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IES Anniversary issue

The Publication of the International EPR (ESR) Society

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Please feel free to contact us with items (news, notices, technical notes, and comments) or ideas for the *EPR newsletter*.

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epr newsletter

The Publication of the International EPR (ESR) Society

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The cover picture is dedicated to a most historical event – the International EPR (ESR) Society is 30 this year!

Editorial

Dear colleagues,

two great dates are to be celebrated this year: 75 years of the discovery of EPR and 30 years of the IES. The International conference "Magnetic Resonance – Current State and Future Perspectives" is the key conference devoted to 75 years of EPR including the Zavoisky Award 2019 celebration with a special session devoted to 30 years of the IES (p. 32). The XIth EFEPR Conference is selected by the IES as the main symposium of its 30th anniversary (p. 31). The IES Annual General Meeting is organized within this conference and some of the IES Awards and Award lectures are to be delivered.

Fortunately, we may find all we need to know about the discovery of EPR and the IES while surfing the pages of this publication.

Igor Silkin, curator of the Zavoisky museum at the Kazan Federal University (14/4, pp. 12, 13) inducts us into the reconstructed experimental setup of E. K. Zavoisky, the extremely simple equipment, which gave birth to this great discovery on January 21, 1944, when an EPR signal was observed for the first time. We may learn from Nataliya Zavoiskaya, daughter of Evgeny Zavoisky, some personal details about her father (13/1-2, pp. 13, 14) and about his fascination by the avant-garde art (14/4, pp. 6, 7). See also the article of Kev Salikhov on 100th anniversary of E. K. Zavoisky (17/4, pp. 4, 5) and the article of Yurii Smirnov on the Zavoisky's participation in the Soviet atomic project (17/4, p. 7).

In the course of his life Evgeny Zavoisky courageously moved from one new field of science to another and in each field he made important discoveries. To quote V. I. Ginzburg, Nobel Prize laureate: "... The discovery of EPR (Kazan, 1944), a very sensitive method to study the structure of matter, ...; the creation with a collective of collaborators of electron optical converters, enabling one to "see" separate photons and to measure super-short time intervals (Moscow, 1953); studies in the field of thermonuclear synthesis, leading to the discovery of the anomalous increase of the resistance and turbulent heating of plasma by electric current (Moscow, 1961) – this is far from being a complete list of works in which his talent of an experimenter manifested itself brightly and fruitfully."

The IES aims to stimulate scientific development of EPR spectroscopy, facilitate communication among EPR researchers, and encourage the use of EPR techniques across a wide variety of research fields (see *Letter of the President* by Thomas Prisner, p. 3). Twenty years of the IES are summarized in the special issue 19/1-2 (2009) starting with detailed recollections of the establishment of the IES written by Founding President Hal Swartz (19/1-2, pp. 4–7). All thirty years of the diverse IES activities and the vibrant life of the magnetic resonance community are reflected in the issues of the *EPR newsletter*, the official publication of the Society. Visit us at www.epr-newsletter.ethz.ch.

Congratulations on these terrific anniversaries on behalf of our enthusiastic *EPR newsletter* team!

Laila Mosina

Are you interested to become a member of the International EPR (ESR) Society? Please find the registration/information form for new/continuing members of the IES and non-credit-card payment instructions for individual members on this Web site: www.epr-newsletter.ethz.ch/contact.html

Letter of the President

Dear Colleagues,

the International EPR (ESR) Society is getting 30 this year! When I realized that last year, I was actually rather surprised and my first thoughts were "Uh, so young! Even my own career in EPR spans over a longer time." At the same time, I realized that EPR itself has his 75 birthday this year, a more senior birthday indeed. Anyway, both events are worthwhile to memorize the past and to speculate a little bit on the future. If I think 30 years back, the situation was of course very different from now. The first commercial pulsed EPR spectrometers just became available and most research groups built their own setups! The situation was the same for the software controlling the spectrometer or for analyzing experimental data. Nowadays we can buy all kinds of EPR setups commercially and EasySpin allows easy simulation of data. Many new and more efficient experimental techniques have been developed since or have been optimized for specific applications. Nevertheless, most of the active research and application fields of EPR spectroscopy active have been pioneered and explored already even before the foundation of IES! Of course, many of these early ideas became much more elaborate recently, got a totally new direction or even emerged from new discoveries or technological advances! Single spin detection became possible by the invention of optical single molecule spectroscopy and developed into a new field of ultra-sensitive atomistic magnetic field sensing (with all their extensions into electrical and force field detection). High-field EPR spectroscopy evolved into a new tool with many applications, ranging from high-spin systems to the characterization and identification of organic radicals in biology or of radicals, which are used for Solid-State DNP applications at the same high magnetic field strengths. Pulsed dipolar spectroscopy in combination with site-directed spin-labeling became a well-established method in structural biology. EPR spectroscopy has become a very important tool in the characterization of photovoltaic materials and the fundamental understanding of the relevant processes (which also implied new EPR methodology developments, as for example electrical detection). Miniaturized electrical circuit technology allow creating 'EPR-on-a-chip' devices, which might be interesting for sensor technology in the future. Just to name a few examples! Some of these applications areas developed very fast and created their own sub-communities (or became strong parts in the respective application field communities). Thus, I would not be surprised to see in this field specialized 'table-top' instruments appearing in the near future (similar as in the field of optical spectroscopy and microscopy).

Despite the fact that many scientists already use such well explored and developed EPR methods for applications in physics, materials sciences, chemistry, biology and medicine, Astonishingly, the EPR method in all its different flavors (continuous-wave EPR, pulsed EPR, pulse dipolar spectroscopy, hyperfine spectroscopy, optical and electrical detection and imagine) still sees ongoing technical and methodological developments! Similar like in the field of NMR spectroscopy this leads to a larger diversity in background and skills of the researchers in our EPR field nowadays. This broadening of the scope is reflected in the extended portfolio of journals, where EPR research is published nowadays, and in the diversity of conferences from different application fields, where EPR results are presented. Conference series, which are centered on EPR spectroscopy method (or on magnetic resonance techniques in general). The attendance in some of them is even increasing, demonstrating the importance of magnetic resonance methods in many application fields. On the other hand, more and more scientists, which are using magnetic resonance techniques, rather present their research results at conferences specialized more on the specific application field and within other research communities. Therefore, schools to teach on the theoretical, technical and methodical basics of our EPR method are becoming increasingly important for young researchers! As already stated in their foundation status, IES will support and encourage EPR teaching schools in the future! It is of increasing importance to give young scientists a good theoretical background and foundation of all the different aspects of EPR, helping them to apply such techniques to their specific research. This year, IES together with the Shared EPR initiative initiated an EPR school for beginners, which will take place a week before the Rocky Mountain Conference in Denver. The overwhelming response of applicants shows the demand and importance of such initiatives! IES also supports the EPR school activities of the European Federation of EPR groups (EFEPR), which organizes already there 8th edition of their EPR school this November in Czech. To create a depository of teaching material (from former EPR schools and other activities of our members) at the IES webpage is another goal for the near future. The recently initiated Twitter page of IES where new EPR publications can be found is another step to encourage communication and exchange between EPR researchers from different fields and backgrounds. In addition, the *EPR newsletter*, our beloved 'Vereins-Zeitung', will continue to keep us updated with ongoing activities and news related to EPR spectroscopy and imaging and related fields. I hope very much that the International EPR society can serve as home base for such a scientific exchange within our community, for communication and interaction with companies and for networking activities to the outside.

