

Curriculum Vitae, Robert D. Hancock

Postgraduate: D.Sc., 1991, University of the Witwatersrand, Johannesburg, South Africa.

Title of Thesis: “The Recognition of Metal Ions by Ligands.” (The D.Sc. is a British type of award based on research where one was the research advisor, and typically involves work with students over a long period of time on a specific topic. It is similar to the Habilitation of European Universities).

Postgraduate: Ph. D., 1969, University of Cape Town (supervised by Prof. D. A. Thornton).

Title of Thesis: “Crystal Field Aspects of Vibrational Spectra.”

Undergraduate: Rhodes University, B.Sc.(Hons), 1966 (with Distinction).
Rhodes University, B.Sc., 1965.

Schooling: St Andrews College, Grahamstown, 1958-1962.
St Andrews Preparatory School, Grahamstown, 1955-1957.
Fort Beaufort Primary School, 1950-1954.

Born: Fort Beaufort, Cape Province, South Africa, May 27, 1944.

Employment: 2012-present Professor, Chemistry, UNCW.
2002-2012. Will S. de Loach Distinguished Professor of
Chemistry, UNCW. (Term limited to 10 years)
1997-2002 Principal Scientist, Power Engineering Co. SLC, Utah.
1995-1997 Senior Scientist, IBC Advanced Technologies
1993-1995. Visiting Professor, Texas A&M University.

University of the Witwatersrand.

1987-1993. **Professor of Inorganic Chemistry.**

1984. *Ad Hominem* **Professor** of Coordination Chemistry.
(Personal Chair).

1982. Promoted to **Reader** (somewhat higher than Associate
Professor)

1980. Started as **Senior Lecturer** (approx. equivalent to
Associate Professor)

National Institute for Metallurgy, 1970-1980.

Started with rank of Scientist, left with rank of **Assistant Director.**

Graduate Students Supervised (University of the Witwatersrand, 22 students).

V. J. Thom (Ph.D)	1984	P. W. Wade (Ph.D.)	1990.
B. S. Nakani (Ph.D)	1984	G. Croft (M.S.)	1991
G. Kyriakakis (M.S.)	1984	T. Chantson (M.S.)	1992
S. M. Dobson (Ph.D)	1985	A. S. de Sousa (Ph.D.)	1995
M. J. Van der Merwe (Ph.D)	1985	J. Twyford (M.S.)	1995
M. S. Shaikjee (M.S.)	1987	H. Maumela (Ph.D.)	1995
A. H. Schwelnus (M.S.)	1987	W. Van Otterlo (M.S.)	1995
M. P. Ngwenya (Ph.D)	1989	R. Luckay (Ph.D.)	1996
K. V. Damu (Ph.D)	1989	T. Mali (Ph.D.)	1996
R. Bhavan (Ph.D)	1989	G. Pattrick (Ph.D.)	1996
M. Adams (Ph.D.)	1989	E. Casimiro (Ph.D.)	1996

Graduate Students supervised since 2002 at UNCW (34 MS students to date):

- M. H. Salter, Jr. (M.S.) 2003 Thesis: *The study of models for Zinc(II) metalloenzymes in aqueous solution.*
- C. J. Siddons (M.S.) 2004 Thesis: *Metal Ion Complexing Properties of Amide Donor Ligands.*
- W. Gan (M.S.) 2004 Thesis: *Design of Fluorescent Ligands for the detection of tetrahedral metal ions.*
- K. A. M. Oscarson (M.S.) 2004 Thesis: *Complexation of metal ions in aqueous solution by fluorescent ligands containing pyridyl groups.*
- D. L. Melton (MS) 2005 Thesis: *Metal Ion Complexing properties of the two dimensional highly preorganized ligand 1,10-phenanthroline-2,9-dicarboxylic acid.*
- F. C. McDonald (MS) 2005 Thesis: *The Study of 8-hydroxyquinoline-2-carboxylic acid and its metal ion complexing properties.*
- R. T. Gephart (MS) 2006 Thesis: *The highly preorganized ligand 2,9-bis(hydroxymethyl)-1,10-phenanthroline, and its complexation properties with metal ions.*
- Lindsay L. Boone (MS) 2006 Thesis: *The highly preorganized ligands 1,10-phenanthroline-2,9-dialdoxime and bis-1,10-phenanthroline, and their complexing properties with metal ions.*
- Jason R. Whitehead (MS) 2007 Thesis: *Metal ion complexing and fluorescence properties of the novel hemicycle, dipyridoacridine, with computational studies on metal ion selectivity.*
- Gregory M. Cockrell (MS) 2007 Thesis: *The highly preorganized ligand 2,9-di-(2'-pyridyl)-1,10-phenanthroline, and its complexation properties with metal ions.*

