



Prof. Austen ANGELL
Curriculum Vitae

Regents' Professor of Chemistry and Biochemistry
School of Molecular Sciences

(a) Professional Preparation

B. Sc: Chemical Metallurgy, Melbourne University, Australia	1954
M. Sc: Chemical Metallurgy, Melbourne University, Australia	1956
Research Fellow: Chemistry Department, University of Pennsylvania	1956-58
Stanley Elmore Fellow (PD): Imperial College of Science, University of London	1958-60
Ph. D.: Chemistry, Imperial College of Science, University of London	1961
Research Associate: Argonne National Laboratory (with D. M. Gruen)	1964-66

(b) Appointments

	Place	Date
Visiting Professor	Dept. Theor. Phys., Univ. Rome (May-June)	1997
Professor of Chemistry	Arizona State University	1989
Professor of Chemistry	Purdue University	1971
Assoc. Prof. of Chemistry	Purdue University	1968
Asst. Prof. of Chemistry	Purdue University	1966
Lecturer	Melbourne University, Australia	1962-64

(c) Impact of research, awards etc, H index (Google scholar 2019) 110, see section (h) below for details.

(d) Publications: (total 540) 20yrAv. cites/paper: **72**. Five most cited: 3470, 1784, 1740, 1573, 1449,
No. of papers cited >100x: 110: No. of papers cited >1000x: 6

1. Five most Relevant Publications: (citation nos. in bold)

- (i) "Solvent-free electrolytes with aqueous solution-like conductivities. Wu Xu and C. A. Angell, *Science*, 302, 422-425, (2003) **(404x)**
- ii) "Ionic Liquids: Ion Mobilities, Glass temperatures and fragilities." Wu Xu, E. I. Cooper and C. A. Angell, *J. Phys Chem. B* 107, 6170, (2003) **(686x)**
- (iii) "Protic ionic liquids: Preparation and characterization, and the proton energy level diagram". *J. Phys. Chem. B* 111 (18), 4926-4937 **(306x)**
- (iv) "Rubbery Solid Electrolytes with Dominant Cationic Transport, and High Ambient Conductivity". Angell, C. A.; Liu, C.-L.; Sanchez, E., *Nature*, 362, 137 **(1993) (386x)**
- (v) "Ionic Liquids: past Present and Future, C. A. Angell, Y. Ansari and Z.-F. Zhao, Faraday Discussion on Ionic Liquids, 154 9-27, 2012 Introductory Lecture (244x)

2. Five other relevant publications (citations in bold)

- (i) "Formation of Glasses from Liquids and Biopolymers," C. A. Angell, *Science*, **267**, 1924 (1995). **(3470x)**
- (ii) "Ionic liquids by proton transfer : vapor pressure and conductivity, and the relevance of ΔpK_a from aqueous solutions". . M. Yoshizawa*, Wu. Xu, and C. A. Angell, *J. Am. Chem. Soc.*, **125**, 13411-15419 (2003) **(589x)**

- (iii) "Dynamic processes in Ionic glasses" C. A. Angell, *Chem. Revs.*, 90, 3, 523 (1990) **(445x)**
- (iii) "LiBOB as a salt for lithium ion batteries: a possible solution for high temperature operation," K. Xu, S.-S. Zhang, R. Jow, W. Xu and C. A. Angell, *Electrochem. Solid State Letters* **5**(1), A26-A29 (2002). **(353x)**
- (iv) "High Anodic Stability of a New Electrolyte Solvent: Unsymmetric Non-Cyclic Aliphatic Sulfone," K. Xu and C. A. Angell, *J. Elec. Chem. Soc.* **145**, L70 (1998). **(60x)**
- (v) "PolyLiMOB-lithium salt complexes: from salt-in-polymer to polymer-in-salt electrolytes," W. Xu, L. Wang, and C. A. Angell, *Electrochimica Acta*, **48**, 2037, (2003)

(e) Synergistic activities. (integration and transfer of knowledge)

(1) Selected invited International Conference Opening or plenary talks: 2010-2018