Thomas Prisner, IES President

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University of Denver
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Fellow of the IES 2019

Michael Mehring
University of Stuttgart
Stuttgart Germany

IES Silver Medal for Biology/Medicine 2019

Hassane S. Mchaourab
Vanderbilt University
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IES Silver Medal for Physics/Materials 2019

Robert Bittl
Free University Berlin
Berlin Germany

Detailed information will be given in a future issues of the *EPR newsletter*

Congratulations

Congratulations to the International EPR/ESR Society for celebrating its 30th anniversary! Founded at the Rocky Mountain Conference in 1989, the IES has become an indispensable tool for the community to show the vitality of an important field of science. For an outside observevwr, the *EPR newsletter* is certainly the most visible activity. It became a communication platform which is recognized worldwide and is the figurehead of the IES. The *EPR newsletter*, reaching out to a large community of scientists united under the EPR umbrella, is one of the favorite media we use to announce our latest products and achievements in the field of EPR instrumentation. For the EPR community, the *EPR newsletter* serves as platform to announce meetings and positions and report on recent conferences. Bruker has been proud to underwrite the distribution costs for the Society.

Big thanks go to the presidents, previous and current, for leading the Society successfully now over 30 years. The enormous efforts by Laila Mosina and her team to put together an attractive issue each time must be acknowledged greatly.

We hope that the IES prospers for many more years to come!

Peter Höfer and the Bruker EPR Team

On behalf of the International Society of Magnetic Resonance, I would like to congratulate the International EPR (ESR) Society for the valuable role it has played in supporting and promoting research involving EPR/ESR for the past thirty years. I have been personally impressed by the continuing vitality and expanding importance of EPR/ESR in all areas of physical and biological sciences over this time period, especially in the past decade. I am sure that the IES has been a major contributor to the success of this field, and will continue to be a major contributor for many years to come. I look forward to all future interactions between IES and ISMAR.

Sincerely,
Rob Tycko, ISMAR President
National Institutes of Health
Bethesda, MD USA

On behalf of Asia-Pacific EPR Society, we are happy to congratulate International EPR Society to its 30ths anniversary. During these years IES became a very important and powerful society and stimulated scientific achievements in the development of EPR techniques and applications in many different fields (physics, chemistry, biology, materials science, electronics, etc.).

IES Gold and Silver medals, awards for young scientists were introduced and became the IES tradition. These awards are highly respected and considered as significant awards by the scientists all over the world.

We wish the prosperity to the International EPR Society in future years and productive and fruitful work for the development of EPR.

Elena Bagryanskaya
President of the Asia-Pacific EPR Society
N. N. Vorozhtsov Institute of Organic Chemistry, SB, RAS, Novosibirsk, Russia

Groupement AMPERE

The International EPR (ESR) Society is celebrating her 30th anniversary. On this occasion it is my privilege and great honor to convey my sincere and affectionate congratulations to this proud anniversary on behalf of the Groupement AMPÈRE. Yvgeny Zavoisky has pioneered magnetic resonance with the first observation of spin precession in condensed matter in 1944. While often in the shadow of its younger sibling, EPR today is not only a multifaceted analytical methodology but also a vigorous evolutionary driver to modern NMR spectroscopy with a multitude of applications in biology, chemistry, materials science, and quantum physics. The foundation of the International EPR (ESR) Society has sharpened the profile of the analytical concepts of the method and advanced its progress and dissemination by becoming the nodal point of interaction for the world's best scientists in applying and further developing electron paramagnetic resonance. I wish the Society and all her members a flourishing future with a growing footprint in the global science community.

Sincerely,
Bernhard Blümich
President of the Groupement AMPÈRE

New IES Executives

Peter Z. Qin, IES Treasurer

Peter Z. Qin received his B.S. degree in Physics from Peking University in China in 1991. He carried out his graduate study on RNA folding and catalysis under the mentorship of Professor Anna Marie Pyle at Columbia University in the City of New York, and received his Ph.D. degree in 1999. From 1999 to 2002, Dr. Qin carried out postdoctoral research work with Professor Wayne L. Hubbell at University of California, Los Angeles, developing methods of Site-Directed Spin Labeling to study RNA. In 2002, Dr. Qin joined the faculty of the Department of Chemistry, University of Southern California, at which he was promoted through the rank and current holds a tenured full professor appointment. Dr. Qin's research focuses on understanding mechanisms of nucleic acid recognition by studying the relationship between structure, dynamics, and function of nucleic acids and protein/nucleic acid complexes. The Qin group develops and applies Site-Directed Spin Labeling techniques, both in bulk and at the single-molecule level, to monitor structure and dynamics of nucleic acids and protein-nuclei acid complexes under physiological conditions. Current projects in the Qin group focus on using spin-labeling in conjunction with other techniques to investigate mechanisms of target recognition by the programmable CRISPR nucleases that are revolutionizing genome engineering.

Interview with Professor Hideo Utsumi on the Occasion of His IES Fellowship 2018

EPR newsletter: *Dear Professor Utsumi, on behalf of the readers of the EPR newsletter we congratulate you on your IES Fellowship 2018. We are most appreciative that you agreed to answer the questions of this interview. Why did you start towards your career in science?*

As an ordinary young boy, I enjoyed making things, a radio, a hut, etc. using various electric work tools and parts in my father's radio-shop. I still keep my father's presents, pliers and screwdrivers. After the education of liberal arts for two years in University of Tokyo, I selected the faculty of pharmaceutical sciences, because I have an incurable disease, sarcoidosis since the age of sixteen, and studied the interdisciplinary fields, biochemistry, organic synthesis, physical chemistry, and engineering. Before graduation, I hoped to work in the trading enterprise, Mitsubishi Corporation, but I gave up having a position in private enterprises due to the incurable disease. The employment charged professor of Tokyo University advised me to take the entrance examination for the graduate school and then find the position in a public institution. This was my first discouragement, fortunately leading me to concentrate on my graduation research on ESR in the laboratory of drug production engineering (Professor Takao Kwan).

Who introduced you into magnetic resonance?

This was first Professor Takao Kwan, who was working on the physical chemistry of the catalyst using ESR spectroscopy and gas chromatography and claimed the idea "Wisdom from Organism". He asked me to start my graduation research with an elder graduate student, Mr. Yutaka Kirino, becoming the successor of the laboratory, who was carrying out his doctor thesis on the one-electron oxidation intermediate radical of vitamin C with TiO_2 using ESR and gave me the research task, "ESR studies on intermediate radical of vitamin C with hydrazine", which was my master's thesis in 1973. He taught me ESR and organic synthesis, and left for Dr. Richard Fessenden, causing that I should find my research task of the doctor thesis by myself. At those days, I was affected by "Wisdom from Organism" and interested in the biological application of ESR, especially in spin-labelling studies by Harden McConnell. Receiving the encouragement by Prof. Kwan, I started it alone in the lab by learning the technology through the publications by McConnell and the oral presentations by Ohnishi's lab (Kyoto University) in the annual meetings. Under guidance by the lipid biochemists, Professors Nojima and Inoue, who were introduced by Prof. Kwan, I synthesized new spin-labeled lipids and demonstrated the relation of lipid dynamics with various biological phenomena. After moving to Health Science Lab in Showa University (Prof. Akira Hamada), I changed research subjects and had several results on in vivo ESR under the support by Prof. Akira Hamada and the collaboration with JEOL.