- Nolan E. Dean (MS) 2007 Thesis: *Metal ion complexing properties of the highly preorganized ligand 1,10-phenanthroline-2,9-dicarboxylic acid.*
- Charles Richard Gaver Jr. (MS) 2008 Thesis: *The highly preorganized ligands 8-(2-pyridyl)quinoline, 2,2'-dipyridyl amine and 1,10-phenanthroline-2,9-dicarboxylic acid, and their complexing properties with metal ions*
- David Buist (MS) 2009 Thesis: *The geometry of the bis-imidazole chelate ring and its selectivity for the largest metal ions.*
- Daniel Kissel (MS) 2009 Thesis: *Metal ion complexing properties of two-dimensional sulfur ligands and their use in neurodegenerative diseases.*
- Adam Brenneman (MS) 2009 Thesis: *Metal ion complexing properties of the highly preorganized ligands 8-quinolyl-1,10phenanthroline and 1,10-phenanthroline-2,9-dicarboxyaldehyde.*
- Neil J. Williams (MS) 2010 Thesis: *Metal ion complexing and fluorescence properties of the highly preorganized ligands 1,10-phenanthroline-2,9-dicarboxylic acid, 2,9-bis(hydroxymethyl)-1,10-phenanthroline and dipyridoacridine*
- Amy Mroz (MS) 2010 Thesis: *Affinity of Actinide Ions for Nitrogen-donor ligands.*
- Danielle Merrill (MS) 2010 Thesis: *Metal ion complexing properties of the highly preorganized tetradentate ligand 1,10-phenanthroline-2,9-dicarboxamide.*
- T. Neal Triplett (MS) 2010 Thesis: *Metal ion complexing properties of 8-quinolyl-1,10-phenanthroline and 2-(2-pyridinylamino)-8-quinolinol.*
- Ashley N. Carolan (MS) 2011 Thesis: *The Effect of Ligand Preorganization on the Metal Ion Selectivity of Polypyridyl Ligands.*

- Francheska L. Vázquez (MS)
(with Dr. S. Bart Jones) 2012 Thesis: *Determination of Formation Constants of Highly Preorganized low solubility Ligands with Metals using Long Pathlength UV-Vis Instrumentation.*
- Jesika B. Norris (MS) 2012 Thesis: *Addition of Anions to Metal-ligand Complexes and the Effects on Fluorescence.*
- Ryan H. Tillman (MS)
(with Dr. S. Bart Jones) 2012 Thesis: *Kinetic Studies of Complex-Formation of Highly Preorganized Pyridyl-Based Ligands with d^8 Metal Ions.*
- Galen C. Littman (MS) 2012 Thesis: *Selective Separation of Actinides from Lanthanides by the Polypyridal Ligands TPTZ and Diphen.*
- Nefertari McKoy (MS) 2013 Thesis: *Metal ion Complexing Properties of Highly Preorganized Polypyridyl Ligands with Silver(I) and Mercury(II).*
- Daniel G. Ballance (MS) 2015 Thesis: *The Complexation of Organic Ligands with Metal Ions and its Applications.*
- Joseph W. Nugent (MS) 2015 Thesis: *The Role of Metal-Fluorophore π -Contacts in the Fluorescence, Absorbance, and NMR Spectra of Tethered Fluorescence Sensors.*
- Benjamin E. Colenda (MS) 2015 Thesis: *The Role of Hydrogen Bonding in Chelation Enhanced Fluorescence of Sensors with Indole-Based Tethered Fluorophores.*
- Bruna B. Correia (MS) 2016 Thesis: *The Influence of π -contacts on Fluorescence Of Metal-Ligand Complexes.*
- Lindsay Tucker (MS) 2016 Thesis: *Complexation of Uranyl and Trivalent f-block Elements by Polypyridyl Ligands*
- Justin C. Deems (MS) 2016 Thesis: *The Role of Metal-Fluorophore π -contacts in the Fluorescence of Heterocyclic Sensors*