- (a) 16th Internat. Symp. on Polymer Electrolytes, Yokohama, June 2018 Opener
- (b) 100th Turner Symposium Glass Technology, Sheffield, UK. Sept 2016 Opener
- (c) International Congress on Glass, Bangkok, Sept. 21-24, 2015 Plenary Lecture
- (d) Science for Life, Inaugural meeting Lampedusa, Italy May 24-June 3 2015. Opening speaker
- (e) Fermi School of Physics School Properties of water, Varenna, Italy, July 2013, Opener
- (f) International Conference on Slow Dynamics, Sendai, Japan, December, 2012 (opener)
- (g) Japanese Annual Conference on Ionic Liquids, Kyoto, Japan December 2011 (plenary)
- (h) 17th ISNOG (Non-Oxide Glasses), Ningbo, China June 15-22 (2010) Opening Speaker
- (i) 10th Internatl. Wkshop on Non-Cryst. Solids, Barcelona, Spain April 21-23 (2010) (Opener)
- (j) International School on Science of glass. Bangalore, India. Jan. 4, 2010, Opening speaker

(2) Gordon Conference Chairmanships: (1) 1977 - Molten Salts and Metals

(2) 1980 Water and Aqueous Solutions (3) 1997 - Chemistry and Physics of Liquids

Invited Gordon Research Conference Contributions (as speaker or discussion leader) between 1965 and 2012: **57 (45 as speaker, 12 as Discussion Leader)**

(3) Reviews of fields of knowledge: invited by *Annual Review of Physical Chemistry*

(i) (Fused Salts (1971) 30 cites **(ii)** Supercooled Water (1983) **380 cites (iii)** Mobile Ions in Amorphous Materials (1992) **531 cites (iv)** Amorphous Water (2003) **120 cites.**

invited by *Chemical Reviews* **(i)** Dynamics in Glass (1991) **445 cites (ii)** Liquid Fragility and Glass transition in water and aqueous (2002) **388 cites (iii)** Amorphous Water (**254 cites (iv)** Polyamorphism **(iv)** Negative pressure liquids (open invite)

invited by *J. Appl. Phys.* **(i)** Relaxation in Glassforming liquids & amorphous solids (**1573 cites)**

invited by *J. Phys.Chem. Solids* **(i)** Perspective on the glass transition (**881 cites)**

(4) Recent Opening Chapters of Books: (1). *Water Science for Food, Health, Agriculture and*

Environment (eds. Birk et al., 2000), (2) *Insulating and semi-conducting glasses* (Boalchand, 1999), (3) *Physics and Applications of Disordered Materials.* (M. Popescu. 2003),

(f) Number of Ph.D.s graduated (1966 (Asst. Prof., Purdue Univ.) till present: 47

(g) Number of post-doctoral fellows (1966-present): 56

(h) Impact of research.)

(i) H index 101 (according to Google Scholar):

Reports, or invited N&V **Nature or Science total; 27. Since 1998; 15**

(ii) Awards

- **2010** Max Bredig award of the Electrochem. Soc. (for molten salt/ionic liquids)
- 2009 Outstanding reviewer award, Amer. Phys. Soc.
- 2006: Turnbull Lecture of the Materials Research Society (for glass studies)
- 2004 Humboldt Senior Research Fellowship, Germany.
- 2004: Hildebrand award of the Amer. Chem. Soc. (for liquids studies)
- 1992: Neville Mott Award of the Journal of Non-Cryst. Solids.
- **NSF Special Creativity Awards** (DMR, Solid State Chemistry) 1985 & 1994

(iii) Other recognitions: Special issue of *J. Phys. Chem.* (May, 1999)

(i) all ARTICLES (a) AND INVITED TALKS (b) for 2017, 2016, 2015 and 2014

(a) ARTICLES

2018 PAPERS

541. **Concepts and conflicts in polymer electrolytes: the search for ion mobility**, C. Austen Angell, *Electrochimica Acta*, (special issue) accepted and in press)

540. **Postspace- a Personal Retrospective** (Concluding remarks in the Encyclopedia of Glass, Ed. Pascal Richet (in press)

539. Proton transfer and ionicity: an ^{15}N NMR study of pyridine base protonation, Mohammad Hasani, Samrat A. Amin, Jeffery L. Yarger, Stephen K. Davidowski,* C. Austen Angell* *J. Phys. Chem.* (In press)

538. Breakdown of the Stokes-Einstein Relation Above the Melting Temperature in a Liquid Phase-Change Material, Shuai Wei, Zach Evenson, Moritz Stolpe, Pierre Lucas, C. Austen Angell, *Science Advances*, 2018;4: eaat8632 30 November 2018 online