What part of your research is most dear to your heart and why?

For a pharmaceutical scientist, the direct and non-invasive detection and imaging of free radicals in whole body are an exciting dream, because of their participation in physiology and pathology. When I touched the information of in vivo ESR from Mr. Fujimoto, a serviceman of JEOL in 1985, immediately I searched the related papers with highly exciting, decided to change my research from spin labeling to in vivo ESR and its imaging. At first, we prepared the field gradient coils for X-band ESR and the algorithm for Fourier transformation and computer tomography. By good fortune, Showa University succeeded in the big grant for research instrument (1M$) and the first prototype L-band ESR spectroscopy was installed in 1988. At the closure of the year we succeeded in the observation of a weak ESR signal at abdomen of mouse after intravenous injection of nitroxyl probe, and applied to various disease models, ischemia reperfusion, hyperoxia, Vitamin E etc. Several trials, 2D spectral-spatial imaging, microscopic ESR imaging, and 300 MHz ESR for a human hand were also prepared until I moved to Kyushu University. In the new lab, the in vivo ESR application to clinical researches were started with young students including my successor Prof. Yamada and in collaboration with several clinical departments. A prototype of Overhauser-enhanced MRI from Philips was installed in 2003 to improve the spatial resolution of free radical imaging, and applied to simultaneous imaging of plural intrinsic radicals, various disease models. To encourage the young students in Japan for internship in foreign ESR laboratories, we started JSPS Core-to-Core Program in collaboration with Drs. Kuppusamy and Lurie in 2007, and two dozen students studied in the foreign labs. The development of a new FC-DNP-MRI system was also tried but not yet completed, mainly due to my sudden appointment as a program officer of JSPS, where I worked full-time of Thursday and Friday in Tokyo office during 2003–2007, and the another one during 2010-2014.

What is the driving motivation for you in your research?

The curiosity led me to ESR studies on life sciences, and I tried to keep the challenge to the original works, the deep consideration through the original literature, and the concentration on the researches owing to my incurable disease, and then continued them by good fortune with my excellent colleagues and good collaboration.

What is your message to the younger generation of the magnetic resonance researchers?

During the discussion with students in my laboratory, I have emphasized the originality of research, the enough learning from the original literatures and the deep consideration about the significance. There were so many original important literatures on the magnetic resonance and its applications from 1950s to the present. I believe that any application of the magnetic resonance without fundamental understanding from the original literatures would lead to no success.

Interview with Professor Michael Wasielewski on the Occasion of His IES Silver Medal for Chemistry 2018

EPR newsletter: *Dear Professor Wasielewski, on behalf of the readers of the EPR newsletter we congratulate you on your IES Silver Medal for Chemistry 2018. We are most appreciative that you agreed to answer the questions of this interview. Why did you start towards your career in science?*

I spent my earliest years in a neighborhood next to Lake Michigan, which at the time was sandwiched between the University of Chicago on the north and the steel industry on the south. When traveling south along the lake shore, especially at night, I was fascinated by the sights, sounds, and scents of steel making. In addition, being a young child in the 1950's, the singular event that demonstrated the magic of science and led me to pursue it as a career was the dawn of the space age. I distinctly remember the excitement that I felt when Sputnik was launched in 1957. It enhanced my already well-developed interest in finding out how things work. I remember a fondness for dismantling my grandparents' short-wave radios and putting them back together, something that, much to their dismay, did not always go as planned. I naturally became interested in astronomy and space exploration as well, and was brought to chemistry by wanting to understand rocket propulsion.

This strong interest in science, and chemistry in particular, continued through high school and during my undergraduate and graduate degree studies at the University of Chicago. There, I had the opportunity to perform undergraduate research under one of the first NSF-sponsored programs for that purpose. At that time I developed a strong interest in the physical properties of organic molecules, especially under the guidance of Leon Stock, Gerhard Closs, and N. C. Yang. I was equally influenced by the work of Clyde Hutchison, a pioneer in EPR spectroscopy. I remember that Clyde would patiently explain complex magnetic resonance concepts to me, an undergraduate who had barely enough background at the time to understand them.

Who introduced you into magnetic resonance?

My Ph.D. research under the guidance of Leon Stock focused on how electron spin is delocalized through bonds. I focused on how the electron-nuclear hyperfine couplings of hydrogen, carbon-13 and fluorine atoms depend on the structure of paramagnetic molecules. Large couplings were studied using EPR spectroscopy, while smaller ones were determined indirectly using NMR chemical shifts in paramagnetic Ni complexes. At that time I continued to interact strongly with Gerhard Closs and his group as they explored chemically induced dynamic nuclear polarization (CIDNP). In addition, I continued to learn about the EPR spectroscopy of triplet states from Clyde Hutchison and his group members.

What part of your research is most dear to your heart and why?

My most satisfying research has been developing a detailed understanding of photo-driven electron transfer reactions, and using this knowledge to mimic key aspects of photosynthesis leading to the establishment of the field of artificial photosynthesis for solar energy conversion. A key event in this process was the development of the first electron donor-acceptor molecules that successfully mimicked the subtle features of electronic coupling between radical ion pairs at fixed distances that lead to the spin-polarized radical ion pair and charge recombination triplet states characteristic of photosynthetic reaction center proteins. I accomplished this by applying time-resolved EPR techniques to directly observe the spin-polarized radical pairs and triplets in molecules designed to control the electronic coupling and consequently the spin-spin interactions in well-defined structures.

This work paved the way for much more general results. The small electronic couplings characteristic of non-adiabatic electron transfer reactions are important determinants of electron transfer rates, yet are very difficult to measure and even more difficult to calculate accurately. I used a combination of magnetic field effects on the triplet yield following charge recombination and time-resolved EPR measurements of radical ion pair dynamics within structurally well-defined molecules to directly measure these interactions in photo-generated radical ion pairs. This work lead me to apply magnetic field effects and time-resolved EPR spectroscopy to demonstrate the energetic and electronic coupling criteria necessary to make long organic molecules function as molecular wires, as well as demonstrate that the mechanism of electron transfer mediated by bridge molecules changes from the strongly distance dependent superexchange mechanism in short bridges to the weakly distance dependent charge hopping mechanism in longer bridges. This change makes it possible to design molecules that transport charge over long distances, which has potential technological importance. In the past decade, I have focused a significant part of my research on understanding spin dynamics in radical pairs with an emphasis on their properties as quantum entangled two-particle systems, exploring the nature of decoherence processes as well as the implementation of quantum gates and teleportation schemes that are important for the rapidly emerging field of Quantum Information Science. This field presents a new set of challenges and opportunities for EPR spectroscopy applied to novel molecules and materials.

What is the driving motivation for you in your research?

Mainly, my desire to understand how Nature works is at the root of what drives my research. But once I understand some aspects of a problem, I enjoy designing and building new molecules, materials, and instrumentation that can test whether my understanding is correct. It is somewhat like first developing a plan for a house with all the drawings and details in place, then having the satisfaction of seeing the house built in physical reality.

What is your message to the younger generation of the magnetic resonance researchers?