- Mark A Lashley (MS) 2018 Thesis: *Extraction of uranium from seawater: A spectroscopic study of the selective complexation of the uranyl(VI) cation.*
- Amber C. Watson (MS)
(with Dr. S. Bart Jones) 2018 Thesis: *Formation Constant Determination of Ligands with Metal ions of interest in Medicinal and Nuclear Applications*
- Thomas R. Brown (MS) 2018 Thesis: *The Influences of Metal Complexation on the Photo-Physical Properties of Benzyl Substituted Ligands.*

Honors Students:

- Curtis M. Whaley 2003. Research Project: *Complexation of metal ions by bridging sulfur-donors from the Nickel(II) complex of N,N-bis(2mercaptoethyl)-1,5-diazacyclooctane.*
- James M. Harrington 2003-2005. Research Project: *Relativistic Effects in the Formation of Cadmium Complexes with Crown Ethers.*
- Laura M. Clapp 2004-2005. Research Project: *Complexation of metal ions by the ligand ethylenediamine-N,N,N',N'-tetraacetamide as a model of binding sites in calcium-selective proteins.*
- Jason R. Whitehead 2005. Research Project: *Exploration of Calcium Selectivity in Proteins.*
- Natalie White 2017 Research Project: *The design of fluorescent sensors for metal ions and anions in medical and environmental applications.*

Societies.

Fellow of the Royal Society of South Africa.

Fellow of the Royal Society of Chemistry (London).

Member of the South African Chemical Society.

Member American Chemical Society.

- Awards:**
- 1976. Raikes Medal.** Awarded annually to most promising Chemist in South Africa under age of 35.
 - 1980. Mintek Gold Medal.** Awarded for outstanding contributions to Research at MINTEK.
 - 1987. Sir Earnest Oppenheimer Travel Fellowship.** Awarded annually to one senior South African Scientist for Overseas travel.

Lectures.

- International Conference on Solute-Solute Interactions, **Florence**, 1980
- Conference on Macrocyclic Chemistry, **Florence**, 1986.
- Conference on Macrocyclic Chemistry, **Durham (UK)**, 1989
- American Chemical Society Meeting, **Atlanta**, Georgia. Symposium on Ligand Design, 1991.
- Snowbird**, Utah, 1992. IUPAC Symposium on Chemical Thermodynamics.
- Provo**, Utah, 1992. XVII International Conference on Macrocyclic Chemistry.
- Lausanne**, Switzerland, 1992. ICCS Symposium on Ligand Design.
- San Diego**, August 23-27 1993, International Conference on Bioinorganic Chemistry.
- Prague**. XI Symposium on Chemistry of Heterocyclic Compounds. September 1993.

Kansas. XIX International Meeting on Macrocyclic Chemistry, June 1994.

Glasgow. Royal Society of Chemistry, September 1994. Invited Speaker.

Kansas, Local Meeting of ACS, June 1995.

Vancouver, XI International Meeting on Radiopharmaceutical Chemistry and VI Workshop on Targetry and Target Chemistry. August 1995,

Plenary Lecture.

Liverpool, 1996. RSC Workshop on Radiopharmaceuticals.

San Francisco. 1997. ACS meeting, IC division, on Ligand Design.

