

# American Chemical Society

## National Awards Nomination Packet

### *Alfred Bader Award in Bioinorganic or Bioorganic Chemistry:2018 for: R Britt*

Received: 10/30/2015

Cycle Year: 2

*"For pioneering pulse EPR spectroscopy characterizing the Photosystem II Oxygen Evolving Complex, and continuing EPR spectroscopy probing a wide variety of important metalloenzymes and catalysts"*

#### **NOMINATOR:**

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- Have you discussed this award nomination with the nominee? Yes

#### **NOMINEE:**

R Britt  
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ACS Current Member: Yes  
Years of Service: 20  
Date of birth: 01/01/1956  
Present Position: Distinguished Professor of Chemistry  
Industry: Academia

- Does the nominee employ and require good safety protocols and practices in his/her laboratory? Yes
- What is the nominee's present position? Distinguished Professor of Chemistry
- What professional discipline does the nominee work in? Academia

#### **SUPPORTER 1**

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October 27, 2015

To: the Selection Committee for the Alfred Bader Award in Bioinorganic or Bioorganic Chemistry

It is a pleasure to nominate R. David Britt for this award. In his 27 years as a Professor of Chemistry at UC Davis, R. David Britt has run a strong and well-funded program applying electron paramagnetic resonance methods to study the roles of metals and radicals in metalloenzymes and bioinspired catalysts, with a particular interest in reactions involving conversion of solar energy to chemical energy. In his Ph.D. work at UC Berkeley, under the tutelage of Dr. Melvin P. Klein in the Laboratory of Chemical Biodynamics, David had built a pulse EPR spectrometer and used it in pioneering electron spin echo envelope modulation (ESEEM) studies of the manganese cluster centered Oxygen Evolving Complex (OEC) of Photosystem II, for example characterizing the binding of the ammonia water oxidation inhibitor to the manganese cluster [20]. As a new Assistant Professor at UC Davis, David and his new students built a more capable second generation pulse EPR spectrometer [29], with a greater frequency range and pulse electron nuclear double resonance (ENDOR) capabilities. With this instrument they carried out a number of seminal experiments on the OEC, including demonstrating there are four exchange coupled manganese ions arranged in a 3 + 1 "dangler Mn" geometry [77], characterizing the interaction between the Mn cluster and the PSII tyrosine radical YZ<sup>•</sup> [40,59], and determining the amino acid ligation of the cluster with its single key histidine ligand [35]. Professor Britt has maintained continual funding by NIH and DOE for this OEC EPR work for over 25 years.

Over this time, Professor Britt has developed a strong instrumentation suite in his CalEPR center, with both homebuilt and commercial EPR instruments covering a frequency range from 8 to 130 GHz, along with a unique high power 263 GHz spectrometer currently under construction. With these instruments the Britt lab has expanded their focus beyond PSII, working on a wide variety of enzymes and catalytic synthetic complex. For example, building on research experience in PSII water splitting, the lab has tackled EPR characterization of Nocera's electrodeposited cobalt water oxidation catalyst and multinuclear cobalt cluster analogs [137, 151] along with a wider array of catalysts developed in the NSF funded Solar Fuels CCI (Gray, PI).

The Britt lab has also used these multifrequency advanced EPR instruments to characterize a wide variety of metal and radical based enzyme mechanisms [124, 139, 152, 158, 188], including catalytic RNA "ribozyme" systems [110]. One particularly interesting problem recently tackled by the Britt group is the bioassembly of the catalytic "H-Cluster" of the [Fe-Fe] hydrogenase family. This six-Fe cluster, which can form ~10,000 H<sub>2</sub> molecules/sec, consists of a [4Fe-4S] cluster bridged to a unique dinuclear

Fe center which has CO and CN ligands along with an azadithiolate bridge between the two irons. The CO and CN are sourced from tyrosine, and the Britt lab and their collaborators recently showed in a series of papers that instead of the CO and CN ligands binding to a preformed 2Fe-2S cluster, instead a radical generating enzyme HydG cleaves the tyrosine substrate and binds the resultant diatomics on a unique fifth Fe of a novel five Fe cluster [173, 174, 192]. Intermediates of this enzyme cycle have been characterized for the first time with a variety of spectroscopic techniques, including EPR, stopped flow FTIR, and Mossbauer spectroscopy. Professor Britt and colleagues propose that the product of the HydG reaction is an  $\text{Fe}(\text{CO})_2(\text{CN})(\text{l-cysteine})$  organometallic synthon [192]. In their model two of these synthons are converted into the binuclear cluster via their interactions with two other maturase enzymes, HydF and HydE, through processes currently being investigated by the Britt group and their collaborators.

This is novel chemistry and is gaining significant attention in the metallobiochemistry community. Because of his interesting scientific advancements, Professor Britt receives numerous lecture invitations each year. He is known for giving clear and enthusiastic lectures about his research. Along these lines I note that in 2014 Professor Britt received the International EPR Society Gold Medal Award, which is awarded once every 3-years, and he is the recipient of the 2016 Royal Society of Chemistry Bruker Prize for career contributions to EPR spectroscopy. He was also recently elected Chair of the Metals in Biology Gordon Research Conference (2017).

Sincerely,

A handwritten signature in black ink that reads "Alan L Balch". The signature is written in a cursive, flowing style with a large, stylized "A" and "B".

Alan L. Balch  
Distinguished Professor

**R. David Britt**  
**Distinguished Professor of Chemistry**  
**University of California, Davis**

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**Education:**

B.S. Physics, North Carolina State University, Raleigh NC 1978

Ph.D Physics, University of California, Berkeley, CA 1988

**Professional Positions:**

1989-1994 Assistant Professor, Department of Chemistry, University of California at Davis

1994-1997 Associate Professor, Department of Chemistry, University of California at Davis

1997- Professor, Department of Chemistry, University of California at Davis

2005-2008 Chair, Department of Chemistry, University of California at Davis

**Honors and Awards:**

1978-81 National Science Foundation Graduate Fellowship, University of California, Berkeley

1989 Camille and Henry Dreyfus New Faculty Award

1995 International EPR Society Young Investigator Award

2012 Elected Fellow of the American Association for the Advancement of Science

2012 Japan Society for the Promotion of Science Visiting Fellow

2014 International EPR Society Gold Medal (awarded every third year)

2015 University of California Distinguished Professor

2016 Royal Society of Chemistry Bruker Prize

**Professional Service:**

2000-04 Member, National Institutes of Health Metallobiochemistry Study Section

2006 Chair, Photosynthesis Gordon Research Conference

2008-13 Scientific Advisory Board, NSF Center for Chemical Innovation in Solar Fuels.

2010-13 Elected Member, National High Magnetic Field Laboratory EMR Advisory Committee

2012- External Advisory Committee, ASU Center for Bio-Inspired Solar Fuel Production

2014 Elected Chair of the 2017 Metals in Biology Gordon Research Conference

2014- External Advisory Committee, National High Magnetic Field Laboratory

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## LIST OF PUBLICATIONS

R. David Britt

1. 1981 Britt, R. D. and P. L. Richards. **An Adiabatic Demagnetization Refrigerator for Infrared Bolometers.** J. Infrared Millimeter Waves 2:1083-1096.
2. 1984 Goodin, D. B., V. K. Yachandra, R. D. Britt, K. Sauer, and M. P. Klein. **Light-Induced Changes in X-ray Absorption (K-edge) Energies of Manganese in Photosynthetic Membranes.** Biochim. Biophys. Acta 767:209-216.
3. 1984 Goodin, D. B., V. K. Yachandra, R. D. Guiles, R. D. Britt, A. E. McDermott, K. Sauer, and M. P. Klein. **Light-Induced Changes in X-ray Absorption (K-edge) Energies of Manganese in Photosynthetic Membranes.** In *EXAFS and Near Edge Structure III* (eds. K. O. Hodgson, B. Hedman, and J. E. Penner-Hahn) Springer-Verlag, New York. p.130-135.
4. 1986 Yachandra, V. K., R. D. Guiles, A. E. McDermott, R. D. Britt, K. Sauer, and M. P. Klein. **Structure of the Manganese Complex in Photosystem II Studied Using EXAFS Spectroscopy. The S<sub>1</sub> State of the O<sub>2</sub>-Evolving Complex in Spinach.** Biochim. Biophys. Acta 850:324-332.
5. 1986 Yachandra, V. K., R. D. Guiles, A. E. McDermott, R. D. Britt, J. Cole, S. L. Dexheimer, K. Sauer, and M. P. Klein. **The State of Manganese in the Photosynthetic Apparatus Determined by X-ray Absorption Spectroscopy.** In *EXAFS and Near Edge Structure IV* (eds. P. Lagarde, D. Raoux, and J. Petiau) J. Phys. 47: C8:1121-1128.
6. 1987 Britt, R. D. and M. P. Klein. **A Versatile Loop-Gap Resonator Probe for Low-Temperature Electron Spin-Echo Studies.** J. Magn. Reson. 74:535-540.
7. 1987 Britt, R. D., K. Sauer and M. P. Klein. **Electron Spin Echo Studies of PSII Membranes.** In *Progress in Photosynthesis Research* (ed. J. Biggins) Martinus Nijhoff, Dordrecht. Vol 1:573-576.
8. 1987 Yachandra, V. K., R. D. Guiles, A. E. McDermott, J. Cole, R. D. Britt, S. L. Dexheimer, K. Sauer, and M. P. Klein. **Comparison of**

