

## Balaka Barkakaty

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### EDUCATION

- **PhD.** Chemistry, Okayama University, Japan (2006)
- **M.S.** Chemistry, Indian Institute of Technology, Guwahati, India (2002)
- **B.S.** Chemistry, Gauhati University, India (2000)

### RESEARCH EXPERIENCE

*Postdoctoral Research Associate, Center for Nanophase Materials Sciences (CNMS), Oak Ridge National Laboratory (ORNL), Oak Ridge, TN (01/2013 – present)*

**Achievements:** Developed

- Novel block copolymer nanoparticles for light initiated drug delivery applications.
- Novel CO<sub>2</sub> responsive polymers and polymer surfaces with high and selective CO<sub>2</sub> capturing efficiency.
- A new environment friendly method to graft hydroxyl functionalized poly(cyclohexadiene) to silica-nanoparticles.
- Novel ionic liquid monomers for controlled radical polymerization.
- A new multi-environment chamber for *in-situ* neutron reflectivity characterization of CO<sub>2</sub> responsive thin-films (10-100 nm) under controlled exposure to CO<sub>2</sub> and moisture.
- A new polymer functionalized surface with potential applications for anti-fouling by capturing CO<sub>2</sub>.

*Postdoctoral Research Associate, Department of Polymer Science, Department of Polymer Engineering, Department of Chemical and Biomolecular Engineering, University of Akron, OH (2010 – 2012)*

**Achievements:** Developed

- New styrene based block copolymers for applications as breast implants.
- Novel sulfonated polystyrene membrane for fuel cell applications.
- New method to study the mechanism of *in-vitro* growth of Natural Rubber by using deuterated compounds.
- New terpyridine based structures to drive and control supramolecular assembly to form bowtie and butterfly type architectures.
- A new chemical method for detection and estimation of free formaldehyde gas present in insulating foams used in US homes.
- A bench foaming gun to duplicate industrial foaming process (50 KG-100 KG) in laboratory scale (50G-500G).

***Postdoctoral Research Associate, Molecular Engineering Institute, Kinki University, Iizuka, Japan (2007 – 2010)***

**Achievements:** Developed

- Room temperature method to capture CO<sub>2</sub> under atmospheric pressure and its *in-situ* utilization for chemical transformation of epoxides to cyclic carbonates.
- A Novel and green method to synthesize polymer cross-linking agent “cyclic tri-thiocarbonates” in water.
- Six novel pH sensitive adamantyl based hemiacetal monomers and polymers for photoresist applications.
- A cyclohexyl cyclic carbonate based methacrylic monomer and polymer for photoresist applications.
- New polymerization method for ring opening poly-condensation reactions of bislactones under acidic conditions.
- New ionic liquid based monomers and polymers for lithium ion battery applications.

***Graduate Research Assistant, Graduate School of Environmental Science, Okayama University, Okayama, Japan (2003 – 2006)***

**Achievements:** Developed

- A new environment friendly ultrasonic method to synthesize aromatic-fluoro alcohols utilizing green-house gas “trichlorofluoromethane” or CFC-11.
- New reaction pathways to synthesize novel fluorinated aromatic ketones as synthetic precursors for important fluorinated pharmaceuticals.
- New reaction pathway to synthesize optically active fluorinated aromatic alcohols.
- New room temperature *in-situ* Grignard reaction for obtaining novel fluorinated aromatic alcohols.

***Associate Scientist, Department of Chemistry, Indian Institute of Technology, Guwahati, India (2002 – 2003)***

**Achievements:** Developed

- A new mild, green and high-yielding method for one-pot chemical transformation of aldehydes to esters under industrial conditions.

## **TEACHING AND MENTORING EXPERIENCE**

- Laboratory Instructor, Graduate School of Environmental Science, Okayama University, Okayama, Japan (2004-2006): Organic Chemistry Laboratory Course
- Co-Teaching Instructor, Department of Chemical and Biomolecular Engineering, University of Akron, OH (08/11-12/11): Green Chemistry Course.
- Teaching Assistant, Department of Chemical and Biomolecular Engineering, University of Akron, OH (2011-2012): Organic Chemistry; Physical Chemistry; In-Organic Chemistry; Quantum Chemistry
- Mentored Attila Gergely, Department of Polymer Science, University of Akron, OH (2011-2012): Synthesis and characterization of poly(alloocimene-*b*-isobutylene) thermoplastic elastomers
- Mentored Alejandra Alvarez, Department of Polymer Science, University of Akron, OH (2011-2012): Modular surface functionalization of polyisobutylene-based thermoplastic elastomers

