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Tribute to Prof. John C. Wright



Photograph by Dawna Wright

This special issue is dedicated to Professor John C. Wright on the occasion of his 70th birthday. We are pleased to honor him for his spectacular scientific and academic career as a professor and educator.

John's career presents a sustained effort to successfully define the boundaries of laser spectroscopy. Originally trained as a physicist, he has applied his unique talents to both envision the great potential of new spectroscopic methods and elegantly bring them into reality. By rapidly adopting breakthroughs in laser technology his research group has opened the door to many previously unapproachable chemical and materials problems. The list of new spectroscopic techniques that he and his group have developed is long and includes site-selective fluorescence laser spectroscopy, electronically enhanced vibrational nonlinear laser spectroscopy, vibrationally enhanced four-wave mixing spectroscopy, and coherent multidimensional spectroscopy (CMDS), one of the first optical analogues of 2D NMR. His contributions have made a tremendous impact on a number of research communities, and we look forward with great anticipation to the next breakthrough.

In 1972 John started his academic career in the Department of Chemistry of the University of Wisconsin at Madison. Among his first efforts was to apply Ted Hänsch's high-resolution nitrogen-laser-pumped dye laser to his research in analytical chemistry. Using this new technology, John developed site-selective laser spectroscopy for solid-state defect chemistry and energy transfer studies. This technique offered unprecedented access to solid defect equilibria, an analogue of acid–base equilibria in aqueous solution. By using lanthanide, actinide, and transition metal ions as probes, site-selective spectroscopy was developed to achieve subparts-per-trillion detection limits for trace analysis even for nonfluorescent ions. This site-selective technique was applied to probe calcium-binding proteins, guided-wave optical devices, and high-T_c superconductors in his group. John also developed site-selective laser spectroscopy to study energy transfer mechanisms in the processes involving exciton fission, multiexciton generation, three-body energy transfer, and up-conversion, which became the basis for up-conversion lasers. In addition to over 100 research articles published in this field, the technology that grew from this research resulted in a stirred dye cell marketed by Molelectron Corporation and a US patent on site-selective laser spectroscopy for chemical analysis of ions.

In 1978, John decided to open a new field in his group by developing multidimensional nonlinear vibrational spectroscopy. This new technique allowed him to remove the constraint of the need for fluorescence in site-selective spectroscopy. By combining sharp vibrational resonances for selectivity and strong electronic resonances for the sensitivity, this technique proved particularly suitable for studying complex systems. John went on to develop a family of fully resonant and fully coherent spectroscopies, including fully resonant CARS, MENS, MEPS, and CSRS. Simultaneously, the necessary theoretical framework was developed with inclusion of mode coupling, dephasing induced resonances, coherent interference, population relaxation, absorption and refractive index effects, etc., all critical aspects for quantitative interpretation of resonant four-wave mixing. This work illustrated many of the unique capabilities of these fully resonant four-wave mixing, including fully coherent pathways, line-narrowing of inhomogeneous broadening, selectivity for specific components in complex samples, and sensitivity to coupling between quantum states. This pioneering research provided the foundations of CMDS that are now commonly accepted. His work on atoms in flames led to a fundamental understanding of dynamic Stark effects on CMDS, which became useful for his current work on higher order processes. He also applied four-wave mixing interference line shape analysis to measure nonlinear third-order electronic susceptibility of novel optical materials including conjugated polymers and buckminsterfullerene.

When scientific research comes to a crossroads, you need someone to direct the right way forward, and John has played