**the Structure of the Mn-Complex in the S<sub>1</sub> and S<sub>2</sub> States of the Photosynthetic O<sub>2</sub>-Evolving Complex. An X-ray Absorption Spectroscopy Study.** Biochemistry 26:5974-5981.

9. 1987 Cole, J., V. K. Yachandra, R. D. Guiles, A. E. McDermott, R. D. Britt, S. L. Dexheimer, K. Sauer, and M. P. Klein. **Assignment of the g=4.1 EPR Signal to Mn in the S<sub>2</sub> State of the Photosynthetic O<sub>2</sub>-Evolving Complex: An X-ray Absorption Edge Spectroscopy Study.** Biochim. Biophys. Acta 890:395-398.
10. 1987 Cole, J., V. K. Yachandra, A. E. McDermott, R. D. Guiles, R. D. Britt, S. L. Dexheimer, K. Sauer, and M. P. Klein. **Structure of the Mn Complex of Photosystem II upon Removal of the 33 kDa Extrinsic Protein: An X-ray Absorption Spectroscopy Study.** Biochemistry 26:5967-5973.
11. 1987 McDermott, A. E., R. D. Guiles, V. K. Yachandra, J. Cole, R. D. Britt, S. L. Dexheimer, K. Sauer, and M. P. Klein. **X-ray Absorption Spectroscopy of Manganese and Iron in the Photosynthetic Apparatus.** In *Biophysics and Synchrotron Radiation* (ed. A. Bianconi, and A. G. Castellano) Springer-Verlag, Heidelberg. p. 223-230.
12. 1987 Yachandra, V. K., R. D. Guiles, A. E. McDermott, J. Cole, R. D. Britt, S. L. Dexheimer, K. Sauer, and M. P. Klein. **The State of Manganese in the Photosynthetic Apparatus: An X-ray Absorption Study.** In *Progress in Photosynthesis Research* (ed. J. Biggins) Martinus Nijhoff, Dordrecht. Vol 1:557-560.
13. 1987 Guiles, R. D., V. K. Yachandra, A. E. McDermott, R. D. Britt, S. L. Dexheimer, K. Sauer, and M. P. Klein. **Structural Features of the Manganese Cluster in Different States of the Oxygen Evolving Complex of PSII and Evidence for a Tetranuclear Cluster.** In *Progress in Photosynthesis Research* (ed. J. Biggins) Martinus Nijhoff, Dordrecht. Vol 1:561-564.
14. 1987 McDermott, A. E., V.K. Yachandra, R. D. Guiles, R. D. Britt, S. L. Dexheimer, K. Sauer, and M. P. Klein. **Characterization of the Mn-Containing O<sub>2</sub>-Evolving Complex from the Cyanobacterium Synechococcus Using EPR and X-ray Absorption Spectroscopy.** In *Progress in Photosynthesis Research* (ed. J. Biggins) Martinus Nijhoff, Dordrecht. Vol 1:565-568.
15. 1987 McDermott, A. E., V. K. Yachandra, R. D. Guiles, R. D. Britt, S. L. Dexheimer, K. Sauer, and M. P. Klein. **Iron X-ray Absorption**

**Spectroscopy of Low Potential Acceptors in Photosystem I.** In *Progress in Photosynthesis Research* (ed. J. Biggins) Martinus Nijhoff, Dordrecht. Vol 1:249-252.

16. 1988 McDermott, A. E., V. K. Yachandra, R. D. Guiles, R. D. Britt, S. L. Dexheimer, K. Sauer, and M. P. Klein. **Low-Potential Membrane Bound Iron-Sulfur Centers in Photosystem I: An X-ray Absorption Spectroscopy Study.** *Biochemistry* 27:4013-4020.
17. 1988 McDermott, A. E., V. K. Yachandra, R. D. Guiles, J. L. Cole, S. L. Dexheimer, R. D. Britt, K. Sauer, and M. P. Klein. **Characterization of the Mn O<sub>2</sub>-Evolving Complex and the Iron Quinone Acceptor Complex in Photosystem II from a Thermophilic Cyanobacterium by Electron Paramagnetic Resonance and X-ray Absorption Spectroscopy.** *Biochemistry* 27:4021-4031.
18. 1988 Britt, R. D., J. L. Zimmermann, K. Sauer, and M. P. Klein. **ESEEM Studies of Ammonia Binding to the Catalytic Mn of the Water Oxidation Complex of Photosystem II.** In *Pulsed EPR: A New Field of Applications*. (eds. C. P. Keijzers, E. J. Reijerse, and J. Schmidt) Nort Holland, Amsterdam. pp. 150-155.
19. 1988 Sauer, K., R. D. Guiles, A. E. McDermott, J. L. Cole, V. K. Yachandra, J. L. Zimmermann, M. P. Klein, S. L. Dexheimer, and R. D. Britt. **Spectroscopic Studies of Mn Involvement in Photosynthetic O<sub>2</sub> Evolution.** *Chemica Scripta* 28A:87-91.
20. 1989 Britt, R. D., J. L. Zimmermann, K. Sauer, and M. P. Klein. **Ammonia Binds to the Catalytic Mn of the Oxygen Evolving Complex of Photosystem II: Evidence by Electron Spin Echo Envelope Modulation Spectroscopy.** *J. Am. Chem. Soc.* 111:3522-3532.
21. 1990 Guiles, R. D., J. L. Zimmermann, A. E. McDermott, V. K. Yachandra, J. L. Cole, S. L. Dexheimer, R. D. Britt, K. Wieghardt, U. Bossek, K. Sauer, and M. P. Klein. **The S<sub>3</sub> State of Photosystem II: Differences between the Structure of the Manganese Complex in the S<sub>2</sub> and S<sub>3</sub> States Determined by X-ray Absorption Spectroscopy.** *Biochemistry* 29:471-485.
22. 1990 Guiles, R. D., V. K. Yachandra, A. E. McDermott, J. L. Cole, S. L. Dexheimer, R. D. Britt, K. Sauer, and M. P. Klein. **The S<sub>0</sub> State of Photosystem II Induced by Hydroxylamine: Differences between the Structure of the Manganese Complex in the S<sub>0</sub>**