537. A liquid-liquid transition in supercooled aqueous solution related to the HADLDA phase transition in water Sander Woutersen, Bernd Ensing, Michiel Hilber, Zuofeng Zhao and C. Austen Angell, *Science* (March 9 2018) DOI: [10.1126/science.aao7049](https://doi.org/10.1126/science.aao7049)

536. A New Version of the Lithium Ion Conducting Plastic Crystal Solid Electrolyte. Iolanda S. Klein, Stephen K. Davidowski, Jeffery L. Yarger and C. Austen Angell. *Adv. Energy Mater.* **2018**, 1801324 DOI: [10.1002/aenm.201801324](https://doi.org/10.1002/aenm.201801324)

2017 PAPERS

534. Polymer electrolytes- some principles, cautions, and new practices. C. Austen Angell, *Electrochimica Acta*, Special issue from ISPE-15 250, 368-375 (2017)

533. An inverse Aluminum battery. Putting the Aluminum in the cathode. Leigang Xu, Sen Xin, John B. Goodenough and C. Austen Angell. *ACS Energy Letters*. 2, 1534-1538 (2017)

532. Silicon hydrogen sulfates: Solid acids with exceptional conductivities and possible fuel cell applications. Iolanda S. Klein, Stephen K. Davidowski, Jeffery L. Yarger and C. Austen Angell. *ACS Materials Chemistry* (advance copy online) July (2017)

531. Glass transitions, semiconductor-metal (SC-M) transitions and fragilities in Ge-V-Te (V=As, or Sb) liquid alloys: the difference one element can make. Shuai Wei, Garrett J. Coleman, Pierre Lucas, and C. Austen Angell* *Phys. Rev. Applied*, 7 (3), 034035 (2017)

530. Inorganic vs. Organic Cation Ionic Liquids and Their Solutions with Alkali Metal Containing Ionic Liquids, T.G. Tucker, S. K. Davidowski, C.A. Angell, *Electrochemical Society*, 164 (4), 153-H158 (2017).

529. "Contrasting dynamics of fragile and non-fragile polyalcohols through the glass, and dynamical, transitions: a comparison of neutron scattering and dielectric relaxation data for sorbitol and glycerol" F. Migliardo^{1*}, C. A. Angell², S. Magazù³= Biochimica et Biophysica Acta (BBA), General Subjects 1861 (1), 3540-3545, (2017)

2016 PAPERS

530. Nanoporous, transparent MOF glasses with accessible internal surface. Yingbo Zhao¹, Seung-Yul Lee², Omar M. Yaghi^{1,3} and C. Austen Angell^{2*}, *J. Am. Chem. Soc.*, , 138 (34), pp 10818–10821 (2016) (Communication, CHOSEN AS JACS "SPOTLIGHT" - 2,147 READS)
528. Potential tuning in the S-W system. (i) Bringing $T_{c,2}$ to ambient pressure, and (ii) colliding $T_{c,2}$ with the liquid-vapor spinodal. C. Austen Angell* and Vitaliy Kapko. *J. Stat. Mech. Theor & Expt.* 2016 (9), 094004 (2016)
527. On the Use of a Protic Ionic Liquid with a Novel Cation to Study Anion Basicity. Mohammad Hasani,* Jeffery L. Yarger and C. Austen Angell *Chem. Euro. J. Chemistry-A European Journal* 22 (37), 13312-13319, (2016)
526. Excess thermodynamic properties of glassforming liquids: the rational scaling of heat capacities, and the thermodynamic fragility dilemma resolved. Iolanda S. Klein, and C. Austen Angell, *J. Non-Cryst. Solids*, 451, 116-123 (2016)
525. Water: a Tale of Two Liquids, P. Gallo, K. Amann-Winkel, C. A. Angell, M. Anisimov, F. Caupin, C. Chakravorty, T. Loerting, A. Panagiotopoulos, J. Russo, H. Stanley, H. Tanaka, C. Vega se los Heras, Xu Limei, and L. Pettersen. *Chemical Reviews* 116 (13), 7463-7500 (2016)
524. Advanced High Voltage Aqueous Li-ion Battery Enabled by "Water-in-Bisalt" Electrolyte. Liumin Suo, Oleg Borodin, Wei Sun, Xiulin Fan, Fei Wang, Chongyin Yang, Tao Gao, Zhaohui Ma, Marshall Schroeder, Arthur von Wald Cresce, Selena M. Russell, Michel Armand, C. Austen Angell, Kang Xu and Chunsheng Wang *Angewandte Chemie Intern. Ed.* 128, ppp, (2016) DOI: 10.1002/anie.201602397
522. NMR characterization of ionicity and transport properties for a series of diethylmeth-ylamine based protic ionic liquids. Stephen K. Davidowski, Forrest Thompson, Wei Huang, Mohammad Hasani, Samrat A. Amin, C. Austen Angell, Jeffery L. Yarger *J. Phys Chem, B* 120 (18), 4279-4285 (2016) DOI: 10.1021/acs.jpcc.6b01203
521. Apparent first order liquid-liquid transition, with pre-transition density anomaly, in water-rich ideal solutions. Z.-F. Zhao and C. A. Angell. *Angew. Chem. Int. Ed.*, 55, 1 – 5 (2016) DOI: 10.1002/anie.201510717
520. A flexible inorganic fuel cell membrane with conductivity above Nafion, and durable fuel cell operation at 150°C. Y. Ansari, T. G. Tucker, W. Huang, I. S. Klein, S.-Y. Lee, J. L Yarger and C. A. Angell* *J. Power Sources*, 303, 142-149 (2016) <http://dx.doi.org/10.1016/j.jpowsour.2015.10.034>