Invited Speaker.

San Francisco. 1999. ACS meeting, IC division, on Molecular Mechanics. Invited Speaker.

San Diego. 2005. ACS Meeting, IC Division. Symposium on 'Designed Ligands and Binding Constants'. **Invited Speaker.**

Pacificchem. Honolulu Dec. 2005. Symposium on Molecular Mechanics calculations in the age of DFT.

Cape Town, South Africa. August 2006. XXXVII International Conference on Coordination Chemistry. **Keynote Lecture.**

Sermacs, Augusta, South Carolina. November 2006. Symposium on Metal Ions in Biology.

Sermacs, Greenville, South Carolina, October 2007. Symposium on sulfur and selenium donors.

Sermacs, Nashville, Tennessee, November 2008, 'Metal Ion Complexing Properties of a New Class of Tetradentate Ligands of the Highest Levels of Preorganization.

- Lectures:**
- (Universities)**
- 1987.** Purdue University, Texas A&M, Notre Dame, Houston, Ohio State.
- 1989.** Cambridge University, Stanford University, Berkeley, Harvard University, Boston College.
- 1990.** Delivered the P. D. Hahn Lecture (University of Cape Town).
- 1992.** Washington University (St. Louis, Missouri).
- 1993.** Delivered the Barker Lecture (Rhodes University).
- 1993.** Brigham Young University, University of Miami, Vanderbilt University.
- 1994.** Harvard University, University of Texas (Dallas), Texas Tech.
- 1995.** Texas A&M University.
- 1997.** University of Utah.
- 2001.** University of North Carolina, Wilmington.
- 2003.** University of North Carolina, Chapel Hill.
- 2004.** Clemson University; Clemson, South Carolina.
- University of Kentucky, Louisville.
- 2005.** Pembroke University, North Carolina.
- 2006.** Kentucky State University
- 2006.** University of Kentucky, Lexington (ACS dinner, local section).

2006. East Carolina University, Greenville NC.

2007. University Distinguished Visiting Lecturer, University of Tennessee, Chattanooga, Department of Chemistry.

2012. University of North Carolina Charlotte.

2015. North Carolina Central University, Durham.

Overseas Study; Post-Doctoral year, Oxford, 1972, under supervision of Dr F. J. C. Rossotti.

Visiting Professor: Texas A&M University, 1987-1988, and 1993-1995, Hosted by Dr A. E. Martell.

Funding:	2002	NSF Grant CHE-0111131	\$150,000
	2007	Department of Energy (Grant # DE-FG07-07ID14896)	\$210,000
	2013	DOE. (Grant # DE-AC05-00OR22725)	\$75,000
	2016	NSF Grant # CHE- 1565981	\$330,000
	2016	DOE. (Grant # DE-AC05-00OR22725)	\$20,000

Research. Since 1980, the focus of my research has been on ligand design, with some 238 papers in international journals, plus a book co-authored with Dr A. E. Martell. (see attached list). This interest has evolved into an interest in design of fluorescent sensors for sensing metal ions and anions. An important aspect of this has been an investigation into the role of π contacts between metal ions and the aromatic fluorophores of fluorescent sensors in quenching fluorescence. This concept leads to a rational design approach for fluorescent sensors, which should lead to improved sensors for metal ions in the future, as well as for anions.

My research has at one time or another touched on nearly all of the metals in the periodic

table which have an aqueous chemistry. At this time I have papers that touch on the chemistry of metallic elements from Li (atomic number 3) to Rg (Roentgenium, atomic number 111, a 'superheavy' element with a half-life of 3.6 seconds). An early area of interest, which continues to the present, lies in the separation of metal ions in extractive metallurgical application. Since 1980 a growing focus has been on metal ions in biomedical applications. This has led to an ongoing study of the solution chemistry of the heavy post-transition elements, particularly Pb(II), Cd(II), Hg(II), Bi(III), Ga(III) and In(III). These metal ions are of growing interest in medical applications, and for many of them little is known about their chemistry. Other metal ions of interest are Gd(III) in MRI, and Th(IV), Am(III)/(IV), Cm(III)/(IV), Pu(IV) and Np(IV) in radioactive waste. A new interest is the recovery of uranium from the oceans, funded by the DOE, which involves the selective complexation of the uranyl cation at a concentration of 3 ppb. Even at this low concentration, the amount of uranium in the oceans is ten times the estimated amount on land, and could provide nuclear power for thousands of years.