**and S<sub>1</sub> States Determined by X-ray Absorption Spectroscopy.** *Biochemistry* 29:486-496.

23. 1990 Britt, R. D., V. J. DeRose, V. K. Yachandra, D. K. Kim, K. Sauer, and M. P. Klein. **Pulsed EPR Studies of the Manganese Center of the Oxygen-Evolving Complex of Photosystem II.** In *Current Research in Photosynthesis*, Vol. 1, ed., M. Baltscheffsky, Kluwer Academic, pp. 769-772.
24. 1990 Kim, D. H., R. D. Britt, M. P. Klein, and K. Sauer. **The g=4.1 EPR Signal of the S<sub>2</sub> State of the Photosynthetic Oxygen Evolving Complex Arises from a Multinuclear Mn Cluster.** *J. Am. Chem. Soc.* 112:9389-9391.
25. 1991 DeRose, V. J., V. K. Yachandra, A. E. McDermott, R. D. Britt, K. Sauer, and M. P. Klein. **Nitrogen Ligation to Manganese in the Photosynthetic Oxygen Evolving Complex: Continuous Wave and Pulsed EPR Studies of Photosystem II Particles Enriched with <sup>14</sup>N and <sup>15</sup>N Isotopes.** *Biochemistry* 30:1335-1341.
26. 1991 Britt, R. D., K. Sauer, M. P. Klein, D. B. Knaff, A. Kriauciunas, C. - A. Yu, L. Yu, and R. Malkin. **Electron Spin Echo Envelope Modulation Spectroscopy Supports the Suggested Coordination of Two Histidine Ligands to the Rieske FeS Centers of the Cytochrome b<sub>6</sub>f Complex of Spinach and the Cytochrome bc<sub>1</sub> Complexes of *Rhodospirillum rubrum*, *Rhodobacter sphaeroides* R26, and Bovine heart Mitochondria.** *Biochemistry* 30:1892-1901.
27. 1992 Sauer, K., V. K. Yachandra, R. D. Britt, and M. P. Klein. **The Photosynthetic Water Oxidation Complex Studied by EPR and X-ray Absorption Spectroscopy.** In *Manganese Redox Enzymes* (ed. V. Pecoraro) VCH Publishers, New York. pp. 141-175.
28. 1992 Kim, D. H., R. D. Britt, M. P. Klein, and K. Sauer. **The Manganese Site of the Photosynthetic Oxygen-Evolving Complex Probed by EPR Spectroscopy of Oriented Photosystem II Membranes: The g=4 and g=2 Multiline Signals.** *Biochemistry* 31:541-547.
29. 1992 Sturgeon, B. E. and R. D. Britt. **Design of a Sensitive Pulsed EPR Spectrometer with an 8 to 18 GHz Frequency Range.** *Rev. Sci. Instrum.* 63:2187-2192.



30. 1992 Britt, R. D. and M. P. Klein. **Electron Spin Echo Envelope Modulation Studies of Mixed Valence Manganese Complexes: Applications to the Catalytic Manganese Cluster of Photosynthetic Oxygen Evolution.** In *Pulsed Magnetic Resonance: NMR, ESR, and Optics, a recognition of E.L. Hahn* (ed. D. M. S. Bagguley) Clarendon Press, Oxford pp. 390-410.
31. 1992 Britt, R. D., G. A. Lorigan, K. Sauer, M. P. Klein, and J. L. Zimmermann. **The g=2 multiline EPR signal of the S<sub>2</sub> state of the photosynthetic oxygen-evolving complex originates from a ground spin state.** *Biochim. Biophys. Acta* 1040:95-101.
32. 1992 Gilchrist, M. L., G. A. Lorigan and R. D. Britt. **Pulsed Electron Paramagnetic Resonance Studies Of Calcium-Depleted Photosystem II Membranes.** In *Research in Photosynthesis*, (N. Murata (ed.)), Kluwer Academic Publishers, Vol. II. pp. 317-320.
33. 1993 Britt, R. D. **Time-domain electron paramagnetic resonance spectroscopy.** *Curr. Opin. Struct. Biol.* 3:774-779.
34. 1993 Hansen, A. P., R. D. Britt, M. P. Klein, C. J. Bender, and G. T. Babcock. **ENDOR and ESEEM Studies of Cytochrome c Oxidase: Evidence for Exchangeable Protons at the Cu<sub>A</sub> Site.** *Biochemistry* 32:13718-13724.
35. 1994 Tang, X.-S., B. A. Diner, B. S. Larsen, M. L. Gilchrist, G. A. Lorigan, and R. D. Britt. **Identification of Histidine at the Catalytic Site of the Photosynthetic Oxygen-Evolving Complex.** *Proc. Natl. Acad. Sci. U.S.A.* 91:704-708.
36. 1994 Lorigan, G. A., R. D. Britt, J. K. Kim, and R. Hille. **Electron Spin Echo Envelope Modulation Spectroscopy Of The Molybdenum Center Of Xanthine Oxidase.** *Biochim. Biophys. Acta* 1185:284-294.
37. 1994 Britt, R. D., X.-S. Tang, M. L. Gilchrist, G. A. Lorigan, B. S. Larsen, and B. A. Diner. **Histidine at the Catalytic Site of the Photosynthetic Oxygen-Evolving Complex.** *Biochem. Soc. Trans.* 22:343-347.
38. 1994 Lorigan, G. A. and R. D. Britt. **Temperature-Dependent Pulsed Electron Paramagnetic Resonance Studies of the S<sub>2</sub> State Multiline Signal of the Photosynthetic Oxygen-Evolving Complex.** *Biochemistry* 33:12072-12076.

39. 1994 Sturgeon, B. E., J. A. Ball, D. W. Randall, and R. D. Britt. **<sup>55</sup>Mn Electron Spin Echo ENDOR of Mn<sup>2+</sup> Complexes.** J. Phys. Chem. 98:12871-12883.
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41. 1995 Randall, D. W., B. E. Sturgeon, J. A. Ball, G. A. Lorigan, M. K. Chan, M. P. Klein, W. H. Armstrong, and R. D. Britt. **ESE-ENDOR of a Mixed Valence Mn(III)Mn(IV) Complex: Comparison with the Mn Cluster of the Photosynthetic Oxygen Evolving Complex.** J. Am. Chem. Soc. 117:11780-11789.
42. 1995 Tang, X.-S, J. M. Peloquin, G. A. Lorigan, R. D. Britt, and B. A. Diner. **The Binding Environment of the Reduced Primary Quinone Electron Acceptor, Q<sub>A</sub><sup>-</sup>, of PSII.** In *Photosynthesis: from Light to Biosphere* (ed. P. Mathis) Kluwer Academic Publishers, Amsterdam, Vol. I, pp. 775-778.
43. 1995 Britt, R. D., D. W. Randall, J. A. Ball, M. L. Gilchrist, D. A. Force, B. E. Sturgeon, G. A. Lorigan, X.-S. Tang, B. A. Diner, M. P. Klein, M. K. Chan, and W. H. Armstrong. **Electron Spin Echo - ENDOR Studies of the Tyrosine Radicals and the Manganese Cluster of Photosystem II.** In *Photosynthesis: from Light to Biosphere* (ed. P. Mathis) Kluwer Academic Publishers, Amsterdam, Vol. II, pp. 223-228.
44. 1995 Diner, B. A., M. Zheng, X. S. Tang, G. C. Dismukes, D. A. Force, D. W. Randall, and R. D. Britt. **Environment and Function of the Redox Active Tyrosines of Photosystem II.** In *Photosynthesis: from Light to Biosphere* (ed. P. Mathis) Kluwer Academic Publishers, Amsterdam, Vol. II, pp. 229-234.
45. 1995 Force, D. A., D. W. Randall, R. D. Britt, X.-S. Tang, and B. A. Diner. **<sup>2</sup>H ESE-ENDOR Study of Hydrogen Bonding to the Tyrosine Radicals Y<sub>D</sub><sup>•</sup> and Y<sub>Z</sub><sup>•</sup> of Photosystem II.** J. Am. Chem. Soc. 117:12643-12644.
46. 1996 Britt, R. D. **Electron Spin Echo Methods in Photosynthesis Research.** In *Advances in Photosynthesis: Biophysical Techniques in Photosynthesis* (eds. A.J. Hoff and J. Ames) Kluwer Academic Publishers, Amsterdam, pp. 235-253.

