Yingzhong Ma

Chemical Sciences Division, Oak Ridge National Laboratory
One Bethel Valley Road, Oak Ridge, TN 37831-6142
Office: (865) 574-7213 | Cell: (510) 856-6169
Email: may1@ornl.gov
ORCID: 0000-0002-8154-1006
Web of Science researcher profile: https://www.webofscience.com/wos/author/record/L-6261-2016
Google Scholar: https://scholar.google.com/citations?user=VeBrezcAAAAJ&hl=en

Research and Professional Experience:

2022-present	Senior Scientist, Chemical Separation Group, ORNL.
2009-2021	Research Staff Member, Chemical Separation Group, ORNL.
2004-2009	Associate Specialist, Department of Chemistry, University of California, Berkeley, CA. Advisor: Graham Fleming
2000-2004	Postdoctoral Fellow, University of California, Berkeley Advisor: Graham Fleming
1999-2000	Postdoctoral Fellow, Max-Planck Institute for Radiation Chemistry, Germany Advisor: Alfred R. Holzwarth
1999-2000	Graduate Student, Department of Chemistry, Umeå University, Sweden Advisor: Tomas Gillbro
1987-1993	Researcher, Changchun Institute of Physics, Chinese Academy of Sciences, China
1984-1987	Researcher, Changchun Institute of Meteorological Instruments, China

Education and Training:

Umeå University, Sweden	Ph.D.	1999	Physical Chemistry
Changchun Institute of Physics, Chinese Acad. of Sci., China	M.S.	1990	Solid State Physics
Harbin University of Science and Technology, China	B.S.	1984	Applied Physics

Brief Bio (from my work profile: https://www.ornl.gov/staff-profile/yingzhong-ma)**:**

Yingzhong received his Ph.D. in physical chemistry from Umeå University, Sweden, under the supervision of Prof. Tomas Gillbro in 1999. His graduate research was focused on an ultrafast optical spectroscopic study of electronic excitation energy and electron transfer processes in purple and green photosynthetic bacteria. He then joined the group of Prof. Alfred Holzwarth at the Max-Planck Institute for Radiation Chemistry (now the Max Planck Institute for Chemical Energy Conversion) as a postdoctoral researcher, where his work was centered on time-resolved spectroscopic characterization of artificial photosynthetic systems. Yingzhong moved to California in 2000 where he had an extended stay in the group of Prof. Graham Fleming, University of California, Berkeley. There he fortunately had the opportunities of exploring several challenging questions, which include the physical mechanisms underlying the nonphotochemical quenching process that regulates photosynthetic light harvesting in plants as a protective response to excessive incident light radiation, ultrafast electronic excited-state phenomena in semiconducting single- and doubled-walled carbon nanotubes, and laser-induced drug delivery, etc. These studies involved use of a suite of complementary ultrafast laser spectroscopic tools, including two- and three-pulse photon echo, heterodyne-detected transient grating, and frequencyresolved transient absorption spectroscopies, etc. In 2009, Yingzhong joined the Chemical Sciences Division as a staff member, where he initiated a systematic ultrafast optical spectroscopy and microscopy research at ORNL, with specific focuses on understanding fundamental electronic excited-state phenomena with high spatial, spectral, and temporal resolution. His research has since span from low-dimensional nanostructures, molecular systems to polymeric and semiconducting photovoltaic materials. In recent several years, he has been leading a systematic research effort to unravel the complex electronic dynamics in spatially heterogeneous systems using co-registered multimodal all-optical imaging techniques including femtosecond transient absorption, time-integrated and time-resolved photoluminescence, transmission, and confocal reflectance microscopies in combination with specifically developed data analysis algorithms. His latest imaging efforts are focused on developing a separate multimodal optical microscope involving total internal reflection enabled wide-field Coherent anti-Stokes Raman scattering (CARS), fluorescence, second-harmonic and electronic sum-frequency generation microscopies for biological applications. Very recently, Yingzhong's research has been further extending to quantum light spectroscopy and microscopy, an emerging field with enormous potential for non-invasive probing of biological and chemical processes *in vivo* and *in operando* as well as various highly promising imaging applications at truly ultralow light levels.

- **Honors and Awards:**
- 2020 ORNL Innovation Award for Patent - 10,620,050 - Vibrational Sum Frequency Generation Using Shaped Near Infrared Light
- 2023 ORNL Innovation Award for Patent – 11,604,144 – Total Internal Reflection Enabled Wide-Filed Coherent anti-Stokes Raman Scattering Microscopy
- 2023 ORNL Innovation Award for Patent – 11,740,182 – Multimodal Nonlinear Optical Imaging via Evanescent Wave Excitation
- ORNL performance award for 9 years
- Invited talks at ACS, APS, CLEO and Photonics West conferences, etc.