In order to understand more fully the chemistry of metal ions in solution a wide variety of techniques has been employed, including Molecular Mechanics calculations, wave mechanical calculations (including DFT calculations), X-ray Crystallography, NMR, Polarography, Potentiometry, Fluorimetry, and UV-visible spectroscopy. The type of research that I do is thus well suited to training students in useful skills, as well as being of considerable usefulness in medicine, separation of isotopes in treatment of radioactive wastes, removal of toxic metals from the environment, extractive metallurgy, and areas in industry ranging from the development of detergents to production of ultrapure acids for etching computer chips. A new interest since the move to UNCW is the use of Density Functional Theory calculations in studying complexation reactions in aqueous solutions (see papers number 11, 12, 16, 17, 44, 49, and 53 below). Of particular interest is determining factors that control the behavior of fluorescent sensors for both cations and anions. Work in this area is represented by papers 5, 8, 9, 10, 12, 16, 29, 31, 34, and 44.

Publications.

At this time I have 249 publications in international refereed journals, as well as a book co-authored with the late Dr. A. E. Martell, "Metal Complexes in Aqueous Solutions" (Plenum, New York, 1996). The latter book has been well received, and almost the entire printing was sold out. I have been invited to produce a second edition. I have also been invited by Plenum to write a book on Ligand Design, but at this time due to pressure of work have not been able to do much on it.

In 2000 I was invited to be Honorary Editor of a Volume of Coordination Chemistry Reviews devoted to Molecular Mechanics of Coordination Compounds, in view of my contributions to this field. It has recently come to my attention that paper number 155 in the list below is a citation classic, and has been cited so far 1049 times. I have several other papers that have been cited more than 100 times, such as references 18 (174 citations), 37 (114 citations), 40 (104 citations), 55 (102 citations), 60 (120 citations), 129 (159 citations), 146 (234 citations), 148 (238 citations), 151 (232 citations), 155 (116 citations), 157 (253 citations), 177 (148 citations), 185 (170 citations), and 187 (102 citations). In total my papers have been cited altogether some 8000 times. A list of publications since 1984 is attached. I was recently invited to contribute papers to the special editions of *Chemical Society Reviews* (paper number 18 below) and *Polyhedron* (paper number 17) which are commemorating the Centennial of the award of the Nobel Prize in 1913 to Alfred Werner, the father of modern Inorganic Chemistry.

PUBLICATIONS, Robert D. Hancock (Since 1984).

- 1) Bruna B. Correia, Thomas R. Brown, Hee-Seung Lee, Joseph H. Reibenspies, and Robert D. Hancock, "Exciplex formation as an approach to selective copper(II) fluorescent sensors" *Inorg. Chim. Acta*, in the press (2020).
- 2) Bruna B. Correia, Thomas R. Brown, Hee-Seung Lee, Joseph H. Reibenspies, and Robert D. Hancock, "Mono-N-benzyl cyclen, a highly selective multi-functional 'turn-on' fluorescent sensor for Pb²⁺, Hg²⁺, and Zn²⁺" *Polyhedron*. In the press (2020).