47. 1996 Tang, X.-S., D. W. Randall, D. A. Force, B. A. Diner, and R. D. Britt. **Manganese-Tyrosine Interaction in the Photosystem II Oxygen-Evolving Complex.** J. Am. Chem. Soc. 118:7638-7639.
48. 1996 Britt, R. D. **Oxygen Evolution.** In *Advances in Photosynthesis: Oxygenic Photosynthesis, The Light Reactions* (eds. C.Y. Yocum and D. Ort) Kluwer Academic Publishers, Amsterdam, pp. 137-164.
49. 1997 Randall, D. W., A. Gelasco, M. Tyler Caudle, V. L. Pecoraro, and R. D. Britt. **ESE-ENDOR and ESEEM Characterization of Water and Methanol Ligation to a Dinuclear Mn(III)Mn(IV) Complex.** J. Am. Chem. Soc. 119:4481-4491.
50. 1997 Campbell, K. A., J. M. Peloquin, B. A. Diner, X.-S. Tang, D. A. Chisholm, and R. D. Britt. **The  $\tau$ -Nitrogen of D2 Histidine 189 is the Hydrogen Bond Donor to the Tyrosine Radical  $Y_D^\bullet$  of Photosystem II.** J. Am. Chem. Soc. 119:4787-4788.
51. 1997 Farrar, C. T., G. J. Gerfen, R. G. Griffin, D. A. Force, and R. D. Britt. **Electronic Structure of the  $Y_D^\bullet$  Tyrosyl Radical in Photosystem II: A High Frequency EPR Spectroscopy and Density Functional Theoretical Study.** J. Phys. Chem.101:6634-6641.
52. 1997 Stemmler, T. L., B. E. Sturgeon, D. W. Randall, R. D. Britt, and J. E. Penner-Hahn. **Spectroscopic Characterization of Inhibitor Interactions with the Mn(III)/Mn(IV) Core in *Lactobacillus plantarum* Manganese Catalase.** J. Am. Chem. Soc. 119:9215-9225.
53. 1997 Force, D. A., D. W. Randall and R. D. Britt. **Proximity of Acetate, Manganese, and Exchangeable Deuterons to Tyrosine  $Y_Z^\bullet$  in Acetate-Inhibited Photosystem II Membranes: Implications for the Direct Involvement of  $Y_Z^\bullet$  in Water-Splitting.** Biochemistry 36:12062-12070.
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57. 1998 Britt, R. D., D. A. Force, K. A. Campbell, D. W. Randall, L. M. Gilchrist, Jr., K. L. Clemens, D. M. Gingell, J. M. Peloquin, D. P. Pham, and R. J. Debus. **Progress in Characterization of the Photosystem II Oxygen Evolving Complex Using Advanced EPR Methods.** In *Spectroscopic Methods in Bioinorganic Chemistry* (eds. E. I. Solomon and K. O. Hodgson) Oxford University Press. pp. 272-285.
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146. 2011 Ohlin, C. A., S. J. Harley, J. G. McAlpin, R. K. Hocking, B. Q. Mercado, R. L. Johnson, E. M. Villa, M. K. Fidler, M. M. Olmstead, L. Spiccia, R. D. Britt, and W. H. Casey. **Rates of Water Exchange for Two Cobalt(II) Heteropolyoxotungstate Compounds in Aqueous Solution.** Chem. Eur. J. 17:4408-4417.
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152. 2011 Stoll, S., H. S. Shafaat, J. Krzystek, A. Ozarowski, M. J. Tauber, J. E. Kim, and R. D. Britt. **Hydrogen Bonding of Tryptophan Radicals Revealed by EPR at 700 GHz.** *J. Am. Chem. Soc.* 133:18098-18101.
153. 2011 Sheng, Y., T. A. Stich, K. Barnese, E. B. Gralla, D. Cascio, R. D. Britt, D. E. Cabelli, and J. S. Valentine. **Comparison of Two Yeast MnSODs: Mitochondrial *Saccharomyces cerevisiae* versus Cytosolic *Candida albicans*.** *J. Am. Chem. Soc.* 133:20878-20889.
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156. 2012 Mukherjee, S., J. A. Stull, J. Yano, T. C. Stamatatos, K. Pringouri, T. A. Stich, K. A. Abboud, R. D. Britt, V. K. Yachandra, and G. Christou. **Synthetic Model Of The Asymmetric [Mn<sub>3</sub>CaO<sub>4</sub>] Cubane Core Of The Oxygen-Evolving Complex Of Photosystem II.** *Proc. Natl. Acad. Sci. U. S. A.* 109:2257-2262.
157. 2012 Ragsdale, S. W., Li Yi, G. Bender, N. Gupta, Y. Kung, L. Yan, T. A. Stich, T. Doukov, L. Leichert, P. M. Jenkins, C. M. Bianchetti, S. J. George, S. P. Cramer, R. D. Britt, U. Jakob, J. R. Martens, G. N. Phillips and C. L. Drennan. **Redox, Haem And CO In Enzymatic Catalysis And Regulation.** *Biochem. Soc. Trans.* 40:501-507.
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**Biotin Synthase from *Escherichia coli*.** J. Am. Chem. Soc. 134:9042-9045.

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162. 2012 Gunn, A., E. R. Derbyshire, M. A. Marletta, and R. D. Britt. **Conformationally Distinct Five-Coordinate Heme-NO Complexes of Soluble Guanylate Cyclase Elucidated by Multifrequency Electron Paramagnetic Resonance (EPR).** Biochemistry 51:8384-8390.
163. 2012 Kuchenreuther, J. M., R. D. Britt, J. R. Swartz. **New Insights into [FeFe] Hydrogenase Activation and Maturase Function.** PLoS One 7:e45850.
164. 2012 Stull, J. A., R. D. Britt, J. L. McHale, F. J. Knorr, S. V. Lyman, and J. K. Hurst. **Anomalous Reactivity of Ceric Nitrate in Ruthenium “Blue Dimer”-Catalyzed Water Oxidation.** J. Am. Chem. Soc. 134:19973-19976.
165. 2013 Kuchenreuther, J. M., Y. Guo, H. Wang, W. K. Myers, S. J. George, C. A. Boyke, Y. Yoda, E. E. Alp, J. Zhao, R. D. Britt, J. R. Swartz, and S. P. Cramer. **Nuclear Resonance Vibrational Spectroscopy and Electron Paramagnetic Resonance Spectroscopy of  $^{57}\text{Fe}$ -enriched [FeFe] Hydrogenase Indicate Stepwise Assembly of the H-Cluster.** Biochemistry 52:818-826.
166. 2013 Cotruvo, Jr., J. A., T. A. Stich, R. D. Britt, and J. Stubbe. **Mechanism of Assembly of the Dimanganese-Tyrosyl Radical Cofactor of Class Ib Ribonucleotide Reductase: Enzymatic Generation of Superoxide Is Required for Tyrosine Oxidation via a Mn(III)Mn(IV) Intermediate.** J. Am. Chem. Soc. 135:4027-4039.



167. 2013 Stull, J. A., T. A. Stich, J. K. Hurst, and R. D. Britt. **Electron Paramagnetic Resonance Analysis of a Transient Species Formed During Water Oxidation Catalyzed by the Complex Ion [(bpy)<sub>2</sub>Ru(OH<sub>2</sub>)<sub>2</sub>O<sup>4+</sup>].** *Inorg. Chem.* 52:4578-4586.
168. 2013 Khabuanchalad, S., J. Wittayakun, R. J. Lobo-Lapidus, S. Stoll, R. D. Britt, and B. C. Gates. **Formation of MgO-Supported Manganese Carbonyl Complexes by Chemisorption of Mn(CO)<sub>5</sub>CH<sub>3</sub>.** *Langmuir* 29:6279-6286.
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173. 2013 Kuchenreuther, J. M., W. K. Myers, T. A. Stich, S. J. George, Y. NajatyJahromy, J. R. Swartz, and R. D. Britt. **A Radical Intermediate in Tyrosine Scission to the CO and CN- Ligands of FeFe Hydrogenase.** *Science* 342:472-475.
174. 2013 Kanady, J. S., R. Tran, J. A. Stull, L. Lu, T. A. Stich, M. W. Day, J. Yano, R. D. Britt and T. Agapie. **Role of Oxido Incorporation and Ligand Lability in Expanding Redox Accessibility Of Structurally Related Mn<sub>4</sub> Clusters.** *Chem. Sci.* 4:3986-3996.
175. 2014 Kuchenreuther, J. M., W. K. Myers, D. L. M. Suess, T. A. Stich, V. Pelmentschikov, S. A. Shiigi, S. P. Cramer, J. R. Swartz, R. D. Britt, and S. J. George. **The HydG Enzyme Generates an Fe(CO)<sub>2</sub>(CN) Synthron in Assembly of the FeFe Hydrogenase H-Cluster.** *Science* 343:424-427.