- Mentored Marcela Castano Gil, Department of Polymer Science, University of Akron, OH (2011-2012): Synthesis and characterization of polyisobutylene and polyethylene glycol dendrimers using enzymatic reactions with application in drug delivery
- Mentored Andrea Charif, Department of Polymer Science, University of Akron, OH (2011-2012): Synthesis and characterization of new bent-core liquid crystal in a biocompatible thermoplastic elastomer
- Mentored Kurtis Chiang, Department of Polymer Science, University of Akron, OH (2011-2012): Biosynthesis of natural rubber
- Mentored Katie L. Browning (Summer Intern, undergraduate from the Department of Materials Science and Engineering, University of Tennessee, Knoxville)
- Mentored Ivana Karpisova (Intern, Department of Nuclear Physics and Biophysics, Comenius University, Slovakia), Center for Nanophase Materials Sciences, Oak Ridge National Laboratory, Oak Ridge, TN (05/2014-07/2014): Laboratory methods and techniques related to fabrication of CO<sub>2</sub> sensitive polymer surface and their characterization.
- Co-advised Master's thesis, Ivana Karpisova, Department of Nuclear Physics and Biophysics, Comenius University, Slovakia: Monitoring of CO<sub>2</sub> reversible interaction with functionalized PVDMA polymer (2015).
- Mentoring Kamlesh Bornani, Department of Chemistry, University of Tennessee, Knoxville (12/2014-present): Studying the impact of tunable flexibility (chain microstructure) on dispersion of Polycyclohexadiene (PCHD)-grafted Silica nanoparticles in a polymer nanocomposite.

## OTHER EXPERIENCE

*Adjunct Faculty Assistant Professor, Department of Chemical and Biomolecular Engineering, University of Akron, OH (08/2013 – 05/2015)*

**Achievements:** During this period, I collaborated with Professor Judit E. Puskas in the Department of Chemical and Biomolecular Engineering from University of Akron in Ohio and published a journal article and a book chapter with her. I also assisted her in her research project for investigating new mechanism for *in-vitro* Natural Rubber synthesis. I also assisted other professors from the same department to make new research collaborations with several research groups at ORNL.

*Chief Executive Officer (CEO) and Founder, Bienatech LLC, Akron, OH (11/2010 – 05/2011)*

**Achievements:** My innovative technology and business idea as a principal investigator (PI) of developing a room temperature CO<sub>2</sub> conducting polymer fuel cell membrane won two important entrepreneurial recognitions in Ohio.

## GRANTS AND AWARDS

- Senior Personnel, NSF CHE: “Reversed Isoprenoid Biosynthesis using Isoprene as an Abundant Substrate: A New Pathway to Renewable Hydrocarbon-Based Compounds and Materials”, Department of Chemical and Biomolecular Engineering, University of Akron, \$315K (09/2010-08/2014)
- Senior Personnel, NSF-SBIR Phase I: “Green Nanotechnology for Medicine: Scaling up the Synthesis of Novel Poly(ethylene glycol) based Dendrimers for Targeted Drug Delivery

- Operations”, Department of Chemical and Biomolecular Engineering, University of Akron, \$150K (01/2012 – 12/2012)
- Principal Investigator, Finalist in The Ohio State University’s New 10x Tech Accelerator for Aspiring Tech Entrepreneurs: “Room Temperature Bicarbonate Fuel Cell”, Biena Tech LLC, \$20K (2011)
  - Principal Investigator, Launch Town Entrepreneurship Winner: “Room Temperature Bicarbonate Fuel Cell”, Biena Tech LLC, \$10K (2011)
  - Principal Investigator, Competitive research grant for graduate students: “Enantiomeric Synthesis of Fluorinated 1,2-aminoalcohols”, Graduate School of Environmental Science, \$5K (2006)