Synergistic Activities:

- Mail-in reviewer for research proposals submitted to various US Department of Energy, BES programs such as CSGB, MSTD, CPIMS and SBIR/STTR programs, as well as Cottrell Scholar Award.
- Panel reviewer for the United States Department of Energy (DOE) Office of Basic Energy Sciences (BES) Energy Frontier Research Center (EFRC) program
- Subject Matter Expert in University of Tennessee Knoxville Mock Study Section to review NIH proposals.
- Reviewer for manuscripts submitted to various ACS (ACS Appl. Mater. Interfaces, ACS Energy Lett., ACS photonics, J. Am. Chem. Soc., J. Phys. Chem., J. Phys. Chem. Lett., Nano Lett.), Elsivier (Chem. Eng. J., Environ. Pollut., J. Lumin., J. Mol. Liq., Nano-Structures & Nano-Objects), RSC (Nanoscale Horizons), Wiley (Adv. Mater., Adv. Sci., Encyclopedia of Applied Physics, Macromol. Rapid Commun., Small, Small Methods, Small Science), AIP (AIP Adv., J. Chem. Phys.), and

Optical Publishing Group Journal (Optics Lett.), as well as Nature, Nature Communications, Communications Physics, etc.

Patents:

1. Vibrational sum frequency generation using shaped near infrared light. Chowdhury, A. U.; Doughty, B.; Lutterman, D. A.; Ma, Y.-Z.; Calhoun, T. R.; Watson, B. R., **2020,** Patent number: 10620050, Application number: 16292676.
2. Total Internal Reflection Enabled Wide-Field Coherent Anti-Stokes Raman Scattering Microscopy by Doughty B. and Ma, Y.-Z., **2023,** Patent application no. 17/240514, US. Patent No. 11,604,144.
3. Multimodal Nonlinear Optical Imaging via Evanescent Wave Excitation. By Doughty, D.; Ma, Y.-Z.; Premadasa, U. I., **2023,** Patent application no. 17/726,906, US. Patent No. 11,740,182

Publications:

1. Liu, Z.; Lin, L.; Li, T.; Premadasa, U. I.; Hong, K.; Ma, Y.-Z.; Sacci, R. L.; Katsaras, J.; Carrillo, J.-M.; Doughty, B.; Collier, C. P. Physicochemical control of solvation and molecular assembly of charged amphiphilic oligomers at air-aqueous interfaces. *J. Colloid and Interf. Sci.* **2024,** *669,* 552-560. https://doi.org/10.1016/j.jcis.2024.05.008.

2. Premadasa, U. I.; Doughty, B.; Custelcean, R.; Ma, Y.-Z. Towards Energy-Efficient Direct Air Capture with Photochemically-Driven CO2 Release and Solvent Regeneration. **Invited Concept Paper,** *ChemPlusChem* **2024,** DOI: 10.1002/cplu.202300713.

3. Premadasa, U. I.; Kumar, N.; Zhu, Z.; Stamberga, D.; Li, T.; Roy, S.; Carrillo, J.-M. Y.; Einkauf, J. D.; Custelcean, R.; Ma, Y.-Z.; Bocharova, V.; Bryantsev, V. S.; Doughty, B. Synergistic Assembly of Charged Oligomers and Amino Acids at the Air–Water Interface: An Avenue toward Surface-Directed CO2 Capture. *ACS Appl. Mater. Interfaces* **2024,** *16,* 12052–12061. DOI: 10.1021/acsami.3c18225.

4. Ma, Y.-Z.; Premadasa, U. I.; Bryantsev, V. S.; Miles, A. R.; Ivanov, I. N.; Elgattar, A.; Liao, Y.; Doughty, B. Unravelling photoisomerization dynamics in a metastable-state photoacid. *Phys. Chem. Chem. Phys.* **2024,** *26,* 4062–4070. DOI: 10.1039/D3CP04454H.

5. Premadasa, U. I.; Bocharova, V.; Miles, A. R.; Stamberga, D.; Belony, S.; Bryantsev, V. S.; Elgattar, A.; Liao, Y.; Damron, J. T.; Kidder, M. K.; et al. Photochemically-Driven CO_2 Release Using a Metastable-State Photoacid for Energy Efficient Direct Air Capture. *Angew. Chem. Int. Ed.* **2023**, *62* (29), e202304957. DOI: 10.1002/anie.202304957.

6. Premadasa, U. I.; Dong, D.; Stamberga, D.; Custelcean, R.; Roy, S.; Ma, Y.-Z.; Bocharova, V.; Bryantsev, V. S.; Doughty, B. Chemical Feedback in the Self-Assembly and Function of Air–Liquid Interfaces: Insight into the Bottlenecks of CO_2 Direct Air Capture. *ACS Appl. Mater. Interfaces* **2023**, *15* (15), 19634-19645. DOI: 10.1021/acsami.3c00719.

7. Premadasa, U. I.; Bocharova, V.; Lin, L.; Genix, A.-C.; Heller, W. T.; Sacci, R. L.; Ma, Y.-Z.; Thiele, N. A.; Doughty, B. Tracking Molecular Transport Across Oil/Aqueous Interfaces: Insight into "Antagonistic" Binding in Solvent Extraction. *J. Phys. Chem. B.* **2023,** *127,* 4886–4895. DOI: 10.1021/acs.jpcb.3c00386.