176. 2014 Britt, R. D. and Paul H. Oyala. **One Step Closer to O<sub>2</sub>.** Science, 345:736.
177. 2014 Stich, T. A., W. K. Myers, and R. D. Britt. **Paramagnetic Intermediates Generated by Radical S-Adenosylmethionine (SAM) Enzymes.** Acc. Chem. Res. 47:2235-2243.
178. 2014 Myers, W. K., T. A. Stich, D. L. M. Suess, J. M. Kuchenreuther, J. R. Swartz, and R. D. Britt. **The Cyanide Ligands of [FeFe] Hydrogenase: Pulse EPR Studies of <sup>13</sup>C and <sup>15</sup>N-Labeled H-Cluster.** J. Am. Chem. Soc. 136:12237-12240.
179. 2014 Karagas, N. E. C. N. Osborn, D. J. Osborn, A. L. Dzierlenga, P. Oyala, M. E. Konkle, E. M. Whitney, R. D. Britt, and L. M. Hunsicker-Wang. **The Reduction Rates Of DEPC-Modified Mutant Thermus Thermophilus Rieske Proteins Differ When There Is a Negative Charge Proximal to the Cluster.** J. Biol. Inorg. Chem. 19:1121-1135.
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181. 2015 Stich, T. A. and R. D. Britt. **Advanced Electron Paramagnetic Resonance Studies of the Oxygen Evolving Complex.** In *Metalloproteins: Theory, Calculations, and Experiments.* A. E. Cho and W. Goddard, Eds., CRC Press. pp. 1-58.
182. 2015 Oyala, P. H., T. A. Stich, and R. D. Britt. **Metal Ion Oxidation State Assignment Based on Coordinating Ligand Hyperfine Interaction.** Photosynth. Res., 124:7-18.
183. 2015 Dinis, P., D. L. M. Suess , S. J. Fox , J. E. Harmer , R. C. Driesener, L. De La Paz , J. R. Swartz, J. W Essex , R D. Britt, and P. L. Roach. **X-ray Crystallographic and EPR Spectroscopic Analysis of HydG, a Maturase in [FeFe]-Hydrogenase H-Cluster Assembly.** Proc. Natl. Acad. Sci. U.S.A. 112:1362-1367.
184. 2015 Gagnon, D. .M, M. B. Brophy, S. E. J. Bowman, T. A. Stich, C. L. Drennan, R. D. Britt, and E. M. Nolan. **Manganese Binding Properties of Human Calprotectin Under Conditions of High and Low Calcium.** J. Am. Chem. Soc. 137:3004-3016.

185. 2015 Parthasarathy, A., T. A. Stich, S. T. Lohner, A. Lesnefsky, M. Fincker, R. D. Britt, and A. M. Spormann. **Biochemical and EPR-spectroscopic Investigation into Heterologously Expressed Vinyl Chloride Reductive Dehalogenase (VcrA) from *Dehalococcoides mccartyi* strain VS.** J. Am. Chem. Soc. 137:3525-3532.
186. 2015 Britt, R. D., D. L. M. Suess, and T. A. Stich. **An Mn(V)-Oxo Role in Splitting Water?** Proc. Natl. Acad. Sci. U.S.A. 112:5265-5266.
187. 2015 Oyala, P. H., T. A. Stich, R. J. Debus, and R. D. Britt. **Ammonia Binds to the Dangler Manganese of the Photosystem II Oxygen-Evolving Complex.** J. Am. Chem. Soc. 137:8829-8837.
188. 2015 Chang, Y. G., S. Cohen, C. Phong, W. K. Meyers, Y. I. Kim, R. Tseng, J. Lin, L. Zhang, J. Boyd, R. D. Britt, M. Rust, S. S. Golden, and A. LiWang. **KaiB Fold Switching Is The Linchpin That Joins Oscillator Function To Clock Output.** Science 349:324-328.
189. 2015 Suess, D. L. M. and R. D. Britt. **EPR Spectroscopic Studies of [FeFe]-Hydrogenase Maturation.** Top. Catal. 58:699-707.
190. 2015 Tao, L., T. A. Stich, C. N. Butterfield, C. A. Romano, T. G. Spiro, B. M. Tebo, W. H. Casey, and R. D. Britt. **Mn(II) Binding and Subsequent Oxidation by the Multicopper Oxidase MnxG Investigated by Electron Paramagnetic Resonance Spectroscopy.** J. Am. Chem. Soc. 137:10563-10575.
191. 2015 Butterfield, C. N, L. Tao, K. N. Chacon, T. G. Spiro, N. J. Blackburn, W. H. Casey, R. D. Britt, B. M. Tebo. **Multicopper Manganese Oxidase Accessory Proteins Bind Cu and Heme.** Biochim. Biophys. Acta, published online before print: doi:10.1016/j.bbapap.2015.08.012
192. 2015 Suess, D. L. M., I Burstel, L. De La Paz, J. M. Kuchenreuther, C. Pham, S. P. Cramer, J. R. Swartz, and R. D. Britt. **Cysteine as a Ligand Platform in the Biosynthesis of the FeFe Hydrogenase H-cluster.** Proc. Natl. Acad. Sci. U.S.A., Published online before print, doi: 10.1073/pnas.1508440112

## **R. David Britt: Grants (1997-present [since promotion to Professor])**

### **Research Grants**

1. Title: Time-Domain EPR Studies of Tyrosine Z of Photosystem II  
Agency: National Science Foundation  
Amount: \$243,806 Direct Cost; \$290,000 Total Cost  
Dates: 2/1/96 - 1/31/99  
PI: R. David Britt
2. Title: Pulsed EPR Studies of Biological Manganese Clusters (R01 GM48242)  
Agency: National Institutes of Health  
Amount: \$507,547 Direct Cost; \$706,233 Total Cost  
Dates: 7/1/97 - 6/30/01  
PI: R. David Britt
3. Title: Pulsed EPR Studies of Photosystem II Radicals  
Agency: National Science Foundation  
Amount: \$280,148 Direct Cost; \$375,000 Total Cost  
Dates: 3/15/99 - 2/28/02  
PI: R. David Britt
4. Title: EPR Studies of Cytochrome c Oxidase Intermediates  
Agency: National Institutes of Health (R21)  
Amount: \$140,000 Direct Cost; \$196,666 Total Cost  
Dates: 4/1/00 - 3/31/02  
PI: R. David Britt
5. Title: EPR Studies of Metal-Nucleic Acid Interactions  
Agency: National Institutes of Health (R01 GM61211)  
Amount: \$687,092 Direct Cost; \$915,459 Total Cost  
Dates: 4/1/00 - 3/31/04  
PI: R. David Britt
6. Title: Pulsed EPR Studies of Biological Manganese Clusters  
Agency: National Institutes of Health (R01 GM48242)  
Amount: \$720,000 Direct Cost; \$980,791 Total Cost  
Dates: 7/1/01 - 6/30/06  
PI: R. David Britt
7. Title: Multifrequency EPR/ENDOR Spectrometer  
Agency: National Institutes of Health (S01 RR021075)  
Amount: \$500,000 Direct Cost; \$500,000 Total Cost  
Dates: 1/15/05 – 1/14/07  
PI: R. David Britt

- Co-PIs: Glenn Millhauser, John Voss, Steve Cramer, Michael Marletta, Judith Klinman, Paul Ludden, Edward Solomon
8. Title: EPR Studies of Biological PCET Elements  
Agency: National Institutes of Health (R01 GM073789)  
Amount: \$706,601 Direct Cost; \$1,042,207 Total Cost  
Dates: 3/5/05 - 2/28/11  
PI: R. David Britt
  9. Title: Pulsed EPR Studies of Biological Manganese Clusters  
Agency: National Institutes of Health (R01 GM48242)  
Amount: \$850,227 Direct Cost; \$1,187,131 Total Cost  
Dates: 7/1/06 - 5/31/12  
PI: R. David Britt
  10. Title: A High Magnetic Field Mössbauer Instrument  
Agency: National Institutes of Health (1S10 RR023656)  
Amount: \$273,000 Direct & Total Cost  
Dates: 4/15/08 - 4/14/09  
PI: Stephen P. Cramer  
Co-PI: R. David Britt et al.
  11. Title: EPR Spectroscopy of the Cobalt Water Splitting Catalyst  
Agency: National Science Foundation EAGER (CHE-0939178)  
Amount: \$165,226 Direct Cost; \$240,000 Total Cost  
Dates: 8/1/09 - 7/31/12  
PI: R. David Britt
  12. Title: Purchase of an X-ray Diffractometer  
Agency: National Science Foundation (08-002425) ARRA  
Amount: \$348,552 Direct Cost; \$349,828 Total Cost  
Dates: 08/01/2009 - 07/31/2012  
PI: R. David Britt (as Chemistry Dept Chair)
  13. Title: Pulsed EPR Studies of Biological Manganese Clusters  
Agency: National Institutes of Health (R01, GM48242, ARRA Supplement)  
Amount: \$100,000 Direct Cost; \$153,000 Total Cost  
Dates: 7/1/10 - 6/30/11  
PI: R. David Britt
  14. Title: Multifrequency Pulsed EPR Studies of the Photosystem II Oxygen Evolving Complex  
Agency: Department of Energy, Basic Energy Sciences  
Amount: \$360,000 Direct Cost; \$540,000 Total Cost  
Dates: 9/1/11 – 8/30/14  
PI: R. David Britt