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this role on many occasions as the field of CMDS has matured. In 1986, he implemented the first six-wave mixing experiment and found the signals were compromised by two strong cascaded four-wave mixing processes. He then focused on developing vibrationally enhanced four wave mixing spectroscopies in room temperature samples, a significant challenge. With his persistence and confidence, in December of 1998, "the impossible" finally turned into a reality with the demonstration of the doubly vibrationally enhanced (DOVE) four-wave mixing spectroscopy, one of the first optical analogues to 2D NMR. Once demonstrated, the unique capabilities of CMDS, isolating mode coupling, isotope selection, and suppression of background absorption came in rapid succession. The experimental findings were complemented with complete modeling of the complicated DOVE spectra to provide a wealth of fundamental molecular information. Together with other colleagues, the CMDS work was highlighted in C&E News in February 2000. Two years later, John launched the International Conference on Coherent Multidimensional Spectroscopy. The first conference was held in 2002 in Seoul, Korea, with 19 submitted abstracts. Ten years later, the sixth conference was held in Berlin, where it had grown into three days and over 100 presentations. In addition to DOVE, other members of the CMDS family were also developed, including triply vibrationally enhanced (TRIVE) four-wave mixing spectroscopy and triple sum frequency (TFS) spectroscopy. In more recent work John has unveiled the power of combining the frequency domain and time domain to identify and isolate coherence transfer using TRIVE. This discovery led to a simplified CMDS method requiring only a single laser frequency. In 2005, with his colleagues, the CMDS methods for molecular interaction studies were patented.

Currently, John is pushing the applications of CMDS to a new level by studying excitonic states in nanostructural materials and probing the oxygen-evolving complexes in photosystems. The inclusion of a new femtosecond fully computer-controlled laser system tunable from the UV to infrared range in his group enables one to track fast dynamics in a broad range of nanostructures. As usual, we expect that new breakthroughs will be born in his group with the availability of the new laser technology.

John is also a remarkable teacher. He is striving for excellent teaching by inspiring all levels of students, from his grandchildren Forest and Eve, to middle school students, and to postdoctoral fellows. He has about half a dozen papers on education, including several in the *Journal of Chemical Education*. He devised ways to engage students in lecture through active learning. The dedicated commitments in teaching won John teaching awards three times. The active learning method has been recognized as a more effective model to improve learning.

John is also a great mentor and supporter for his group members and junior colleagues. He is well-known for his wholehearted support for junior researchers. He invites them to give talks in conferences and at his and nearby institutes, which greatly enhances their visibility. He is very supportive and encouraging at critical junctures of their careers. The joint effort from four guest editors with diverse research backgrounds reflects their appreciation toward John's support and mentorship during their academic careers.

With a fascinating career located between Lake Mendota and Lake Monona, John is always excited about boating. He likes running as well. He can sharply focus on complex problems

when running and many great ideas were thus born. The summer picnic is a tradition for his family and group members. His wife Carol excels as a host for numerous group events, making every member feel at home. Every year, John and Carol write a letter to the group members, reporting their adventures in the year. For his group members, it became a tradition for them to read the letter around Christmas.

Throughout his spectacular career, John has published over 200 peer-reviewed research papers and given over 200 invited talks and lectures around the world. He has worked with over 100 students and collaborators. The seminal work has won John numerous awards and honors including Andreas C. Albrecht Chair of Chemistry from 2001 to present, Fellow of the Society of Applied Spectroscopy in 2013, GSFLC Outstanding Mentor Award in 2008, NSF Creativity Grant Extension from 2005 to 2007, Fellow of the American Association for the Advancement of Science in 2005, Fellow of the American Physical Society in 2003, Benjamin Smith Reynolds Award for Teaching Excellence in Engineering in 2002, Dow Lecturer at University of British Columbia in 2002, Kellett Mid-Career Faculty Researcher Award from 1997 to present, Chancellor's Excellence in Teaching Award in 1994, Upjohn Award for Excellence in Teaching in 1992, Evan Helfaer Chair of Chemistry from 1991 to 1996, American Chemical Society Award in Spectrochemical Analysis in 1991, A. I. Romnes Faculty Fellow in 1984, Applied Spectroscopy Society William F. Meggars Award in 1981, DuPont Assistant Professor in 1972, and Phi Beta Kappa.

John has also provided his leadership by serving as the chair of the Department of Chemistry of the University of Wisconsin at Madison from 2001 to 2004, the Editorial Board of *Applied Spectroscopy* from 2009 to 2012, and Chair of the International Organizing Committee for the International Conference on Coherent Multidimensional Spectroscopy from 2004 to present, just to name a few, among many other service and outreach activities, and on a variety of conference program organizing committees, review panels, award committees, etc.

Through this special issue, it is our privilege to say Thank You to John, a mentor, collaborator, and friend. By joining with his many other friends and colleagues, we wish him a wonderful 70th birthday and hope to celebrate his scientific and academic achievements in every 10 years to come.

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