The key bit of advice I always give to young people in this field is: Make the power of magnetic resonance for understanding chemical, physical, and biological systems accessible to the broader community. While basic concepts of NMR are taught to undergraduates as an analytical tool, the fundamentals of EPR spectroscopy are not. In addition, advanced EPR techniques, such as pulse-EPR, are not widely known or appreciated by many members of the scientific community, whose research could greatly benefit from using them. Part of the problem is the complex nature of the instrumentation and data analysis, but a large part is our own tendency to not spend enough time getting the scientific community interested and excited about the field. A second bit of advice is focus your research on problems that have great importance to society, such as health, energy, environment, or information. This research has countless fundamental scientific problems that can benefit from a molecular understanding, and that can be obtained from magnetic resonance techniques.

The JEOL Prize 2018

Leah Weiss

I had the privilege of attending the 2018 Royal Society of Chemistry Electron Spin Resonance (ESR) Conference at Queen Mary University in London. I would first like to thank the conference organizers and funding bodies for this stimulating, interdisciplinary conference. The breadth of topics highlighted for me how powerful spin-sensitive methods are in the study of materials and their function on a local level and how methods development goes hand-in-hand with new physical insights.

I am thankful to have had the opportunity to present my own research – on the spin physics of materials for solar energy harvesting – as part of the 2018 JEOL-funded prize talk competition. JEOL is a company that has developed scientific instruments for a range of applications including nuclear and electron spin resonance with recent development in high sensitivity cw-ESR spectrometers. The JEOL prize talks included contributions in a diverse set of topics ranging from next-generation methods development utilizing arbitrary waveform generation to applications of double electron-electron resonance spectroscopy to probe topological edge states. I am honored to have participated with a cohort of fellow early career researchers and to have been awarded this year's talk prize for a presentation of my doctoral research entitled *Spin-signatures and dynamics of exchange coupled triplet excitons from singlet fission*.

My doctoral work, in the group of Prof. Sir Richard Friend at the University of Cambridge, is focused on a class of materials called organic semiconductors: conjugated hydrocarbons that form printable solid-state semiconductors. In this class of molecular materials, excited-state electrons and the positively charged 'holes' form bound-states, composite particles called excitons. These excitations hop from molecule to molecule and are harnessed in optoelectronic devices for light harvesting (photovoltaics) and light emission (light-emitting diodes). In these carbon-based materials, excitonic properties are extremely sensitive to spin: spin is conserved throughout excited-state processes due to weak spin-orbit coupling. For example, spin-zero singlet excitons decay rapidly to the spin-zero ground state by emitting a photon, while spin-1 triplet excitons are long-lived, protected from decaying by their spin.

The focus of my talk was on one such spin-dependent process in organic semiconductors called singlet fission: the generation of a pair of triplet excitations on neighboring molecules from one singlet excitation [1]. The process of singlet fission was first discovered and studied in the 1960s where the key experimental 'smoking gun' was the signature magnetic field effects on photoluminescence – a fingerprint of the spin dynamics occurring during the triplet-pair lifetime [2]. Research on singlet fission has undergone a re-awakening in the past 10 years with the vision of using this process to better harness the solar spectrum. Specifically, singlet fission allows for the down-conversion of one high energy excitation into two more usable lower energy excitations which can then be coupled into existing silicon photovoltaics to overcome thermalization losses [1]. Indeed, while this vision was first put forward by David Dexter in 1979 [3], renewed interest coupled with advances in experimental techniques have pushed our understanding of singlet fission and enabled engineering of devices with over 100% external light harvesting efficiency [4]. Key questions remain that are critical for applications. One such question is: 'How does the triplet pair state couple and dissociate?' In the JEOL talk, I presented how spin-sensitive techniques provide a window into the triplet pair state and its evolution by probing exchange interactions between excitons.

While traditional models of fission assumed effectively independent triplets, our work presented the first evidence that triplets couple to form long-lived, exchange-coupled complexes in the solid-state. Working in the labs of Prof. Jan Behrends and Prof. Robert Bittl at the Freie Universität Berlin, we found that strong exchange coupling between spins on neighboring sites can be detected by the presence of spin-quintet ($S = 2$) pair states, which have distinct spin resonance spectra compared to non-interacting spin-1 triplet excitons. Coherent driving under pulsed microwave fields further allowed confirmation of spin multiplicity via the relative Rabi oscillation frequency of each spectral component for strong and weak coupling. In this collaboration we demonstrated the first measurements of microsecond spin coherence times of the quintet state [5]. These experiments showed how the triplet pair state and its evolution from bound to free triplet excitons can be probed via electron spin resonance. Complementary investigations by other groups using spin resonance on other molecules have led to a deeper understanding of singlet fission in the larger space of molecular structures (from dimers and oligomers to solid-state composites) [6–8]. Spin resonance has thereby proved a particularly useful tool in understanding the relationship between inter-molecular structure and exciton interactions in singlet fission.

Motivated by the surprising finding of exchange-coupled triplet pair-states in the solid-state, we turned to experiments in the European high magnetic field facilities to quantify the exchange interaction between triplets in these systems. Using external magnetic fields up to 60 T, the strength of exchange coupling and associated optical signatures were quantified through development of spectrally resolved photoluminescence-detected spin-level anticrossings, which provides a method for spin-sensitive spectral hole-burning [9, 10]. We used external magnetic fields to tune triplet spin-levels into resonance to induce mixing between bright (spin-0) and dark (spin-1,2) pair states. At these field points diminished emission occurs from triplet pairs, revealing the luminescence that arises from pair sites with a matching value of spin-coupling strength. These experiments thereby provided a link between spin parameters (i.e, the exchange interaction) and optical signatures enabling future table-top, all-optical experiments.

The results highlight the novel spin properties of the triplet pair state formed by singlet fission, from long spin lifetimes and coherence to sensitive exchange coupling, which can be used as a probe of molecular packing. These properties expand possible uses of such states in devices, providing a foundation for engineering triplet pair interactions not only for efficiently harnessing triplets in solar applications but also for potential spin-based applications. This work would not have been possible without an interdisciplinary collaboration with groups from the UK, Germany, France, the Netherlands, and the United States. The materials we studied are made by synthetic organic chemists in the group of Prof. John Anthony at the University of Kentucky, who have made a suite of solution-processable derivatives of triplet-bearing linear aromatic molecules. The experiments were the result of collaboration with the electron paramagnetic resonance groups of Prof. Jan Behrends and Prof. Robert Bittl at the Freie Universität Berlin where I was a visiting researcher, and pulsed and static high magnetic field groups of Dr. Paulina Plochocka and Prof. Peter Christianen at the European High Magnetic Field Laboratories in Toulouse and Nijmegen where magneto-optic experiments were completed.

In the time following the Royal Society of Chemistry ESR conference, I have completed my doctoral research and viva examination, and have taken up a three-year Junior Research Fellowship at Clare College, University of Cambridge. In my current role I will be investigating the coupling of spin to nuclear and mechanical degrees of freedom in nanoscale excitonic systems and potential applications of molecular spin-systems for spin-based applications. I am excited to have the opportunity to build on the techniques of my doctoral work, combining spin resonance and optical spectroscopy with local structural probes to explore materials for efficient, synthetically tunable spin-based quantum technologies. I look forward to continuing to connect with the network of spin resonance researchers in the next set of RSC ESR conferences and to explore the many applications of spin resonance in understanding novel materials and their applications.

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Prof. Robert Bittl (left) received the 2019 Silver Medal for Physics/Material Sciences this year at the Royal Society of Chemistry ESR Meeting in Glasgow from the IES president Thomas Prisner (right).