- 3) Justin C. Deems, Joseph H. Reibenspies, Hee-Seung Lee, and Robert D. Hancock, Strategies for a fluorescent sensor with receptor and fluorophore designed for the recognition of heavy metal ions. *Inorg. Chim. Acta*, in the press (2020).
- 4) D. G. Ballance, V. S. Bryantsev, A. S. Ivanov, S. Dai, R. D. Hancock, Complexation of Lanthanides and other metal ions by the polypyridyl ligand quaterpyridine: relation between metal ion size, chelate ring size, and complex stability, *Inorg. Chim. Acta* Vol. 488, pp. 19-27 (2019).
- 5) Benjamin E. Colenda, Hee-Seung Lee, Joseph H. Reibenspies, and Robert D. Hancock, "Indole-Based fluorescence sensors for both cations and anions", *Inorg. Chim. Acta*, Vol. 482, pp. 478-490 (2018).
- 6) Bruna B. Correia, Thoms R. Brown, Joseph H. Reibenspies, Hee-Seung Lee, and Robert D. Hancock, "Exciplex Formation and Aggregation Induced Emission in Di-N-benzylcyclen and its Complexes – Selective Fluorescence with Lead(II), and as the Cd(II) Complex, with the Chloride Ion", *Eur. J. Inorg. Chem.*, pp. 3736-3747 (2018).
- 7) Joseph W. Nugent, Hyunjung Lee, Joseph H. Reibenspies, Hee-Seung Lee, and Robert D. Hancock, 'Effects of Anion Coordination on the Fluorescence of a Photo-induced Electron Transfer (PET) Sensor Complexed with Metal Ions.' *Polyhedron*, Vol. 130, pp. 47-57, (2017).
- 8) Mark A. Lashley, Alexander S. Ivanov, Vyacheslav S. Bryantsev, Sheng Dai, and Robert D. Hancock, "The Highly Preorganized Ligand 1,10-Phenanthroline-2,9-dicarboxylic Acid for the Selective Recovery of Uranium from Seawater in the Presence of Competing Vanadium Species', *Inorg. Chem.* Vol. 55, pp 10818-10829 (2016).
- 9) Nada Mehio, Alexander S. Ivanov, Neil J. Williams, Richard T. Mayes, Vyacheslav S. Bryantsev, Robert D. Hancock, and Sheng Dai. 'Quantifying the Binding Strength of Salicylaldoxime-Uranyl Complexes Relative to Competing Salicylaldoxime-Transition Metal Ion Complexes in Aqueous Solution: A Combined Experimental and Computational Study' *Dalton Transactions*, Vol. 45, pp. 9051-9064 (2016)
- 10) Nada Mehio, Mark A. Lashley, Joseph W. Nugent, Sheng Dai, and Robert D. Hancock. 'Amidoximes as Ligand Functionalities for Polymeric Materials for the Recovery of Uranium from Seawater', *Polyhedron*, Vol. 109, pp. 81-91 (2016).