## PUBLICATIONS

### Articles in Refereed Journals

1. A. Marrocchi, P. Adriaensens, E. Bartollini, **B. Barkakaty**, J. Chen, D. K. Hensley, C. Petrucci, M. Tassi, L. Vaccaro, “Novel cross-linked polystyrenes with larger space network as supports for catalytic systems tailor-made for sustainable media”, *European Journal of Polymer Chemistry*, 73, 391-401 (2015).
2. M. Tassi, E. Bartollini, P. Adriaensens, L. Bianchi, **B. Barkakaty**, R. Carleer, J. Chen, D. K. Hensley, A. Marrocchi, L. Vaccaro, “Synthesis, characterization and catalytic activity of novel large network polystyrene-immobilized organic bases”, *RSC Advances*, 5, 107200-107208 (2015).
3. **B. Barkakaty**, B. Talukdar, and B. S. Lokitz, “Addition of CFC13 to Aromatic Aldehydes via *In-Situ* Grignard Reaction”, *Molecules*, 20, 15098-15107 (2015).
4. C. C. K. Chiang, **B. Barkakaty**, J. E. Puskas, W. Xie, K. Cornis, F. Peruch, A. Deffieux, “Unravelling The Mystery of Natural Rubber Biosynthesis. Part II: Investigation of the Composition and Growth of In Vitro Natural Rubber Using High Resolution Size Exclusion Chromatography”, *Rubber Chemistry and Technology*, 87 (3), 451-458 (2014).
5. A. Schultz, X. Li, **B. Barkakaty**, C. N. Moorefield, C. Wesdemiotis, G. R. Newkome, “Stoichiometric Self-Assembly of Isomeric, Shape-Persistent, Supramacromolecular Bowtie and Butterfly Structures”, *Journal of American Chemical Society*, 134 (18), 7672-7675 (2012).
6. S. Ohsawa, **B. Barkakaty**, A. Sudo, T. Endo, “Acid-promoted double ring-opening reaction of bicyclobis ( $\gamma$ -butyrolactone) with alcohol and its application to polyester synthesis”, *Journal of Polymer Science Part A: Polymer Chemistry* 50, 1281 (2012).
7. **B. Barkakaty**, K. Morino, A. Sudo, T. Endo, “Synthesis of A Methacrylic Monomer having Pendant Cyclohexene Cyclic Carbonate- Easy CO<sub>2</sub> Fixation and Radical Polymerization”, *Journal of Polymer Science Part A: Polymer Chemistry* 49, 545 (2011).
8. **B. Barkakaty**, K. Morino, A. Sudo, T. Endo, “Amidine-Mediated Delivery of CO<sub>2</sub> from Gas to Bulk / Solution Reaction System for Highly Efficient Synthesis of Cyclic Carbonates from Epoxides”, *Green Chemistry* 12 (1), 42 (2010).
9. **B. Barkakaty**, K. Matsumoto, T. Endo, “Synthesis and Radical Polymerization of Adamantyl Methacrylate Monomers having Hemiacetal Moieties”, *Macromolecules* 42 (24), 9481 (2009).
10. **B. Barkakaty**, Y. Takaguchi, S. Tsuboi, “New Synthetic Routes towards Various  $\alpha$ -Fluorinated Aryl Ketones and their Enantioselective Reduction using Baker’s Yeast”, *Tetrahedron*, 63(4), 970 (2007).

11. **B. Barkakaty**, Y. Takaguchi, S. Tsuboi, "Addition of  $\text{CFCl}_3$  to Aromatic Aldehydes under Ultrasonic Irradiation", *Synthesis*, 959 (2006).
12. **B. Barkakaty**, S. Adhikari, "Time-Dependent Discrete Variable Representation Method in a Tunneling Problem", *Journal of Chemical Physics*, 118, 5302 (2003).
13. R. Gopinath, **B. Barkakaty**, B. Talukdar, B. K. Patel, "Peroxovanadium-Catalyzed Oxidative Esterification of Aldehydes", *Journal of Organic Chemistry*, 68(7), 2944 (2003).