The IES Silver Medal in Physics for 2019 is awarded to Professor Robert Bittl in recognition of his many fundamental contributions to the understanding of the spin-physics of EPR spectroscopy with application in biophysics and solar energy materials. Professor Robert Bittl studies natural paramagnetic species in important protein complexes. Within these studies, he works on the theoretical and conceptual understanding of time-resolved and pulsed EPR experiments and contributes to their methodological developments. One of his long-standing topics is the understanding of light-driven electron-transfer processes in proteins. He explored the electron spin polarization and coherence induced by such processes and their appearance in time-resolved or pulsed EPR experiments. Furthermore, he explored the effects arising from high-spin centres and from delocalized spin-systems in EPR experiments. He pioneered the detection of natural occurring paramagnetic species in living cells by EPR and explored the use of micro-resonators to increase the sensitivity for such size-limited samples. Further experimental developments are in high-field/ high-frequency EPR technology up to the Terahertz region. As a second direction, Professor Robert Bittl studies fundamental photo-physical processes in solar cells and light-driven electron transfer reactions in artificial and natural photo-sensors by EPR. With his spectroscopic work and the descriptions of the underlying fundamental spin physics, he contributed greatly to a detailed molecular understanding of the functional properties in both fields.

Bruker Thesis Prize 2018

Audrey Bienfait

Attending the RSC ESR conference in London this April was a wonderful experience. The excellent talks on a wide range of topics gave me the opportunity to discover more about the ESR community and its current challenges - and also enjoy London city!

During this meeting, I was also very honored to receive the Bruker thesis. My PhD took place in the Quantronics group at CEA Paris-Saclay under the supervision of Patrice Bertet, from March 2013 to October 2016 and dealt with performing "magnetic resonance with quantum microwaves" [1]. Indeed, usual magnetic resonance theory treats the spin systems quantum mechanically, while describing their excitation field classically. The experiments that I realized during my thesis aimed to go towards a 'novel' regime in which a quantum description of the excitation field becomes essential. They also evidenced that the excitation field quantum fluctuations can have a major influence on the spectrometer sensitivity as well as on the spin dynamics.

There are usually very good reasons to justify the use of a semi-classical treatment for the spin-field interaction: the spin-field coupling is generally so weak that the quantum fluctuations of the excitation field have negligible effects on the spins dynamics compared to the coupling to other spins or the lattice vibrations. Moreover, at the temperature where most magnetic resonance experiments are realized, the vacuum fluctuations of the excitation field are overcome by its thermal fluctuations. These two arguments are closely related to the rather poor sensitivity of ESR spectrometers: it is because spins are weakly coupled to the excitation field that a successful detection requires a large number of spins for the collected signal to overcome the experimental noise, which itself is largely above the quantum noise limit.

The first experiment thus consisted in implementing a spectrometer making use of quantum microwaves to reach a higher detection sensitivity. The spectrometer itself was based on a high-quality factor superconducting resonator, coupled to the spins with a micron-scale detection volume. The resonator was cooled down to milli-Kelvin temperatures, allowing any thermal fluctuations of the microwave field coupled to the spins to be suppressed. The remaining quantum fluctuations would generally be too small to be detected by typical ESR detectors, if not for the recent advances made in the field of superconducting quantum circuits. One major progress brought by this field is the ability to detect quantum microwave fields with high efficiency by using so-called Josephson Parametric Amplifiers (JPA). Using one of these JPAs cascaded to other low-noise temperature semiconducting amplifiers, we evidenced that the spectrometer output noise becomes dominated by quantum fluctuations, thus realizing ESR measurements at the quantum noise limit. The measurements were carried out on a resonator patterned on a sample containing bismuth donors in silicon spins. Pulsed ESR spectroscopy using this setup reached a sensitivity of 1700 spins/$\sqrt{\text{Hz}}$ [2], a four-order-of-magnitude improvement over the previous state-of-the-art.

Entering the quantum noise regime opens the door to the use of quantum optics techniques to improve the spectrometer sensitivity further. By using squeezed vacuum states, which are engineered vacuum states with less noise on one quadrature at the expense of more noise on the other quadrature, the spectrometer output noise can be reduced below the vacuum noise limit. The idea of performing measurement beyond the standard quantum limit with such engineered states was first proposed by Caves in the context of interferometric measurements, and has since then been used for example to improve the detection of gravitational waves. Our experiment consisted in sending a squeezed vacuum state produced by a second JPA in the spectrometer detection waveguide while driving the spins with a typical spin-echo sequence. The squeezed vacuum quadrature is aligned with the quadrature on which the echo is emitted, leading to reduced noise. This effectively reduces the output noise by 25%, corresponding to a 12% enhancement of the spectrometer sensitivity [3]. The modest improvement is due to the limited degree of squeezing achieved, which is in mainly due to losses in the microwave setup.

Quantum microwave fluctuations can also have a strong impact on the spin dynamics. Indeed, placing a spin at resonance in a high-quality-factor small-mode-volume resonator strongly enhances its relaxation by spontaneous emission of a microwave photon. This effect was predicted by Edwin Purcell in 1946 and has since then be observed for many systems but never for spins. In a third experiment, we demonstrated that the Purcell effect in our spectrometer was large enough to become the dominant spin relaxation mechanism [4]. We achieved sub-second relaxation times, a three-orders of magnitude enhancement compared to the non-radiative relaxation time. This cavity-enhanced relaxation provides a novel and general way to initialize spin systems on-demand, with a direct application to ESR experiments since faster re-initialization leads to higher repetition rates and thus improved sensitivity.

Since January 2017, I am a post-doc in the group of Andrew Cleland at the University of Chicago where I work on coupling superconducting qubits to phononic degrees of freedom. While I am now absent from the ESR field, I look forward to these new techniques and concepts inherited from microwave quantum optics becoming more common place in magnetic resonance experiments.

I wish to end this by thanking all the people with which I worked together during my thesis. First and foremost is my advisor Patrice Bertet for this wonderful journey, as well as all the other members of the Quantronics group, Philippe Campagne-Ibarcq, Cécile Grezes, Yuimaru Kubo, Sebastian Probst, Michael Stern, Xin Zhou as well as Denis Vion and Daniel Estève - to cite only the ones directly involved in these experiments. I am also deeply thankful to John Morton and Jarryd Pla for their involvement - their knowledge of ESR and Silicon spins was very precious. I also wish to thank Alexander Kiilerich, Brian Julsgaard and Klaus Mølmer for developing theory and simulation models. Thanks to Thomas Schenkel from Lawrence Berkeley National Laboratory for providing the Bismuth spins sample without which nothing would have been possible.

Finally, I would also like to thank Bruker for funding such a wonderful prize for young scientists, the reviewers for taking the time to evaluate entire theses, and the organizers of the RSC meeting in London to have made this possible.

Some inside stories about the developments of multi-extreme THz ESR

Hitoshi Ohta

We have been developing the multi-extreme THz ESR technique in Kobe for almost two decades. The specifications of our multi-extreme THz ESR are, 1) frequency region between 0.03 and 7 THz [1], 2) temperature region between 1.8 and 300 K [1], 3) magnetic field region up to 55 T using pulsed magnetic fields [1], 4) pressure region up to 1.5 GPa combined with pulsed magnetic fields [2] and up to 2.5 GPa combined with a steady field up to 10 T [3], 5) THz ESR detection of micro-level samples using the micro-cantilever [4–6] or the commercially available membrane-type surface stress sensor [7, 8]. In this article I would like to tell some inside stories concerning the developments of the last 2 systems (4 and 5).