2015 PAPERS

519. Phase change alloy viscosities down to T_g by Adam Gibbs equation fittings to excess entropy data: a fragile-to-strong transition. Shuai, Wei, Pierre Lucas, and C. Austen Angell, *J. Appl. Phys.* 118 (3), 034903 (2015).

518. Sulfone - carbonate ternary electrolyte with further increased capacity retention and burn resistance for high voltage lithium ion batteries. L.-G. Zue, S. Y. Lee, Z.F. Zhao and C. A. Angell, *J. Power Sources*, 295, 190-196 (2015).
517. Physics of the Jagla Model as the Liquid-Liquid Coexistence Line Approaches Horizontal, J Luo, L Xu, CA Angell, HE Stanley, SV Buldyrev -J. *Chem. Phys.* 142 (22), 224501 (2015).
516. Diffusivity and short-time dynamics in two models of silica. Erik Lascaris, Mahin Hemmati, Sergey V. Buldyrev, H. Eugene Stanley, and C. Austen Angell, *J. Chem. Phys.* 142 (10), 104506 (2015).
515. Ionic Liquid redox catholyte for high efficiency, low - cost energy storage. Leigang Xue, Telpriore G. Tucker, and C. Austen Angell* *Adv. Energy Materials*. 2015, 1500271 doi:org.10.1002/aenm.201500271.
514. Forty years of silica simulations. Which way now? C. Austen Angell, *Intern. Journal of Appl. Glass Science*, Special Issue, 6 [1], 3-14 (2015), DOI: 10.1111/ijag.12112.
513. On the uncertain distinction between fast landscape exploration and second amorphous phase (ideal glass) interpretations of the ultrastable glass phenomenon. C. Austen Angell, *J. Non-Crystalline Solids* 407 (2015) 246–255 DOI: 10.1016/j.jnoncrysol.2014.08.044.

2014 PAPERS

512. Ionic Liquids, Superionic glasses, Quasi-Ionic Liquids, Quasi-Liquid Ionics, all with high Conductivities but some with Little Fluidity. Where does the Paradigm End? *Electrochem. Transactions ECS Trans.* 2014 64(4): 9-20; doi:10.1149/06404.0009e.
- [511.](#) Approaches to, and problems with, ionic liquid electrolytes for alkali metal electrochemical devices: The case of low-melting chloroaluminate binary solutions. T.G. Tucker and C.A. Angell, *J. Electrochem. Soc.* printed online Sept. 2014 DOI 10.1149/2.0471412jes.
- [510.](#) Search for a liquid-liquid critical point in models of silica, Erik Lascaris, Mahin Hemmati, Sergey Buldyrev, H. Eugene Stanley, and C.A. Austen *J. Chem. Phys.* 140, 224502 (2014); DOI: 10.1063/1.4879057.
509. Supercooled water: Two phases? *Nature Materials (News and Views)* 13 (June issue), 673 (2014).
- [508.](#) Enhanced Performance of sulfone, and sulfone-containing, solvents at lithium ion battery electrodes, including the LiNiMnO high voltage cathode, Leigang Xue, Kazuhide Ueno, S.-Y. Lee, C. Austen Angell, *J. Power Sources*, 262, 123-128, 2014.
- [507.](#) Enrico Fermi summer school on Water. Water and its relatives: stable, supercooled, and particularly, the stretched states. (Open Lectures), Stacey Meadley and C. Austen Angell, *Nuovo Cimento*, 2014 (in press), arxiv 1404-4031.
- [506.](#) The fragility of glassforming liquids: thermal vs athermal systems, and kinetic vs thermodynamic manifestations: problems of conception and quantitation. C. Austen Angell, in *Fragility of glass forming liquids* Editors: A.L. Greer, K.F. Kelton, S. Sastry Publisher: Hindustan Book Agency, New Delhi, India (700pp) Chapter 1, 2014.
- [505.](#) Fluctuations, clusters, and phase transitions in liquids, solutions and glasses: from metastable water to phase change memory materials, C. Austen Angell and Zuofeng Zhao, *Faraday Discuss.*, 167, 625, 2013, (concluding lecture). DOI: 10.1039/C3FD00111C.