#### Manuscript Submitted

14. **B. Barkakaty**, K. L. Browning, B. Sumpter, D. Uhrig, I. Karpisova, K. W. Harman, I. Ivanov, J. M. Messman, S. M. Kilbey II, B. S. Lokitz, "Amidine-functionalized poly(2 vinyl-4,4-dimethylazlactone) for selective and efficient  $\text{CO}_2$  fixing", *Macromolecules* (2015). (*currently under the process of minor revisions after peer review*)
15. **B. Barkakaty**, B. S. Lokitz, B. Sumpter, M. Hickner "Materials for capturing carbon directly from Atmosphere", *Environmental International* (2015). (*Invited*)

#### Manuscripts under Preparation

16. **B. Barkakaty**, J. Browning, J. Ankner, K. Browning, I. Ivanov, I. Karpisova, J. Messman, S. M. Kilbey II, B. S. Lokitz "Real-Time Monitoring of *In-Situ* and Reversible  $\text{CO}_2$  Capture in Nanoscale Environments using Neutron Reflectivity and Quartz Crystal Microbalance". Manuscript under co-author review.
17. **B. Barkakaty**, B. S. Lokitz, B. Sumpter "CO<sub>2</sub> Capture- Opportunities, Challenges and Beyond" Manuscript under co-author review.
18. A. C. Charif, **B. Barkakaty**, J. E. Puskas, "Sulfonation of Arborescent SIBS for Proton Exchange Membrane Application", under co-author review.
19. O. Turkarslan, A. L. Gergely, A. A. Albarrán, **B. Barkakaty**, J. E. Puskas, G. Kaszas, "Cationic Copolymerization of Alloocimene with Isobutylene", under co-author review.
20. **B. Barkakaty**, D. Uhrig, Y. Chen, D. J. Pochan, B. S. Lokitz, S. M. Kilbey II, J. M. Messman "Synthesis of a photo-reactive PVDMA-polybutadiene system – a precursor to photodegradable micellar drug-delivery system", manuscript draft under preparation.
21. **B. Barkakaty**, B. S. Lokitz, R. Hansen, I. Ivanov, S. Retterer, S. M. Kilbey II, "CO<sub>2</sub>-switchable polymer modified Si-surfaces for reversible capture and release of proteins", manuscript draft under preparation.

#### Patents

22. T. Endo, **B. Barkakaty**, K. Morino, A. Sudo, "Cyclic Carbonate Compound, its Manufacturing Method and its Polymer", JP 2010235910 A 20101021.
23. T. Endo, **B. Barkakaty**, K. Morino, A. Sudo, "Preparation of Cyclic Carbonates from Oxiranes", JP 2010100539 A 20100506.
24. T. Endo, K. Matsumoto, **B. Barkakaty**, "Adamantane Group-Containing Polymers with Good Water and Heat Resistance, and Acid Dissociation Properties", JP 2009235184 A 20091015.
25. T. Endo, K. Matsumoto, **B. Barkakaty**, "Adamantane-based Unsaturated Polymerizable Compound", JP 2009234956 A 20091015.
26. T. Endo, K. Matsumoto, **B. Barkakaty**, "3-Carboxymethyl-1-Adamantyl Acrylate Derivatives with Good Stability to Water and Acids, and Heat and Alkali Resistance", JP 2009215264 A 20090924.

27. **B. Barkakaty**, B. S. Lokitz, R. R. Hanses, S. T. Retterer, “Selective Protein Adsorption and Release on Polymer Modified Surface with CO<sub>2</sub> Control” (*under preparation*).

#### Book Chapter

28. **B. Barkakaty**, Electro-Active Artificial Muscles with Natural Rubber. In *365 Ideas for Rubber Industries*, H.-J. Graf. Ed. TechnoBiz Group (2016). (*invited and accepted 2015*).
29. J. E. Puskas, C. C. K. Chiang, **B. Barkakaty**, Natural Rubber Biosynthesis Perspectives from Polymer Chemistry. In *Chemistry, Manufacture and Applications of Natural Rubber*; S. Kohjiya, Y. Ikeda, Y. Ed. Woodhead Publishing Limited (2014), 30-67.

#### Scientific Reports and Proceedings

30. C. C. K. Chiang, **B. Barkakaty**, J. E. Puskas, W. Xie, K. Cornis, F. Peruch, A. Deffieux, “Investigation of the Structure and Composition of Guayule Rubber”, Fall Technical Meeting of the Rubber Division, American Chemical Society, 182<sup>nd</sup>, Cincinnati, OH, United States, Oct. 9-11, (2012), 1, 594-609.
31. C. C. K. Chiang, **B. Barkakaty**, J. E. Puskas, W. Xie, K. Cornish, “Investigation of the Structure and Composition of Guayule Rubber”, Polymer Preprints (American Chemical Society, Division of Polymer Chemistry) (2012), 53(2), 343-344.