Around 1998 I came up with the idea to combine high pressure ESR with our high magnetic field THz ESR because the magnetic susceptibility measurements under high pressure using the piston-cylinder type pressure cell and the SQUID magnetometer were becoming popular in the material science at that time. The pressure can change the interactions in magnetic materials, and there were some cases where the pressure induced exotic new magnetic states. My idea was to use sapphire, which transmits the THz wave, for the piston part of the piston-cylinder type pressure cell instead of the conventional metal alloys, and do the transmission THz ESR by putting the pressure cell with the sample in the center of the magnet. This was the starting point for the development of our multi-extreme THz ESR. However, I had no experience in using high pressure cells at that time. Thus, the first thing I had to do was to find a good expert in the field of high pressure measurements, who could help us to design a new transmission type high pressure cell for our high field THz ESR. Fortunately, I had a chance to talk about my idea with Prof. Yoshiya Uwatoko (Saitama University at that time), who is an expert of high pressure, during a party at the Institute for Solid State Physics (ISSP), University of Tokyo – and our collaboration started. Soon he moved to ISSP to take over the high pressure group after the retirement of Prof. Mori. After some discussions we came to the conclusion to use the piston-cylinder type pressure cell rather than the diamond anvil cell because the sample volume was too small for the diamond anvil cell whose inner diameter is less than 0.5 mm and a certain amount of sample (spin number) is required for transmission type THz ESR – although the applied pressure is much higher for the diamond anvil cell. For the piston part we decided to use sapphire because it is strong and has a high transmission in the THz region. Prof. Uwatoko drew the design for us and suggested the company to make the pressure cell. He taught us everything including the pressure transmitting media, how to seal it and how to calibrate the pressure at low temperature. We are very grateful for his kind collaborations. For the starting money to develop this new pressure cell, I would like to thank Prof. Reizo Kato (Riken), who was a group leader of the Grant-in-Aid for Scientific Research on the Priority Area “Metal-assembled Complexes – Chemisty Based on Inorganic-Organic Hybrid Electronic Structures”, for letting us join the project during 1999–2000, which helped us a lot. Finally we succeeded in observing the pressure dependence of ESR on the spin-Peierls substance $CuGeO_3$ using our new pressure cell and the pulsed magnetic field in 2001 [9]. The outer cylinder part was made of Cu-Be alloy and the achieved pressure was 0.35 GPa with an inner diameter of 3 mm [9]. The pressure was extended to 1 GPa by using NiCrAl alloy for the outer cylinder part of the pressure cell and using the 55 T pulsed magnetic field in 2009 [10]. Dr. Takahiro Sakurai, who received his PhD at Kobe University for these developments under my supervision and now our colleague, was the key player in this endeavor. The NiCrAl alloy has the advantages of strength and low conductivity compared to the Cu-Be alloy. Therefore, the heating of NiCrAl alloy by the Eddy current under pulsed magnetic fields is lower. However, the heating is not much of a problem because the ESR measurement is over in 10 msec using the pulsed magnetic field and the heat will thus reach the sample after the ESR measurement. Thus, we can wait to cool down the pressure cell and then go to the next shot. Finally, 1.5 GPa was achieved by increasing the outer diameter of the cylinder, staying within the limit of the inner diameter of our pulsed magnet [2] but we had to seek for other solutions to increase the pressure further.

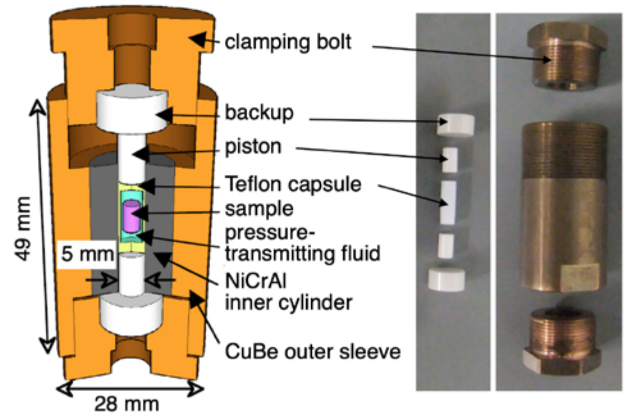

Fig. 1. Schematic diagram (left) and photo (right) of the hybrid pressure cell.

Recently we have developed a hybrid-type pressure cell, which consists of the NiCrAl alloy inner cylinder, the Cu-Be alloy outer cylinder and ceramic piston parts, and achieved 2.5 GPa [3]. The ceramic piston was important because the sapphire will brake under this pressure. However, it took us almost 2 years to select the appropriate ceramic material for the piston part because there is a tendency that the stronger ceramics seem to have lower THz transmittance. The reason is not clear because the companies do not disclose the ingredient of each ceramic. Using this new pressure cell for the THz ESR we have succeeded in finding the first-order pressure-induced transition at 1.85 GPa in the Shastry-Sutherland Model Compound $SrCu_2(BO_3)_2$ [11]. The achievement of 2.5 GPa was really critical for this study. Moreover, the high pressure THz ESR was essential to observe the excited states in this study because the phase transition was from the singlet dimer state to the plaquette singlet state, and the observation of the ground state by the magnetization measurement under high pressure was not useful. However, although the magnetic field for THz ESR is limited up to the steady field of 10 T in Kobe using this hybrid-type pressure cell, we have now developed a new high pressure THz ESR system up to 25 T using the cryogen-free superconducting magnet in the Institute for Material Research (IMR) at Tohoku University [12]. This is a high field user facility [13] and we are looking forward to world-wide users to employ the high pressure THz ESR system for solving their experimental problems.

Now I will move to the story of 5). In 2003 I heard a presentation of Dr. Eiji Ohmichi (ISSP) about the highly-sensitive magnetization measurement of a micro-level (micro-

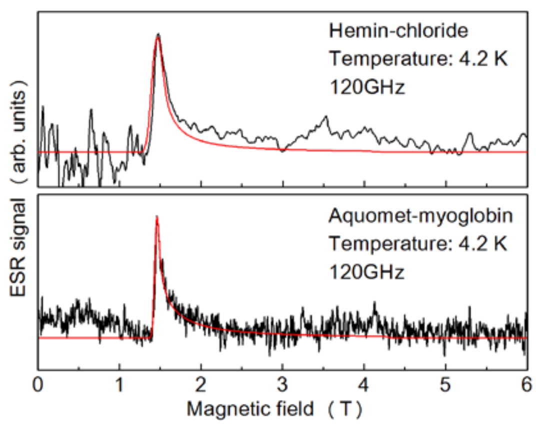

Fig. 2. Results of the EPR measurements obtained at 120 GHz from a frozen solution sample, together with red simulated curves. The top and bottom graphs are for hemin chloride and myoglobin, repspectively. The solution concentrations and sample volumes were 50 mM, 2 μL for hemin chloride, and 8.8 mM, 10 μL for myoglobin [17].