8. Doughty, B.; Premadasa, U. I.; Lin, L.; Ma, Y.-Z.; Sacci, R. L.; Bocharova, V.; Thiele, N. A. Probing liquid/liquid interfaces at and away from equilibrium using vibrational sum frequency generation, *Ultrafast Nonlinear Imaging and Spectroscopy XI*, **2023,** *12681,* 75-80.

9. Lin, L.; Liu, Z.; Premadasa, U. I.; Li, T.; Ma, Y.-Z.; Sacci, R. L.; Katsaras, J.; Hong, K.; Collier, C. P.; Carrillo, J.-M. Y.; Doughty, B. The Unexpected Role of Cations in the Self-Assembly of Positively Charged Amphiphiles at Liquid/Liquid Interfaces. *J. Phys. Chem. Lett.* **2022,** *13,* 10889-10896. DOI: 10.1021/acs.jpclett.2c02921.

10. Ma, Y.-Z.; Morrell-Falvey, J.; Doughty, B. Biological Imaging using Ultralow Quantum Light. *Research Insights* section of *ORNL Review*. **2022,** *55,* 2, https://www.ornl.gov/media/80878.

11. Doughty, B.; Lin, L.; Premadasa, U. I.; Ma, Y.-Z. Considerations in Upconversion: A Practical Guide to Sum Frequency Generation Spectrometer Design and Implementation. *Biointerphases* **2022,** *17,* 021201. DOI: 10.1116/6.0001817.

12. Lin, L.; Chowdhury, A. U.; Ma, Y.-Z.; Sacci, R. L.; Katsaras, J.; Hong, K.; Collier, C. P.; Carrillo, J.-M. Y.; Doughty, B. Ion Pairing and Molecular Orientation at Liquid/Liquid Interfaces: Self-Assembly and Function. *J. Phys. Chem. B* **2022,** *126,* 2316–2323. DOI: 10.1021/acs.jpcb.2c01148.

13. Liu, Z.; Lin, L.; Li, T.; Kinnun, J.; Hong, K.; Ma, Y.-Z.; Sacci, R. L.; Katsaras, J.; Carrillo, J.-M.; Doughty, B.; Collier, C. P. Squeezing Out Interfacial Solvation: The Role of Hydrogen-Bonding in the Structural and Orientational Freedom of Molecular Self-Assembly. *J. Phys. Chem. Lett.* **2022,** *13,* 2273–2280. DOI: 10.1021/acs.jpclett.1c03941.

14. Premadasa, U. I.; Ma, Y.-Z.; Sacci, R. L.; Bocharova, V.; Thiele, N. A.; and Doughty, B. Understanding Self-Assembly and the Stabilization of Liquid/Liquid Interfaces: The Importance of Ligand Tail Branching and Oil-Phase Solvation. *J. Colloid and Interf. Sci.* **2022,** *609,* 807-814. DOI: 10.1016/j.jcis.2021.11.088.

15. Zhang, Z.; Ma, Y.-Z.; Thomas, L.; Gofryk, K.; Saparov, B. *Elec Physical Properties of Candidate X-ray Detector Material* $Rb_4Ag_2BiBr_9$. *Cryst. Growth Des.* **2022,** *22,* 1066–1072. DOI: 10.1021/acs.cgd.1c00986.

16. Premadasa, U. I.; Bible, A. N.; Morrell-Falvey, J. L.; Doughty, B. and Ma, Y.-Z. Spatially Co-registered Wide-field Nonlinear Optical Imaging of Living and Complex Biosystems in a Total Internal Reflection Geometry. *Analyst* **2021,** *146,* 3062-3072. DOI: 10.1039/D1AN00129A.

17. Lin, L.; Chowdhury, A. U.; Ma, Y.-Z.; Sacci, R. L.; Katsaras, J.; Hong, K.; Collier, C. P.; Carrillo, J.-M. Y.; and Doughty, B. Ion Pairing Mediates Molecular Organization Across Liquid/Liquid Interfaces. *ACS Appl. Mater. Interfaces* **2021,** *13,* 33734–33743. DOI: 10.1021/acsami.1c09763.

18. Basham, C. M.; Premadasa, U. I.; Ma, Y.-Z.; Stellacci, F.; Doughty, B.; and Sarles, S. A. Nanoparticle Induced Disorder at Complex Liquid/Liquid Interfaces: Effects of Curvature and Compositional Synergy on Functional Surfaces. *ACS Nano* **2021,** *15,* 14285–14294. DOI: 10.1021/acsnano.1c02663.

19. Ma, Y.-Z; and Doughty, B. Nonlinear Optical Microscopy with Ultralow Quantum Light. **Invited** Perspective article along with journal cover art, *J. Phys. Chem. A,* **2021,** *125,* 8765-8776. DOI: 10.1021/acs.jpca.1c06797.

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**Invited article for special issue dedicated to Professor Leonas Valkūnas.*

29. Ma, Y.-Z.; Lin, H.; Du, M.-H.; Doughty, B.; Ma, B. Direct Evidence of Exciton–Exciton Annihilation in Single-Crystalline Organic Metal Halide Nanotube Assemblies. *J. Phys. Chem. Lett.* **2018,** *9,* 2164-2169. DOI: 10.1021/acs.jpclett.8b00761.

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