- 11) Joseph W. Nugent, Joseph H. Reibenspies and Robert D. Hancock, "Controlling the Fluorescence Response of PET Sensors via the Metal Ion π Contacting Ability of the Fluorophore: Coumarin, a Weaker π Contacter" *Inorg. Chem.*, Vol 54, pp 9976-9988 (2015).
- 12) Nada Mehio, Mark A. Lashley, Joseph W. Nugent, Lyndsay Tucker, Bruna Correia, Chi-Linh Do-Thanh, Sheng Dai, Robert D. Hancock, and Vyacheslav S. Bryantsev, "Acidity of the Amidoxime Functional Group in Aqueous Solution: A Combined Experimental and Computational Study" *J. Phys. Chem., B.*, Vol. 119, pp. 3567-3576 (2015).
- 13) Joseph W. Nugent, Hee-Seung Lee, Joseph H. Reibenspies and Robert D. Hancock, "Spectroscopic, Structural, and Thermodynamic Aspects of the Stereochemically Active Lone Pair on Lead(II): Structure of the Lead(II) DOTA complex." *Polyhedron.*, Vol. 91, pp. 120-127 (2015).
- 14) Joseph W. Nugent, Hyunjung Lee, Hee-Seung Lee, Joseph H. Reibenspies and Robert D. Hancock, "The Effect of π -contacts between Metal Ions and Fluorophores on the Fluorescence of PET Sensors. Implications for Sensor Design for Cations and Anions'." *Inorg. Chem.*, Vol 53, pp 9014-9026 (2014).
- 15) Joseph W. Nugent, Hyunjung Lee, Hee-Seung Lee, Joseph H. Reibenspies and Robert D. Hancock, "Mechanism of chelation enhanced fluorescence in complexes of Cadmium(II), and a possible new type of anion sensor.", *Chem. Commun.*, Vol. 49, pp. 9749-9751 (2013).
- 16) Hyunjung Lee, Robert D. Hancock and Hee-Seung Lee, "The Role of Fluorophore-Metal Interaction in Photoinduced Electron Transfer (PET) Sensors: Time-Dependent Density Functional Theory (TDDFT) Study", *J. Phys. Chem. A*, Vol. 117, pp. 13345-1355 (2013).
- 17) Robert D. Hancock and Libero J. Bartolotti, "A DFT analysis of the effect of chelate ring size on metal ion selectivity in complexes of polyamine ligands", *Polyhedron*, Vol. 52, pp. 284-293 (2013).
- 18) Robert D. Hancock, 'The pyridyl group in ligand design for selective metal ion complexation and sensing.' *Chem. Soc. Rev.*, Vol. 42, pp. 1500-1524 (2013).
- 19) Robert D. Hancock and Libero J. Bartolotti, "A DFT Study of the Affinity of Lanthanide and Actinide Ions for Sulfur-donor and Nitrogen-donor Ligands in Aqueous Solution, and some Implications for Ligand Design." *Inorg. Chim. Acta.*, Vol. 396, pp. 101-107 (2013).

- 20) Ashley N. Carolan, Gregory M. Cockrell, Neil J. Williams, Maya El Ojaimi, Donald G. VanDerveer, Randolph P. Thummel, and Robert D. Hancock, "Metal Ion Size-based Selectivity of the Highly Preorganized Tetradentate Ligand 2,9-Di-(pyrid-2-yl)-1,10-phenanthroline for Metal ions in Aqueous Solution, including Lanthanide(III) ions and the Uranyl Cation." *Inorg. Chem.*, Vol. 52, pp. 15-27 (2013).
- 21) Mark D. Ogden, Serguei I. Sinkov, Mikael Nilson, Gregg J. Lumetta, Robert D. Hancock, and Kenneth L. Nash, "Complexation of Am(III) and Nd(III) by 1,10-phenanthroline-2,9-Dicarboxylic acid", *J. Solution Chem.*, Vol. 42, pp. 211-225 (2013).
- 22) Hyunjung Lee, Hee-Seung Lee, Joseph H. Reibenspies, and Robert D. Hancock "Mechanism of Chelation-enhanced 'turn-on' fluorescent sensors for Mercury(II) in solution, and its implications for ligand design" *Inorg. Chem.* Vol. 51(20), pp. 10904-10915 (2012).
- 23) Robert D. Hancock and Igor V. Nikolayenko, 'Do Non-bonded H--H Interactions in Phenanthrene Stabilize it Relative to Anthracene? Some Evidence on this Question, and its Implications for Ligands such as 2,2'-Bipyridyl.' *J. Phys. Chem.*, Vol. 116, pp. 8572-8583 (2012).
- 24) Ashley N. Carolan, Amy E. Mroz, Maya El Ojaimi, Donald G. VanDerveer, Randolph P. Thummel, and Robert D. Hancock, "Metal Ion complexing properties of 2,2'-pyridyl-1,10-phenanthroline, a more Preorganized analogue of Terpyridyl. A Crystallographic, Fluorescence, and Thermodynamic study." *Inorg. Chem.* Vol. 51, pp. 3007-3015 (2012).
- 25) Manab Chakravarty, Sylvie Pailloux, Eileen N. Duesler, Robert T. Paine, Neil J. Williams and Robert D. Hancock, "Synthesis and metal coordination chemistry of (phenyl)(pyridin-2-ylmethyl)phosphinodithioic acid, [2-C₅H₄N]CH₂P(S)(SH)(Ph)" *Polyhedron*, Vol. 33, pp. 327-335 (2012).
- 26) Neil J. Williams, Raymond T. Gephart III, Ashley E. Hames, Joseph H. Reibenspies, Robert C. Luckay, Alvaro S. de Sousa and Robert D. Hancock "Affinity of two Highly Preorganized Ligands for the base metal ions Co(II), Ni(II) and Cu(II). A Thermodynamic, Crystallographic and Fluorometric Study" *Polyhedron*, Vol. 46, pp 139-148 (2012).
- 27) Joanna M. Hamilton, Jason R. Whitehead, Neil J. Williams, Maya El Ojaimi, Randolph P. Thummel, and Robert D. Hancock, "Metal Ion Complexing Properties of Dipyridoacridine, a Highly Preorganized Tridentate Homologue of 1,10-Phenanthroline", *Inorg. Chem.*, Vol. 50(8), 3785-3790 (2011).