gram or micro-meter) sample using a micro-cantilever under a pulsed magnetic field. The idea came up to me that a micro-cantilever may be used to detect the ESR of micro-level samples because the magnetization will change at the resonance field of the ESR due to the excitation of down spin to up spin states. Very simple – and I thought this is a very good idea and I should be the first person in the world to come up with this idea. However, I was wrong. It was a bit disappointing to learn that Rugar et al. had already developed the Magnetic Resonance Force Microscope (MRFM) [14]. However, their method was in the several GHz range, focused on spatial resolution using the Faraday method and aiming at single spin detection. Therefore, we decided to aim at a highly sensitive ESR detection in the THz region using the torque method. I talked to Dr. Ohmichi about my idea and we started a collaboration. In September 2003, my graduate course student Motoi Kimata and I visited ISSP in Kashiwa, which is outside of Tokyo, to test the micro-cantilever ESR within the joint research program of ISSP [15]. Kimata was the key person for the early stage of this research. He grew the test sample, a Co-Tutton salt single crystal, and carried the sample and Gunn oscillators to ISSP. He received his PhD at Kobe University for the magneto-optical measurements of organic conductors [16] under my supervision; now he is Associate Professor at IMR, Tohoku University. Due to his experimental technique, the "first" micro-cantilever ESR measurements under pulsed magnetic fields at 50, 80, 130 GHz became possible. Such a success is very rare for joint research programs by my experience. At first we worked on a patent application – but were not successful. Therefore, our first presentation was delayed to the Low Temperature Physics Conference in 2005 (LT24, Orlando, USA) and only published in the Proceedings [4]. This project was extended very much with respect to using the Faraday method, angular dependence measurements, and the fabrication of custom micro-cantilevers [5] with Dr. Ohmichi joining our group as Associate Professor in 2006. Moreover, when Dr. H. Takahashi joined our group in 2015, the developments of our micro-cantilever ESR using the torque method reached 1.1 THz [6] and other recent developments have been achieved such as the torque magnetometry [7] and ESR [8] measurements using a commercially available membrane-type surface stress sensor. Very recently our PhD student Tsubasa Okamoto has succeeded in the force-detected THz ESR measurement of a microliter-volume frozen solution sample of hemin and myoglobin [17]. Now I feel that we are entering a new phase of research, expanding our force-detected THz ESR measurements to various applications. We are looking forward to world-wide collaborations in the future.

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The Asia-Pacific EPR/ESR Society reaching maturity at 20th+ Anniversary

The 20th anniversary of establishment of the Asia-Pacific EPR/ESR Society (APES) is a suitable occasion to briefly present the history and current status of the Society. The Society came into being during the First Asia-Pacific EPR/ESR Symposium (APES'97) held at the City University of Hong Kong, 20–24 January 1997. Both initiatives, Society and the series of the Asia-Pacific EPR/ESR Symposia (APES'XY) organized under the APES auspices, were spearheaded by the Founder President, C. Rudowicz. Organization of the APES'97 had been implemented successfully due to dedicated efforts of researchers working as members of the Local Organizing Committee (LOC) and the International Organizing Committee (IOC) for the APES'97. At the Inaugural APES Meeting (see, Fig. 1) the sixty-two researchers from the Asia-Pacific region have elected the Provisional Council with C. Rudowicz as President, A. Kawamori as Vice-President, Y. Y. Yeung as Secretary, and H. Ohya-Nishiguchi as Treasurer, together with Representatives from Australia/New Zealand, Japan, P. R. China, India, Russia (Far East), Republic of Korea, and Vietnam.

The idea of founding a regional EPR/ESR Society and organizing Symposia, intended to be held every other year in a different Asian country, was aimed at satisfying the needs of researchers from the Asia-Pacific region. Such a forum with strong international participation would facilitate collaboration and scientific exchange between the world-acclaimed scientists and Asia-Pacific researchers, who generally could hardly afford attending conferences in Europe or the USA. It would also provide an opportunity for meeting of researchers employing various EMR spectroscopy techniques in different fields, from physics and chemistry to materials and life sciences, both experimentalists and theorists. Note that the more general name electron magnetic resonance (EMR), which corresponds well to the more ubiquitous NMR (nuclear magnetic resonance), is nowadays gaining wider usage. The name EMR encompasses the historically original names electron paramagnetic/spin resonance (EPR/ESR) and other related techniques as, e.g. ferromagnetic/antiferromagnetic resonance (FMR/AFMR). However, back than in 1997 it was hard to achieve consensus and we decided to retain both EPR/ESR in the name of the fledging Society. Hence, the APES Constitution states: "*The main objective of the Society is to promote EPR/ESR research and to foster scientific interaction among EPR spectroscopists in countries of the Asian-Pacific region. To achieve these goals, Society organizes biennial Asian-Pacific EPR/ESR symposia, which are held in turn in one of the countries of the region.*"

Important milestones in the APES history may be summarized as follows. The APES became an Affiliate Society of the International EPR/ESR Society (IES) in March, 1999, due to help from John Pilbrow, the then President of the IES. That brought us closer to fulfilling the APES and IES Mission, i.e. uniting all EPR/ESR researchers. This Mission has been further strengthened by the joint organization of meetings starting from 2014 (more below). It is also worth mentioning that Hitoshi Ohta, the APES Vice-President (2001–2003/4 & 2012–2016) and President (2004–2008), served as the active IES President from Oct. 2012 – June 2013 and was elected as the IES President 2015–2017.

Starting from the 2nd APES'99, during each Symposium, APES Council Meetings and General APES Meetings were held, concluded by the election of the APES Council for the next term of office and selecting the venue for the next Symposium. In the hindsight the most vulnerable was organization of the 2nd Symposium. Luckily with the help of Y. Z. Xu and A. Kawamori, APES'99 was excellently organized. Starting from the 3rd APES'01 our future looked much brighter. Hence, this phase of the APES's development may be considered as a consolidation phase. It comprises three subsequent Symposia (with the names of LOC Chairperson given in brackets). The names of elected President (P) and Vice-President/s (VP/VPs) are also provided.

- The 2nd APES'99 (Y. Z. Xu) was held at Zejiang University, Hangzhou, P. R. China, Oct./Nov. 1999; P: C. Rudowicz, VP: A. Kawamori.
- The 3rd APES'01 (A. Kawamori) was held at Kobe University, Kobe, Japan, Oct./Nov. 2001 with two APES'01 Satellite Meetings: Symposium A (M. Ikeya): ESR Dosimetry and

Fig. 1. Group photo of the Inaugural APES'97 participants.

Fig. 2. Group photo of the 9th APES-IES-SEST2014 participants.

Dating and Symposium B (A. Kawamori): International Workshop on Advanced EPR Applied to Biosciences; P: C. Rudowicz, VPs: S. V. Bhat & H. Ohta.

- The 4th APES'04 (S. V. Bhat) was held at the Indian Institute of Science, Bangalore, India, Nov. 2004 with the Satellite International School on EPR Spectroscopy and Free Radical Research (K. P. Mishra) in Mumbai, India, prior to the APES'04.

Note that because of the SARS epidemic in South-East Asia during early 2003, the APES Council has decided to move the 2003 events to November 2004. Hence, starting from the APES'04 the Symposia moved to even-number years, resulting in a one-year shift in our subsequent anniversaries. Thus the 20th anniversary is falling in 2018 instead of 2017.