15. Title: Photoreceptor Regulation and Optimization of Energy Harvesting in *Nostoc punctiforme*  
Agency: Department of Energy SISGR (DESC0002395)  
Amount: \$261,327 Direct Cost; \$387,970 Total Cost (Britt portion)  
Dates: 9/15/09 - 9/14/12  
PI: J. Clark Lagarias  
Co-PI: R. David Britt et al.
16. Title: Membrane Organized Chemical Photo Redox Systems  
Agency: Department of Energy (DESC0004334)  
Amount: \$65,271 Direct Cost; \$100,000 Total Cost  
Dates: 5/1/10 - 4/30/13  
PI: R. David Britt
17. Title: Acquisition of Dual Frequency Electron Paramagnetic Resonance Spectrometer  
Agency: National Science Foundation (CRIF) CHE-1048671  
Amount: \$301,168 Direct & Total Cost  
Dates: 12/15/10 - 11/30/13  
PI: Carlito B. Lebrilla (as Chemistry Dept Chair)  
Co-PI: R. David Britt
18. Title: Mechanisms of Co, Ni, and Mn based Water Splitting Catalysts Probed by Advanced EPR Spectroscopy  
Agency: National Science Foundation (CHE-1213699)  
Amount: \$341,233 Direct Cost; \$449,999 Total Cost  
Dates: 6/1/12 - 5/31/15  
PI: R. David Britt
19. Title: Mechanistic Studies of the Radical SAM Enzyme QueE  
Agency: NIH – National Institute of General Medical Sciences (supplement to R01 GM072623)  
Amount: \$85,454 Direct Cost; \$131,599 Total Cost (Britt portion)  
Dates: 5/1/12 - 4/30/15  
PI: Vahe Bandarian  
Co-PI: R. David Britt
20. Title: Photoreceptor Regulation and Optimization of Energy Harvesting in *Nostoc punctiforme*  
Agency: Department of Energy SISGR (DESC0002395)  
Amount: \$71,808 Direct Cost; \$110,584 Total Cost (Britt portion)  
Dates: 9/15/12 - 9/14/13  
PI: J. Clark Lagarias  
Co-PI: R. David Britt et al.

21. Title: Chemical Bonding Center: Chemistry as the Driver for Transformative Research and Innovation  
Agency: NSF Center for Chemical Innovation Solar Fuels  
Amount: \$524,272 Direct Cost; \$810,000 Total Cost  
Dates: 10/1/13 – 9/30/18  
PI: Harry Gray (Cal Tech)  
Co-PI: R. David Britt
22. Title: Mechanisms of Radical SAM Enzymes Probed by EPR Spectroscopy  
Agency: National Institutes of Health (R01 GM104543)  
Amount: \$900,000 Direct Cost; \$1,399,500 Total Cost  
Dates: 7/1/14 - 6/30/18  
PI: R. David Britt
23. Title: MRI: 260 GHz Pulse EPR/DEER Spectrometer  
Agency: National Science Foundation  
Amount: \$1,435,026 Direct Cost; \$678,997 Cost Share; \$2,263,323 Total Cost  
Dates: 7/1/14 - 6/30/17  
PI: R. David Britt  
Co-PI: Neville Luhmann, Jr.
24. Title: Multifrequency Pulsed EPR Studies of the Photosystem II Oxygen Evolving Complex  
Agency: Department of Energy, Basic Energy Sciences  
Amount: \$419,344 Direct Cost; \$626,576 Total Cost  
Dates: 7/1/15 – 6/30/17  
PI: R. David Britt

**Seminars and Chaired Sessions (since advancement to Professor Step VI in 2007):**

NSF Chemical Bonding Center "Powering the Planet" Workshop (2007) Ventura, CA

Boise State University, Chemistry Department Seminar (2008) Boise ID

Protein Cofactors, Radicals and Quinones Gordon Research Conference (2008) Ventura CA

Iron Sulfur Enzymes Gordon Research Conference (2008) Colby-Sawyer College, New London NH

International Conference on Magnetic Resonance in Biological Systems (2008) San Diego, CA

Photosynthesis Gordon Research Conference (2009) Bryant University, Smithfield, RI

International Meeting of the Royal Society of Chemistry EPR group (2009) Norwich, UK

Session Chair: International Meeting of the Royal Society of Chemistry EPR group (2009) Norwich, UK

North American/Greece/Cyprus Workshop on Paramagnetic Materials (2009) Cyprus

NSF Center for Chemical Innovation Solar Fuels Annual Retreat [workshop participant] (2009) Ventura, CA

ACERT Workshop on Structure and Dynamics by Multifrequency ESR/EPR (2009) Cornell University, Ithaca NY

Session Chair: Second Annual Workshop of the 10+10 Alliance (2009) Davis CA,

Session Chair: International Conference on Tetrapyrrole Photoreceptors of Photosynthetic Organisms (2009) Asilomar CA

Institute for Complex Adaptive Matter Annual Meeting (2010) Davis CA

NSF Center for Chemical Innovation Solar Fuels Annual Retreat (2010) Huntington Beach CA

University of Oregon, Chemistry Department Seminar (2010) Eugene OR

Chemistry and Biology of Tetrapyrroles Gordon Research Conference (2010) Newport RI

Session Chair: Western Regional Photosynthesis Conference (2010) Asilomar CA

Session Chair (X2): International Conference on Magnetic Resonance in Biological Systems (2010) Cairns Australia

Discussion Leader: Research Frontiers in Bioinspired Energy Workshop, National Academy of Sciences (2010) Washington DC

International Conference on Magnetic Resonance in Biological Systems (2010) Cairns Australia



Metals in Biology Gordon Research Conference (2011) Ventura CA

American Chemical Society National Meeting, Symposium on "Magnetic Spectroscopic Approaches to the Study of Metals in Biology" (2011) Anaheim CA

Solar Fuels: Light Capture and Electron Flow, J. Heyrovsky Institute of Physical Chemistry (2011) Prague, Czech Republic

Brian Hoffman 70th Birthday Symposium (2011) Vancouver, British Columbia

Session Chair: International Congress on Bioinorganic Chemistry (ICBIC-15) (2011) Vancouver, British Columbia

40th Southeastern Magnetic Resonance Conference, Plenary Lecture (2011) Atlanta, GA,

Inorganic Chemistry special student lecture (invited by Prof. Harry Gray) California Institute of Technology (2012) Pasadena CA

American Chemical Society National Meeting, Symposium on "Photochemistry in Biology" (2012) Philadelphia, PA

NSF CCI Solar Site Visit California Institute of Technology (2012) Pasadena CA. Chaired reviewers' question and answer session.