- 28) Danielle Merrill, James M. Harrington, Hee-Seung Lee, and Robert D. Hancock, "Unusual Metal ion Selectivities of the Highly Preorganized tetradentate ligand 1,10-phenanthroline-2,9-dicarboxamide." *Inorg. Chem.*, Vol. 50, pp. 8348-8355 (2011).
- 29) Lindsay L. Boone, Amy E. Mroz, Donald G. VanDerveer, and Robert D. Hancock, "Metal Ion Coordinating Properties of the highly preorganized tetradentate ligand 1,10-phenanthroline-2,9-dicarboxaldehyde-2,9-dioxime." *Eur. J. Inorg. Chem.*, Vol. 99, pp. 161-166, (2011).
- 30) Joanna M. Hamilton, Michael J. Anhorn, Karen A. Oscarson, Joseph H. Reibenspies, and Robert D. Hancock, "Complexation of Metal Ions, including Alkali Earth and Lanthanide(III) Ions, in Aqueous Solution by the Ligand Terpy (2,2',6',2"-terpyridyl)", *Inorg. Chem.*, Vol. 50(7), 2764-2770 (2011).
- 31) Danielle Merrill and Robert D. Hancock, "Metal Ion Selectivities of the Highly preorganized tetradentate ligand 1,10-phenanthroline-2,9-dicarboxamide with Lanthanide(III) ions and some Actinide ions", *Radiochim. Acta*, Vol. 99, pp. 161-166 (2011).
- 32) Sylvie Pailloux, Cornel Edicome Shirima, Karen Ann Smith, Eileen N. Duesler, Robert T. Paine, Neil J. Williams, and Robert D. Hancock, "Synthesis and Reactivity of (Benzoxazol-2-ylmethyl)phosphonic Acid", *Inorg. Chem.*, Vol. 49, pp. 9369-9379 (2010).
- 33) Neil J. Williams, Daniel G. Ballance, Joseph H. Reibenspies, and Robert D. Hancock, "The complexes of the highly preorganized ligand PDALC (2,9-bis(hydroxymethyl)-1,10-phenanthroline) with trivalent Lanthanides. A Thermodynamic and Crystallographic Study." *Inorg. Chim. Acta*, Vol. 363, pp. 3694-3699 (2010).
- 34) David Buist, Neil J. Williams, Joseph H. Reibenspies, and Robert D. Hancock, "Control of metal ion size-based selectivity through chelate ring geometry. Metal ion complexing properties of bis-imidazole", *Inorg. Chem.*, Vol. 49, pp. 50332-5039 (2010).
- 35) Neil J. Williams, Nolan E. Dean, Donald G. VanDerveer, Robert C. Luckay and Robert D. Hancock, "Strong Metal Ion Size-based Selectivity of the Highly Preorganized ligand PDA (1,10-phenanthroline-2,9-dicarboxylic acid) with Trivalent Metal Ions. A Crystallographic, Fluorometric, and Thermodynamic Study". *Inorg. Chem.*, Vol. 48, pp. 7853-7863 (2009).

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