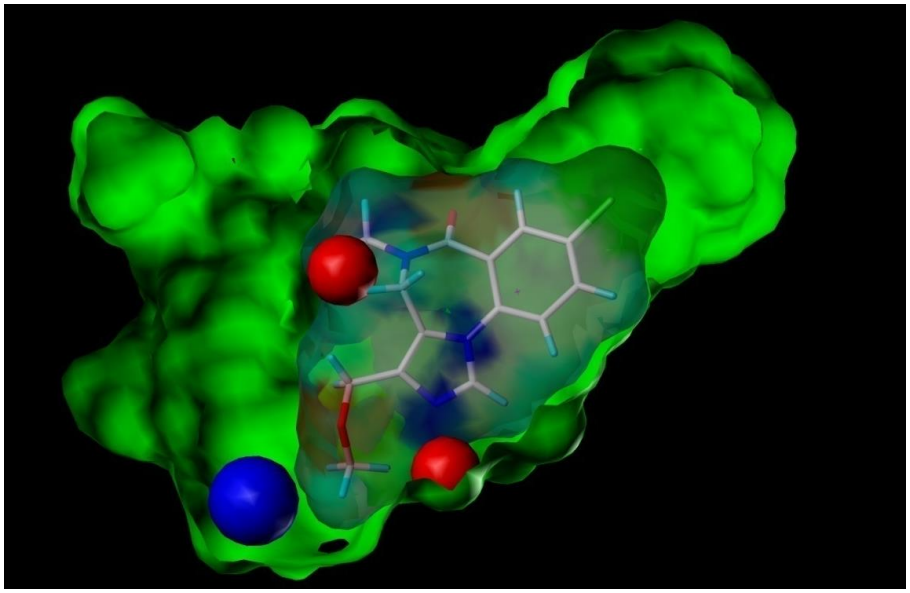


Figure 3. A novel imidazobenzodiazepine docked in the α5 GABA(A) benzodiazepine receptor model. The upper and lower red pharmacophoric descriptor are H_2 and H_1, respectively. The blue pharmacophoric descriptor is A_2.

The pharmacophore/receptor model consists of two hydrogen bond donating descriptors (H_1 and H_2), one hydrogen bond accepting descriptor (A_2) and one lipophilic descriptor (L_1). In addition to these descriptors, there are lipophilic regions of interaction (L_2, L_3 and L_{Di}) as well as regions of negative steric repulsion (S_1, S_2 and S_3). While occupation of L_2 and/or L_3 as well as interactions at H_1, H_2, and L_1 are important for positive allosteric modulation, inverse agonists only require interactions with the H_1, L_1, and A_2. descriptors of the pharmacophore/receptor model for potent activity *in vivo*. The L_{Di} descriptor is a region of lipophilic interaction, for which the difference between the diazepam sensitive (DS) and the diazepam insensitive (DI) sub-pharmacophore models is most pronounced. Depicted in Figure 4 are the relative locations of the different descriptors and regions of the model.

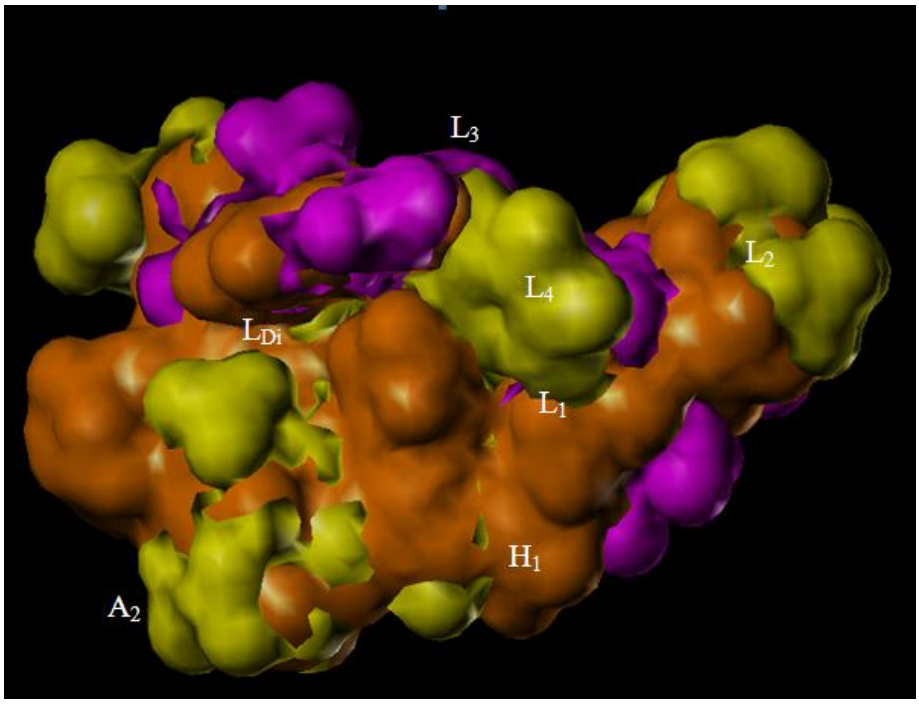


Figure 4. Overlay of the α5β3γ2 receptor (yellow) subtype with the α1β3γ2 receptor (magenta) subtype. Orange surfaces indicate overlapping regions. H_1 is a hydrogen bond donor site while A_2 is a hydrogen bond acceptor site. L_1, L_2, L_3, L_4, and L_{Di} all represent lipophilic pockets. H_2 cannot be seen.