- [504.](#) Energy applications of ionic liquids, Douglas R. MacFarlane, Naoki Tachikawa, Maria Forsyth, Jennifer M. Pringle, Patrick Howlett, Gloria D. Elliott, James Davis, Masahiro Watanabe, Patrice Simon and C. Austen Angell, *Energy Environ. Sci.*, 7, 232–250 (2014), DOI: 10.1039/c3ee42099j.

(b) INVITED CONFERENCE LECTURES (abstract links from website not working)

2016

- 11/28-12/02/2016 Fall meeting Materials Research Society, Boston, MA Invited Talk in Symposium EC2. **Title:** *Some Progress in Novel Solid Electrolyte Membranes for Storage and Conversion Technologies.* (Cancelled due to illness)
- 11/10-11/11/2016 Regional Meeting of Chemical Society, Galveston: Invited talk; **Title:** " Glass transitions in systems with and without second critical points" Cancelled due to illness)
- 10/23-27/2016 Invited talk in the symposium of "Glass, Amorphous, and Optical Materials: Common Issues within Science & Technology" at the MS&T16, Salt Lake City, Utah. **Title:** "[Some new twists](#) on the road to understanding the glass transition in condensed matter, with some emphasis on ΔC_p ." (Cancelled due to illness)
- 10/1-7/2016 PACIFICHEM Conference - Electrochemical Society of PACRIM, Honolulu, Hawaii. **Title:** "[Solvate](#) ionic liquids, "solvent-in-salt" ionic liquids, and "deep eutectic" ionic liquids. What are the relationships - and the ionicities?"
- 9/3-8/2016 Society of Glass Technology Conference in Sheffield, UK, Opening Lecture of the 100th Turner Symposium. 100th Anniversary of the Society of Glass Technology, SGT100, which is combined with the European Society of Glass Conference **Title:** "[Glass transitions](#) in systems with and without second critical points."
- 08/15-19/2016 Plenary Talk at ISPE-16 (Polymer Electrolytes) in Uppsala, Sweden. **Title:** Title "*Flexible inorganic SPEs of a novel type: Anhydrous Fuel cell membranes and the possibility of protic ionic liquid and alkali-ion-conducting cousins.*"
- 05/04/2016 Caltech - Dept. of Materials Sciences, Title: "*Anomalous Liquids: Common features of Water, Metallic glassformers, and Chalcogenide PCMs (Phase Change Materials)*", Pasadena, California.
- 03/30/2016 MRS Spring Meeting Phoenix 2016 Symposium EE4 (Electrodes and electrolytes)
- (a) **March 28:** Invited tutorial on Electrolytes
- (b) **March 30:** Invited lecture Title: "*A new class of single ion conducting electrolyte ($t^+ = 1$): pure alkali cation plastic crystals.*"