#### Scientific Abstracts in Conferences/Meetings

32. K. Bornani, **B. Barkakaty**, B. Lokitz, J. W. Mays, S. M. Kilbey II, “Control of Nanoparticle Dispersion using Semi-Flexible Chains Grafted to Silica: Role of Chain Stiffness and Grafting Density”, Pacificchem 2015, December 15-20, Honolulu, Hawaii, USA (2015).
33. **B. Barkakaty**, B. S. Lokitz, B. Sumpter, D. W. Uhrig, and S. M. Kilbey II, “Selective CO<sub>2</sub> Capture-Release from Flue Gas at Room Temperature using Novel PVDMA-based Polymers”, 248<sup>th</sup> ACS National Meeting and Exposition, August 10-14, San Francisco, CA, USA (2014).
34. **B. Barkakaty**, D. W. Uhrig, Y. Chen, D. J. Pochan, B. S. Lokitz, S. M. Kilbey II and J. M. Messman, “Poly(vinyldimethylazalactone)-*block*-Polybutadiene: Creating Modular Photosensitive Materials”, 246<sup>th</sup> ACS National Meeting and Exposition, September 8-12, Indianapolis, IN, USA (2013).
35. **B. Barkakaty**, D. W. Uhrig, Y. Chen, D. J. Pochan, B. S. Lokitz, S. M. Kilbey II and J. M. Messman “Synthesis of Nitrobenzyl-Linked PVDMA-*block*-Polybutadiene: Modular Access to Photo-responsive Materials”, Gordon Research Conference for Polymers, Mount Holyoke College, June 9-14, South Hadley, MA (2013).
36. C. C. K. Chiang, **B. Barkakaty**, J. E. Puskas, W. Xie, K. Cornis, F. Peruch, A. Deffieux, “Investigation of the Structure and Composition of Guayule Rubber”, Fall Technical Meeting of the Rubber Division, American Chemical Society, 182<sup>nd</sup>, October 9-11, Cincinnati, OH, USA (2012).
37. C. C. K. Chiang, **B. Barkakaty**, J. E. Puskas, W. Xie, K. Cornish, F. Peruch, A. Deffieux “Investigation of the Structure and Composition of Guayule Rubber”, 244<sup>th</sup> ACS National Meeting & Exposition, August 19-23, Philadelphia, PA, USA (2012).
38. C. C. K. Chiang, **B. Barkakaty**, J. E. Puskas, W. Xie, K. Cornish, F. Peruch, A. Deffieux “Investigation of the Structure and Composition of Guayule Rubber”, IUPAC World Polymer Congress, June 24-29, Virginia Tech University, Blacksburg, Virginia, USA (2012).
39. **B. Barkakaty**, K. Morino, A. Sudo, T. Endo, “Development of A New Methacrylic Monomer Having Cyclic Carbonate Moiety – Its Highly Efficient Synthesis Based on The Reaction of

Epoxide and Carbon Dioxide and Radical Polymerization”, 58<sup>th</sup> Symposium on Macromolecules, September 16-18, Kurokami Campus, Kumamoto University, Kumamoto, Japan (2009).

40. **B. Barkakaty**, K. Morino, A. Sudo, T. Endo “Development of Amidine-Mediated Reaction of Epoxide with CO<sub>2</sub> and its Application to Synthesis of A New Methacrylic Monomer having Cyclic Carbonate Moiety”, 58<sup>th</sup> Annual Meeting of The Society of Polymer Science, Japan (SPSJ), May 27-29, Kobe, Japan (2009).
41. **B. Barkakaty**, K. Matsumoto, T. Endo, “Synthesis and Radical Polymerization of Novel Adamantyl Methacrylate Monomers having Hemiacetal Moieties” 57<sup>th</sup> Annual Meeting of The Society of Polymer Science, Japan (SPSJ), May 28-30, Yokohama, Japan (2008).
42. **B. Barkakaty**, Y. Takaguchi, S. Tsuboi, “A New Synthesis of Chiral Fluoromethyl Aromatic Alcohols using CFC<sub>13</sub> and Baker’s Yeast”, 7<sup>th</sup> Tetrahedron Symposium, May 25-26, Kyoto, Japan (2006).
43. **B. Barkakaty**, Y. Takaguchi, S. Tsuboi, “Synthetic Utilization of CFC<sub>13</sub> towards Novel Fluorinated Compounds”, 86<sup>th</sup> Spring Annual Meeting of Japan Chemical Society, March 27-30, Funabashi, Japan (2006).
44. **B. Barkakaty**, Y. Takaguchi, S. Tsuboi, “Utilization of Waste Trichlorofluoromethane (CFC 11) for the Synthesis of Fluorinated Compounds”, Pacificchem 2005, December 15-20, Honolulu, Hawaii, USA (2005).
45. **B. Barkakaty**, Y. Takaguchi, S. Tsuboi, “Addition of Chlorofluoro Carbene to Fullerene Assisted by Ultrasonic Irradiation”, International Symposium on Microwave Science and Its Application to Related Fields, July 27-30, Takamatsu, Japan (2004).