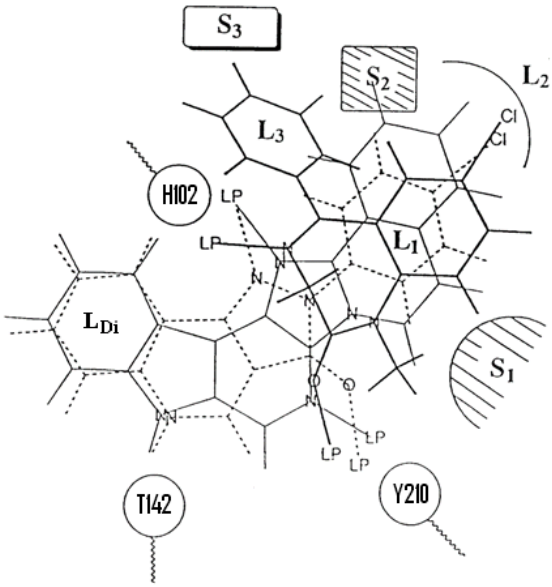


Figure 5. The two dimensional representation of the Milwaukee-based unified pharmacophore with the three key amino acids in the binding site which have been identified from the modeling described above.

V. STATEMENT OF TEACHING RESPONSIBILITIES

There are a large number of students who enter UW-Milwaukee with career goals directed toward the Health Sciences in various subdisciplines including: premedical, predental, preveterinarian, and medical technology.

The candidate's expertise in Medicinal Chemistry as well as his experience in Organic Chemistry enables him to teach students, academically or industrially, in this area quite readily. He has been responsible for teaching analytical and synthetic laboratories to students in the medical technology, biology and environmental engineering fields. In addition, he has taught chemistry, premedical, predental, and preveterinarian students, which also included the laboratories 344. The candidate is happy to teach the above courses at the undergraduate level for it is extremely important to bridge the gap between Organic, Medicinal, and Biological Chemistry. At the graduate level, the candidate is interested in teaching Synthetic Organic and Medicinal Chemistry to students who are enrolled in all disciplines of chemistry. This teaching can also include courses in Medicinal Chemistry, The Biogenesis of Natural Products, A Survey of Natural Products Chemistry and The Total Synthesis of Indole Alkaloids.

A. **Experience as a teacher**

Laboratory Courses Taught at the University of Wisconsin-Milwaukee

Undergraduate Level

Chemistry 101 General and Organic Chemistry for Nursing Students
Chemistry 102 General Chemistry Laboratory I
Chemistry 103 General Chemistry Laboratory II
Chemistry 221 Quantitative Analysis
Chemistry 223 Advanced Quantitative Analysis
Chemistry 342 Introductory Organic Chemistry Laboratory
Chemistry 344 Organic Chemistry Laboratory

Graduate Level

VI. UNDERGRADUATE AND GRADUATE RESEARCH PROJECTS, THESIS AND DISSERTATIONS DIRECTED.

Undergraduate Research 399, 599, and 691 - Students and their Next Position

UCCS-CTI Internship Program in Synthetic Chemistry

Graduate Level - Graduate Students, Thesis Title or Research Project in Progress

Postdoctoral Trainees and Visiting Scientists

VII. CONSULTING SERVICES

1. Consulted for Smoke Break LLC. (2004-2010).
2. Consulted for Circinus LLC (2006).
3. Consulted for MicroBrush International (2010).
4. Consulted for Cardinal Intellectual Property (2008-2010).
5. Consulted for Diet Sticks LLC. Formulation of energy drink (2010-2013).
6. Consulted for Summit Nutraceuticals. Supplements (2013).
7. Consulted for Chromatic Technologies Incorporated (2015) regarding legal dispute.
8. ***Large number of corporate consultations under NDA cannot be disclosed.***