DOE Physical Biosciences Research Meeting (2012) Baltimore MD

Chemistry Department Seminar, Marquette University (2012) Milwaukee WI

Yamaguchi University (2012) Yamaguchi Japan. Japan Society for the Promotion of Science Lecture

Japan Society of Electron Spin Science and Technology (2012) Sapporo Japan. Plenary Lecture

Hokkaido University (2012) Sapporo Japan. Japan Society for the Promotion of Science Lecture

Tohoku University (2012) Sendai Japan. Japan Society for the Promotion of Science Lecture

Nagoya University (2012) Nagoya Japan. Japan Society for the Promotion of Science Lecture

Kobe University (2012) Kobe Japan. Japan Society for the Promotion of Science Lecture

Bioinorganic Chemistry Gordon Research Seminar (2013) Ventura CA. Discussion Leader

MIT/Harvard Joint Inorganic Seminar (2013) Cambridge MA

International Society of Magnetic Resonance International Conference (2013) Rio de Janeiro Brazil

Rocky Mountain Conference on Magnetic Resonance (2013) Denver CO

Solar Fuels Gordon Research Conference (2014) Ventura CA. Discussion Leader

Dean Winston Ko Retirement Symposium (2013) Davis CA

Texas A& M University Chemistry Seminar (2013) College Station TX

University of Michigan Chemistry Seminar (2013) Ann Arbor MI

National Renewable Energy Laboratory Seminar (2013) Golden CO

CBIG Chemical Biology Seminar (2013) Davis CA

DOE Photosynthesis Research Meeting (2012) Annapolis MD

University of Florida Chemistry Seminar (2013) Gainesville FL

Florida State University Chemistry Seminar (2013) Tallahassee FL

Science in the Country (2013) Half Moon Bay CA

University of California, Berkeley Chemistry Seminar (2013) Berkeley CA

California Institute of Technology Chemistry Seminar (2014) Pasadena CA

Inorganic Chemistry special student lecture (invited by Prof. Harry Gray) California Institute of Technology (2014) Pasadena CA

Solar Fuels Gordon Research Conference (2014) Ventura CA. Discussion Leader

Metals in Biology Gordon Research Conference (2014) Ventura CA.

Stanford University Chemistry Seminar (2014) Palo Alto CA

Emory University Chemistry Seminar (2014) Atlanta GA

Georgia State University Chemistry Seminar (2014) Atlanta GA

47th Annual International Meeting of the ESR Spectroscopy Group of the Royal Society of Chemistry Keynote Lecture (2014) Dundee Scotland UK

University of Washington Chemistry Seminar (2014) Seattle WA

97th Canadian Chemistry Conference (2014) Vancouver Canada

Frontiers in Metallobiochemistry III (2014) Penn State University, PA

Iron-Sulfur Enzymes Gordon Research Conference (2014) Easton MA

Photosynthesis Gordon Research Conference Keynote Lecture (2014) West Dover VT

Catalytic Systems for Chemical Energy Conversion International Symposium (2014) Mulheim Germany

European Federation of EPR Groups Plenary Lecture (2014) Marseilles France

Portland State University - Oregon Health Sciences University Joint Seminar (2014)

Joint Conference of Asia-Pacific EPR/ESR Symposium/ International EPR Society Gold Medal Award Lecture (2014) Nara Japan

University of Pennsylvania Biological Chemistry Seminar (2014) Philadelphia PA

University of Illinois Biochemistry Seminar (2014) Urbana-Champaign IL

Oxford University Departmental Seminar (2014) Oxford UK

Imperial University Special Seminar (2014) London UK

Queen Mary University Departmental Seminar (2014) London UK

University of California, Irvine Inorganic Chemistry Seminar (2015) Irvine CA

University of Florida, Departmental Seminar (2015) Gainesville FL

National High Magnetic Field Laboratory, Future Lab Directions Workshop (2015) Tallahassee FL

University of California Davis, Biophysics Seminar (2015) Davis CA

Resolv EPR Symposium (2015) Bochum Germany

Sacramento State University Chemistry Seminar (2015) Sacramento CA

Williamette University Chemistry Seminar (2015) Salem OR

**Scheduled Invited Seminars and Chaired Sessions:**

Southeastern Magnetic Resonance Conference (2015) Daytona Beach FL

University of California Santa Barbara, Departmental Seminar (2015) Santa Barbara CA

University of California Riverside, Departmental Seminar (2015) Santa Barbara CA

University of Utah , Departmental Seminar (2015) Salt Lake City UT

University of California Merced, Departmental Seminar (2015) Merced CA

Frontiers of Iron Chemistry in Biology Symposium, Pacifichem (2015) Honolulu HI

Metals in Biology Gordon Research Conference (2016) Ventura CA

American Society of Biochemistry and Molecular Biology National Meeting (2016) San Diego CA

International Hydrogenase Conference (2016) Marseille France

79th Harden Conference: Oxygen Evolution and Reduction (2016) Innsbruck, Austria

American Chemical Society National Meeting, Symposium on "Understanding Enzymatic Catalysis across Multiple Timescales: Experiment and Theory" (2016) San Diego CA

American Chemical Society National Meeting, (2016) Philadelphia PA

Royal Society of Chemistry Bruker Prize Lecture, (2016) Colchester UK

**R. David Britt:**  
**20 SIGNIFICANT PUBLICATIONS**

20. 1989 Britt, R. D., J. L. Zimmermann, K. Sauer, and M. P. Klein. **Ammonia Binds to the Catalytic Mn of the Oxygen Evolving Complex of Photosystem II: Evidence by Electron Spin Echo Envelope Modulation Spectroscopy.** J. Am. Chem. Soc. 111:3522-3532.
35. 1994 Tang, X.-S., B. A. Diner, B. S. Larsen, M. L. Gilchrist, G. A. Lorigan, and R. D. Britt. **Identification of Histidine at the Catalytic Site of the Photosynthetic Oxygen-Evolving Complex.** Proc. Natl. Acad. Sci. U.S.A. 91:704-708.
40. 1995 Gilchrist, M. L., J. A. Ball, D. W. Randall, and R. D. Britt. **Proximity Of The Manganese Cluster Of Photosystem II To The Redox-Active Tyrosine YZ<sup>•</sup>.** Proc. Natl. Acad. Sci. U.S.A. 92:9545-9549.
41. 1995 Randall, D. W., B. E. Sturgeon, J. A. Ball, G. A. Lorigan, M. K. Chan, M. P. Klein, W. H. Armstrong, and R. D. Britt. **ESE-ENDOR of a Mixed Valence Mn(III)Mn(IV) Complex: Comparison with the Mn Cluster of the Photosynthetic Oxygen Evolving Complex.** J. Am. Chem. Soc. 117:11780-11789.
59. 1998 Peloquin, J. M., K. A. Campbell and R. D. Britt. **<sup>55</sup>Mn Pulsed ENDOR Demonstrates that the Photosystem II "Split" EPR Signal Arises from a Magnetically-Coupled Manganese-Tyrosyl Complex.** J. Am. Chem. Soc. 120:6840-6841.
74. 2000 Campbell, K. A., D. A. Force, P. J. Nixon, F. Dole, B. A. Diner, and R. D. Britt. **Dual-Mode EPR Detects the Initial Intermediate in Photoassembly of the Photosystem II Mn Cluster: The Influence of Amino Acid Residue 170 of the D1 Polypeptide on Mn Coordination.** J. Am. Chem. Soc. 122:3754-3761.
77. 2000 Peloquin, J. M., K. A. Campbell, D. W. Randall, M. A. Evanchik, V. L. Pecoraro, W. H. Armstrong, and R. D. Britt. **<sup>55</sup>Mn ENDOR of the S<sub>2</sub>-state Multiline EPR signal of Photosystem II: Implications on the Structure of the Tetranuclear Mn Cluster.** J. Am. Chem. Soc. 122:10926-10942.
85. 2001 Campbell, K. A., M. R. Lashley, J. K. Wyatt, M. H. Nantz, and R. D. Britt. **Dual-Mode EPR Study of Mn(III) Salen and the Mn(III) Salen-Catalyzed Epoxidation of *cis*- $\beta$ -Methylstyrene.** J. Am. Chem. Soc. 123:5710-5719