#### **INVITED PRESENTATIONS**

1. “CO<sub>2</sub> Responsive Polymers”, Roosevelt University, IL, USA, February 25, 2015.
2. “CO<sub>2</sub> Responsive Macromolecular Nanomaterials”, Center for Nanophase Materials Science, Oak Ridge National Laboratory, Oak Ridge, TN, USA, July 29, 2014.
3. “Design and Synthesis of Functional Polymers using Chemo-Enzymatic Approach”, Center for Nanophase Materials Science, Oak Ridge National Laboratory, Oak Ridge, TN, USA, October 16, 2012.
4. “Synthesis and Evaluation of Lignin Based Insulation Foams and Design and Synthesis of New Monomers for Photoresist Applications”, Department of Chemistry, B. Barooah College, Guwahati, Assam, India, December 24, 2010.

#### **PROFESSIONAL EXPERIENCE**

##### **MEMBERSHIPS**

- American Chemical Society
- Rubber Division of the American Chemical Society
- Biomedical Engineering Society (invited)
- Society for Biomaterials (invited)

##### **JOURNAL EDITORIAL BOARD**

- Open Journal of Advanced Materials Research
- Open Journal of Biomedical Research
- Open Journal of Organic Chemistry

## **PROFESSIONAL SERVICE**

- Co-organizer, General Papers Symposium: New Synthesis and Characterization of Polymers, 247<sup>th</sup> ACS National Meeting and Exposition, March 16-20, 2014, Dallas, TX.
- Co-organizer, General Papers Symposium: Topics open in Polymer Synthesis and Polymer Characterization, 248<sup>th</sup> ACS National Meeting and Exposition, August 10-14, 2014, San Francisco, CA.
- Co-organizer, General Papers Symposium: Topics open in Polymer Synthesis and Polymer Characterization; Organizers, 249<sup>th</sup> ACS National Meeting and Exposition, March 22-26, 2015, Denver, CO.
- Co-organizer, General Papers Symposium: Topics open in Polymer Synthesis and Polymer Characterization; Organizers, 250<sup>th</sup> ACS National Meeting and Exposition, August 16-20, 2015, Boston, MA.
- Co-organizer, General Papers Symposium: Topics open in Polymer Synthesis and Polymer Characterization; Organizers, 251<sup>st</sup> ACS National Meeting and Exposition, March 13-17, 2016, San Diego, CA.

## **MANUSCRIPT REVIEWS FOR REFEREED JOURNALS**

- Chemical Society Reviews
- Journal of Materials Chemistry A
- Journal of Materials Chemistry B
- Journal of Materials Chemistry C
- Polymer Chemistry
- Journal of Polymer Science Part A: Polymer Chemistry
- RSC Advances
- New Journal of Chemistry
- WIREs Nanomedicine and Nanobiotechnology

## **SCIENTIFIC REVIEWS FOR AGENCIES AND PROGRAMS**

- Proposal Review, American Association for Advancement of Science-Global Innovation through Science and Technology (GIST) Tech-I Competition for young science and technology innovators and entrepreneurs from 86 emerging economies worldwide (2015)
- Proposal Review, National Science Foundation (NSF), Department of Materials Research (DMR), (2014, 2015)
- Proposal Review, Users Program, Center for Nanophase Materials Sciences (CNMS), Oak Ridge National Laboratory (ORNL), (2013, 2014, 2015)
- Proposal Review, American Association for Advancement of Science – Science Technology and Security Policy Scientific Exchange Program for Broader Middle East and North African (BMENA) Countries (2013)

## REFERENCES

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