2015

- 09/20-23-2015 Plenary lecture at 2015 International Congress on Glass, Bangkok. Title: "*Are there perfect glasses, how can they be made, and why might it be worth some effort?*"
- 08/03-07/2015 Gordon Research Conference on Liquids, Student Performances Weekend, Invited plenary speaker, and student counsellor.
- 07/20-23/2015 CECAM Conference on Structure and Jamming , Mainz, Germany.
- (a) Invited Tutorial Lecture for students at the meeting Title: "*Fundamentals of, and challenges concerning, the transition from mobile liquid to glass, including cases with intermediate phases.*"
- (b) Invited lecture "*Tuning of second critical temperature in the S-W model gives insight into the ultrastable glass challenge, and supercooled water conundrum.*"
- 06/21-26/2015 Keynote lecturer at 19th Symposium on Thermophysical Properties, National Institute of Standards Technology, Boulder, CO. Title: "*Metastable water: what we know and what we need to know.*"
- 03/16-19/2015 Invited Talk for the symposium honoring Hajime Tanaka on his 60th birthday Fest, Tokyo. **Title:** "*Using the Koop activity criterion for water activity to reveal water's liquid-liquid transition*"
- 01/26/2015 5th Kivelson Lecture Dept of Chemistry, UCLA, CA. **Title:** "*Liquid-liquid, and liquid-glass first order phase changes: fact or fiction?*"
- 01/10-11-2015 DOE Workshop on leading questions on water Research: Invited talk title: "*The water problem: the importance of novel solution and negative pressure studies*"

2014

- 10/29/2014 Opening Speaker at Symposium on Ionic Liquids at Sophia University in Yokohama, JAPAN. **Title:** "*Novel uses of protic and aprotic ionic liquids in water science, protein folding studies and battery research*"
- (and two others: (i) (10/27 Annual Japanese meeting on ionic liquids. Plenary lecture, and 10/28 (ii) "FILL" SYMPOSIUM, Tokyo University of Agriculture and Technology"
- 10/20-25/2014 Opening Speaker at Nordita International Conference on "Water: the most anomalous liquid" in Stockholm, SWEDEN.
- 10/13/2014 Cooper Scholar address for the MS&T meeting in Glass division in Pittsburg, PA, USA.
- 10/5-10/2014 Keynote Speaker at 19th International Symposium on Ionic Liquids and Molten Salts at the 226th meeting of Electrochemical Society in Cancun, MEXICO. **Title:** "*Ionic Liquids, quasi-ionic liquids, and quasi-liquid ionics, all with high conductivities but some with little fluidity.*"
- 08/17-22/2014 Opening Speaker at Gordon Research Conference on "Ionic Liquids and Molten Salts" in Maine, USA. **(This is the First in a new series.)**

- [07/27-31/2014](#) Discussion Leader at Gordon Conference on "Water and Aqueous Solutions" in Holderness, New Hampshire, USA.
- [07/14-17/2014](#) Keynote Speaker, Amorph 14, in Cambridge, UK Honoring Felix Franks. **Title:** *"Water, World's weirdest Liquid wants to be two of them: Does it succeed at negative pressures?"*
- [07/06-11/2014](#) Keynote Speaker at EUCHEM Conference on Ionic Liquids and Molten Salts in Tallinn, ESTONIA. **Title:** *Protic ionic liquids, from superacidic (and superprotonic) through superstable and on to superbasic - with applications.*
- [06/16/2014](#) Colloquium at Physics Department at State University of Porto Allegre, BRAZIL.
- [06/2014](#) Colloquium at State University of Sao Paulo, Araraquara, BRAZIL.
- [04/1/2014](#) Seminar at Yeshiva University, Physics Department, in New York, USA.
- [01/10/2014](#) Invited speaker, Soft Matter Workshop, Hyderabad, India. **Title:** *"Structural transitions in metallic and semiconducting glassformers: some phenomenological relationships with connections to phase change switching materials."*
- [01/4-8/2014](#) Guest of honor at "Symposium on Liquid Fragility", JNCASR, Bangalore, India. **Special Lecture title:** *"The fragility of glassforming liquids: from biblical times to the present, and on."*

(c) Service activities 2016

(i) within Dept., (now SMS)

- *Awards committee
- * hosted minisymposium featuring international speaker at ECS meeting (Mattias Wuttig, University of Aachen) and ASU Faculty

(ii) within the University

(iii) within the US

- * Organized Cooper lecture session for Amer Ceram Soc Fall meeting
- * reviewed total 28 papers for journals ranging from Science, PRL, PNAS, on down, and ranging from 2-24 hours of work per paper.
- *reviewed proposals for DOE and NSF

(iv) International

- *reviewed papers for Nature (1) Angewandte Chemie (2) PCCP and others (included in the total count of 28 in previous item)

*Served as "opponent" for thesis (Luis Aguila) at Dept. of Physics at Chalmers University of Technology, Goteborg, Sweden, Sept. 12,13, 2016