110. 2006 Vogt, M., S. Lahiri, C. G. Hoogstraten, R. D. Britt, and V. J. DeRose. **Coordination Environment Of A Site-Bound Metal Ion In The Hammerhead Ribozyme Determined By  $^{15}\text{N}$  And  $^2\text{H}$  ESEEM Spectroscopy.** J. Am. Chem. Soc. 128:16764-16770.
124. 2009 Stoll, S., A. Gunn, M. Brynda, W. Sughrue, A. C. Kohler, A. Ozarowski, A. J. Fisher, J. C. Lagarias, and R. D. Britt. **Structure of the Biliverdin Radical Intermediate in Phycocyanobilin:Ferredoxin Oxidoreductase Identified by High-Field EPR and DFT.** J. Am. Chem. Soc. 131:1986-1995.
137. 2010 McAlpin, J. G., Y. Surendranath, M. Dinca, T. A. Stich, S. A. Stoian, W. H. Casey, D. G. Nocera, and R. D. Britt. **EPR Evidence of Co(IV) Species Produced During Water Oxidation at Neutral pH.** J. Am. Chem. Soc. 132:6882-6883.
139. 2010 Stoll, S., Y. NajatyJahromy, J. J. Woodward, A. Ozarowski, M. A. Marletta, and R. D. Britt. **Nitric Oxide Synthase Stabilizes the Tetrahydrobiopterin Cofactor Radical by Controlling Its Protonation State.** J. Am. Chem. Soc. 132:11812-11823.
149. 2011 Gerken, J. B., J. G. McAlpin, J. Y. C. Chen, M. L. Rigsby, W. H. Casey, R. D. Britt, and S. S. Stahl. **Electrochemical Water Oxidation with Cobalt-Based Electrocatalysts from pH 0–14: The Thermodynamic Basis for Catalyst Structure, Stability, and Activity.** J. Am. Chem. Soc. 133:14431-14442.
151. 2011 McAlpin, J. G., T. A. Stich, C. A. Ohlin, Y. Surendranath, D. G. Nocera, W. H. Casey, and R. D. Britt. **Electronic Structure Description of a  $[\text{Co(III)}_3\text{Co(IV)O}_4]$  Cluster: A Model for the Paramagnetic Intermediate in Cobalt-Catalyzed Water Oxidation.** J. Am. Chem. Soc. 133:15444-15452.
152. 2011 Stoll, S., H. S. Shafaat, J. Krzystek, A. Ozarowski, M. J. Tauber, J. E. Kim, and R. D. Britt. **Hydrogen Bonding of Tryptophan Radicals Revealed by EPR at 700 GHz.** J. Am. Chem. Soc. 133:18098-18101.
158. 2012 Fugate, C. J., T. A. Stich, E. G. Kim, W. K. Myers, R. D. Britt, and J. T. Jarrett. **9-Mercaptodethiobiotin Is Generated as a Ligand to the  $[\text{2Fe}–\text{2S}]^+$  Cluster during the Reaction Catalyzed by Biotin Synthase from *Escherichia coli*.** J. Am. Chem. Soc. 134:9042-9045.
173. 2013 Kuchenreuther, J. M., W. K. Myers, T. A. Stich, S. J. George, Y. NajatyJahromy, J. R. Swartz, and R. D. Britt. **A Radical Intermediate in Tyrosine Scission to the CO and  $\text{CN}^-$  Ligands of FeFe Hydrogenase.** Science 342:472-475.

175. 2014 Kuchenreuther, J. M., W. K. Myers, D. L. M. Suess, T. A. Stich, V. Pelmentschikov, S. A. Shiigi, S. P. Cramer, J. R. Swartz, R. D. Britt, and S. J. George. **The HydG Enzyme Generates an Fe(CO)<sub>2</sub>(CN) Synthron in Assembly of the FeFe Hydrogenase H-Cluster.** Science 343:424-427.
187. 2015 Oyala, P. H., T. A. Stich, R. J. Debus, and R. D. Britt. **Ammonia Binds to the Dangler Manganese of the Photosystem II Oxygen-Evolving Complex.** J. Am. Chem. Soc. 137:8829-8837.
192. 2015 Suess, D. L. M., I Burstel, L. De La Paz, J. M. Kuchenreuther, C. Pham, S. P. Cramer, J. R. Swartz, and R. D. Britt. **Cysteine as a Ligand Platform in the Biosynthesis of the FeFe Hydrogenase H-cluster.** Proc. Natl. Acad. Sci. U.S.A., 112:11455-11460.



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26 October 2015

Professor **David Britt**, Ltr of Support, ACS Alfred Bader Award in Bioinorganic or  
Bioorganic Chemistry

A flagship of Professor Britt's program is the implementation of a bewildering array of EPR techniques to unveil the structure of biological cofactors. A decade before the Photosystem II (PSII) X-ray crystal structures by Barber (2004), Professor Britt applied electron spin echo electron-nuclear double resonance to show that the tyrosine EPR signal of PSII was altered relative to that observed in a manganese-depleted preparation owing to a magnetic interaction between the manganese cluster of PSII and a nearby tyrosine radical. Not only did he show they were proximate but he was even able to accurately decipher the distance between the two cofactors. It is now known that the tyrosine radical is the key residue that participates in a proton-coupled electron transfer reaction to relay hole equivalents into the OEC for water oxidation. That Britt was able to make this prediction in the mid-1990s when there were only rudimentary 2D electron diffraction maps of the photosynthetic membrane (where the OEC was invisible) is truly stunning. And if that were not enough, he then went on to provide one of the great biophysics studies in my experience. The structure of the OEC was a point of controversy dating back to the 1960s. Britt went against the dogma in the field and boldly proposed a 3+1 Mn structure with the lone manganese labeled by him as "the dangler". His model was later confirmed the membrane-bound X-ray structures. I am still amazed that Britt was able to deduce the structure on the basis of EPR, long before the structural biologists arrived on the scene. His prediction was bold and striking, and better yet, he was entirely correct; I view this work as a gold standard in science.

In addition to PSII, Britt has impacted other areas of bioinorganic chemistry. I briefly mention the SAM enzymes where he has identified almost every possible intermediate, from an analogue of the initial 5'-dA radical to the product radical L-beta-lysine. Characteristic of the Britt signature, the work is meticulously performed and overpowering in its detail and insight.

David Britt is THE premier scientist in the world today in EPR spectroscopy and he has provided the scientific community with the some of the most penetrating and insightful biophysical studies of this generation. I enthusiastically support the nomination of Professor Britt for the ACS Bader Award.



With best regards,

A handwritten signature in black ink that reads "Daniel G. Nocera". The signature is fluid and cursive, with a long, sweeping horizontal line extending to the right from the end of the name.

Daniel G. Nocera

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Britt has made seminal contributions through his development and use of advanced pulsed EPR, (ESEEM, ENDOR) methods for our understanding of complex biological enzymatic mechanisms including: the O<sub>2</sub> evolving complex, the maturation of the cofactor essential for the FeFe hydrogenase (HydA), and many enzymes that utilize S-adenosylmethionine (SAM) and [4Fe4S]<sup>1+</sup> to initiate unprecedented radical mediated transformations. Bioinformatics studies have identified >100,000 enzymes that use SAM and [4Fe4S]<sup>1</sup>, now classified as Radical SAM Superfamily (SF) members. Study of the detailed mechanisms of the transformations by these enzymes requires sophisticated protein purification methods, use of kinetics, isotopic labeling of the enzyme and substrate, and a tool box of time-resolved biophysical spectroscopies.

The Britt and Swartz labs have played a central role in our current understanding of the mechanism by which the unusual metallo-cofactor of the HydA, that catalyzes the interconversion of H<sub>2</sub> and H<sup>+</sup> at 10<sup>4</sup> s<sup>-1</sup>, is biosynthesized. These enzymes contain a catalytic 6Fe-cluster, which is now known to be composed of a “regular” [4Fe4S] cluster bridged by a cysteine thiolate to a uniquely decorated 2Fe-subcluster. The two irons in this subcluster are bridged by dithiomethylamine and CO and each Fe is additionally coordinated to a CO and a CN<sup>-</sup>. The cofactor maturation process requires three proteins, HydE, HydG and HydF; the former two are members of the Radical SAM SF.

HydG was shown (Broderick, Peters and Roach) to use tyrosine as the substrate and produce p-cresol. Isotopic labeling studies of the tyrosine demonstrated that the atoms of its backbone are incorporated into all the CO and CN<sup>-</sup> ligands. HydG also contains an auxiliary FeS cluster, as do many Radical SAM SF members. In a tour de force using protein biochemistry and spectroscopy (Science 2013 342, 472 and 2014, 343, 424), the Britt group in collaboration, identified the HydG bound organometallic Fe(CO)<sub>2</sub>CN synthon and an organic radical intermediate that led to the favored mechanism for this amazing transformation.

While the details of how this synthon is transferred to HydA and acquires the dithiomethyamine ligand are still not understood, a recent paper (PNAS 2015 112, 11455) describes the spectroscopic evidence, that Cys likely binds to the auxiliary cluster and the organometallic synthon. A model for cluster assembly from this intermediate in the presence of HydE and HydF is proposed. The method of cell free protein expression, isotopic labeling and sophisticated spectroscopy is unraveling the amazing mechanisms by which complex and labile intermediates are made and used in Nature.