VIII. **MEMBERSHIPS**

The American Chemical Society: Organic & Medicinal Chemistry Divisions

Sigma Xi

NAPIM

Science Advisory Board

RadTech

IX. **MAJOR PROJECT ACHIEVEMENTS.**

1. Formulated and scaled operation for production of web offset fountain solution (1999).
2. Formulated pilot process for pigment dispersion by "Flush" process (1999).
3. Formulated spine and pocket water based adhesives for custom web production (2000).
4. Formulated book binding hot melt adhesives for perfect bound magazine and book assembly operation (2000).
5. Formulated remoistenable water based adhesives for envelope and orderform printing/converting operation (2001)
6. Formulated solvent based inkjet inks for continuous inkjet. Bitjet & JetArray systems (2003).
7. Formulated a nicotine delivery formulation and device for startup company (2004).
8. Synthesized diacetylene compounds for Smart Packaging with color activation by UV laser excitation (2007).
9. Formulated 'Smart Coatings' for marking/ activation by CO2 laser excitation (2007).
10. Formulated water based inkjet ink for high speed drop on demand roll to roll Screen Press (2007).
11. Designed, installed, and startup of ink plant to produce heatset web and sheetfed Quad/Winkowski, Poland (2008).
12. Formulated water based inkjet ink for continuous inkjet applications. Kodak Equipment (2008).
13. Designed and setup of explosion proof solvent-based inkjet operation (2009).
14. Founding member of the Quad/Graphics Innovation Council. Championed the team that prepared an award winning business plan focused on the expansion of Quad/Med. Booz & Co. reviewed the plan and an execution team was selected to implement the plan. A president and vice president have been hired who specialize in business development. In 2011, QuadMed launched an aggressive nationwide expansion plan and plans to open 7 more clinics and has interest from Toyota and Walt Disney.
15. Formulated UV inkjet ink formulations for drop on demand for Inca Onset Presses for Quad/Graphics, USA (2010).
16. Designed a batch process for specialty pigment production (2010).
17. Fomulated solvent based flexographic inks for film (2010-2015).
18. Formulated water based flexographic inks for label and film (2010-2015).
19. Formulated energy blend concentrate for a startup company (2012).
20. Designed and executed erection of a synthetic laboratory for CTI (2012).
21. Formulated, produced and sold covert (security) ink formulation for machine readable applications to foreign customers (2012).

22. Reduced microencapsulation batch process time by 75% by implementing new innovative processes (2012).
23. Designed and qualified a Novar ink for steel can spindle printing with Rexam, Spain (2012).
24. Designed and qualified a specialty end printing ink with Rexam, Germany (2012).
25. Qualified a Chinese manufacturing partner to produce specialty pens & markers, Hanzhou, China (2013).
26. Led synthetic effort to successfully deliver novel leuco dyes with enhanced thermal and UV stability (2013).
27. Led team to deliver microencapsulation process with enhanced chemical and thermal resistance (2013).
28. Formulated waterbased flexographic inks to replace solvent based for specialty pigment compatability.
29. Delivered a commercial thermochromic coil coating product and manufacturing process with Golden Aluminum, USA (2013).
30. Delivered a polyester wet offset ink for specialty food closures with Fabricas Monterrey, Mexico (2013).
31. Formulated a wet offset UV curable ink for Silgan White Cap, USA (2013).
32. Led application team to deliver a commercial manufacturing program for microcapsule production with D_{50} < 1μm (2013).
33. Developed high speed metal decoration inks with reduced misting, enhanced color and improved rub resistance (2013).
34. Managed execution of new consumer product production with outsourcing partners in China (2013).
35. Formulated commercial UV screen inks and finished goods for major US consumer products company (2013).
36. Prepared photochromic pigment systems with vastly improved thermal and UV stability (2013).
37. Consulted to a nutraceutical company on formulation, manufacture, and packaging of a vitamin and appetite suppressant protein shake product (2013).
38. Established a chemistry internship program with the University of Colorado-Colorado Springs Chemistry Department and Chromatic Technologies (2014).
39. Formulated first LED curable inkset for adhesion to polypropylene and acrylic without the need for primers (2015)
40. Developed a novel black pigment from renewable resources (2016).
41. Developed jetable clear coatings for wide format printing (2017).
42. Developed a scalable carbon black pigment from renewable resources (2018).
43. Designed and constructed world class Inkjet Development Center of Excellence in Manchester, NH (2018).
44. Released commercial formulation and novel manufacturing process to cut inkjet ink manufacturing cost by 30% (2019).
45. Developed novel photopolymer clear formulations for flexible yet mar resistant printing (2020).
46. Developed radiation cure inkjet inks with strong adhesion to nonpolar substrates without primers (2021).
47. Developed radiation curable inkjet inks devoid of type I photoinitiator 2,4,6-trimethylbenzoyl-diphenyl phosphine oxide (2022).
48. Designed a microencapsulation protocol for cannabinoids & fat soluble vitamins to enhance bioavailabilty (2022).
49. Formulated an edible inkjet ink for food decoration (2022).
50. Developed thermoset/thermoplastic building materials for construction industry (2023).

XI. **COMMUNITY INVOLVEMENT**

Big Brother (2000)

Youth Coaching at YMCA (2011-2015)

Village West Board of Directors (2022-Present)