The APES General Meeting held during APES'04 marked also an important change at the helm of the Society. As required by the APES Constitution, C. Rudowicz stepped down after two terms of office and H. Ohta was elected as the APES President with the VPs: Kaushala P. Mishra & Sergei A. Dzuba. During the APES'04 the Founder President, C. Rudowicz, was presented the Silver Medal, quote: "*in recognition of outstanding contribution to founding and fostering APES*" and Recognition Diploma from the IES "*for his contributions to the EPR community – as the Founder and President of the Asia-Pacific EPR/ESR Society 1997–2004 and initiating the Asia-Pacific EPR/ESR Symposium Series*". Notably, the American Physical Society (APS: Forum on International Physics) awarded the APS Fellowship to C. Rudowicz in November 2004; with the citation: "*For his significant contributions to optical and EMR spectroscopy of transition ions and outstanding leadership in promoting international meetings and collaborations as Founder and President of the Asia-Pacific EPR/ESR Society.*".

The next phase in the APES's development may be considered as 'reaching maturity' phase and comprises the Symposia 5th to 9th.

- At the 5th APES'06 (S. A. Dzuba) in Novosibirsk, Russia, August 2006, H. Ohta was reelected as the APES President with the VPs: G. R. Hanson & S. A. Dzuba.
- At the 6th APES'08 (G. R. Hanson) in Cairns, Australia, July 2008, S. A. Dzuba was elected as the APES President with the VPs: G. R. Hanson & Sa-Ouk Kang.
- At the 7th APES'10 (Sa-Ouk Kang) in Jeju, Korea, October 2010, S. A. Dzuba was re-elected as the APES President with the VPs: Sa-Ouk Kang & Yong Li.
- At the 8th APES'12 (Yong Li) in Beijing, China, October 2012, Takeji Takui was elected as the APES President with the VPs: Yong Li & H. Ohta.
- At the 9th APES'14 (H. Ohta) in Nara, Japan, November 2014, Subray Bhat was elected as the APES President with the VPs: E. Bagryanskaya & H. Ohta. The APES-IES-SEST2014 was the first Joint Conference of APES, IES, and SEST (The Society for Electron Spin Science & Technology, i.e. Japanese ESR Society), which has further strengthened our Mission.
- At the 10th APES'16 (Elena Bagryanskaya) held over the Lake Baikal in Listvyanka, Russia, Aug./Sept. 2016, E. Bagryanskaya was elected as the APES President with the VPs: S. Bottle & R. Damle. The election of the

Fig. 3. Group photo of the 10th APES'16 participants.

first woman at the helm of our Society is an important historical landmark (see Fig. 3).

The major activity of our Society nowadays is organization of the APES Symposia by each respective LOC on a rotational basis in different Asian countries. The APES Council plays an active role in coordinating work of the LOCs, e.g. by helping in arrangements and selecting plenary speakers. In our organizational model the burden of arranging financial support is shared by various national groups. The APES model is very well serving also the Polish EPR Group reactivated in a new form by the APES Founder after his returning to native Poland in 2005 and becoming the Group's Founding Chairman (since 2007 – present).

Other activities of the APES Council include various efforts aimed at fulfilling our Mission and ensuring that a better coordination of individual efforts can be achieved. Other important aspects concern, e.g., publication of the Proceedings summarizing presentations delivered at subsequent Symposia. The Proceedings for two Symposia have been published in a book form: (1) APES'97: "*Modern Applications of EPR/ESR: From Biophysics to materials Science*", Proceedings of the First Asia-Pacific EPR/ESR Symposium, Hong Kong, January 20–24, 1997; C. Rudowicz (Editor), K. N. Yu and H. Hiraoka (Assoc. Eds), Springer-Verlag, Singapore (1998), and (2) APES'01: "*EPR in the 21st Century: Basics and Applications to Material, Life and Earth Sciences*", Proceedings of the Third Asia-Pacific EPR/ESR Symposium, Kobe University, Japan, October 29 – November 1, 2001; A. Kawamori, J. Yamauchi, and H. Ohta (Editors), Elsevier, Amsterdam (2002). Later on, in most cases, we have received support Prof. K. Salikov, the Editor, to publish the Proceedings in *Applied Magnetic Resonance*.

The commemorative Symposium APES'18 was held in Brisbane, Australia, in September 2018. That was the second (after Nara) joint conference of the APES Symposium and IES Meeting, while the third joint IES Meeting world-wide. Since the Asia-Pacific EPR/ESR Society notionally has clocked 20 years of its existence, this meeting has been truly a unique Symposium. To celebrate this solemn occasion at the Opening Sessions a special presentation: '*The Asia-Pacific EPR/ESR Society reaching maturity at 20th+ Anniversary*', has been delivered. The APES'2020 is to be organized by Prof. J. F. Du at Huangshan in the Yellow Mountains in China. ***All are most welcome to join us***.

As the APE Society has now entered the full maturity phase, a critical reflection on the past activities and the tasks for the future is appropriate. The future APES activities may be reinvigorated by reconsidering the so far unrealized proposals, e.g. Guidelines for presentation of EPR/ESR data, and Establishment of the International EPR Research and Data Centre. Let's not forget that the success of such world-scale initiatives depends, to a large extent, on the feedback from whole EMR/EPR/ESR community.

The APES Constitution may need a few modifications to suit better this phase. Over the first 20+ years the APES has evolved becoming a ***virtual*** Society, i.e. with a flexible organization model encompassing all researchers working in EMR/EPR/ESR and related areas, but importantly having a ***real*** presence in Asia-Pacific region as well as worldwide. From the very beginning we have adopted a non-profit model where no membership fees are charged. Membership in the Society is open to all researchers from the Asia-Pacific region (including Russia Siberia/Far East) that are active in the EPR/ESR area or have an interest in the applications of the EPR/ESR techniques. All it takes to become an APES member is to fill in the APES Membership & Update Form available on our website. This will help us to bring up to date the APES Database and ensure that researchers interested in attending the Asia-Pacific EPR/ESR Symposia will receive directly pertinent information on time. According to the APES member email list, as of August 2018 the APES membership stood at nearly 160 individual members, originating from 7 countries within the Asia-Pacific region: Japan, China, India, Russia, South Korea, Philippines and Australia.

As a closing remark, let us mention that the Asia-Pacific EPR/ESR Society, created in the now rather distant 1997, is in full strength after more than 20+ years in existence. It is a great satisfaction to all of us that the APES is 'alive and kicking', and suits well the regional as well as the international needs of the EPR/ESR community. To this end, the members of successive APES Councils have diligently worked in the last 20 plus years. We all appreciate very much the hard voluntary work and organizational efforts of many colleagues in various Asian countries who made the above milestones in the APES history possible. Thanks are also due to our colleagues who attended subsequent Asia-Pacific EPR/ESR Symposia, in spite of facing sometimes financial difficulties. To alleviate such problems, a system of support, including Travel Grants for Young Investigators, has been introduced as early as from the Inaugural APES'97 in Hong Kong.

For more information on the APES activities, please visit the APES website: <www.apeprs.org> or the APES-IES2018 one: <www.apes-ies2018.org>.

Czesław Rudowicz,
Elena Bagryanskaya,
Hitoshi Ohta
October, 2018

Virginia Diodes, Inc.
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Transmit and Receive Systems Covering the 70GHz-3THz Spectrum

VDI offers a wide variety of transmit and receive systems covering the 70GHz-3THz spectrum. These systems incorporate VDI's frequency extension and mixer components coupled with commercially available microwave oscillators and amplifiers.

For transmit systems, VDI can configure them with or without a drive oscillator. A VDI Amplifier / Multiplier Chain (AMC) requires a customer supplied low frequency source (typically <20GHz, 10dBm nominal). A VDI Transmitter (Tx) integrates a source (oscillator or synthesizer) with the VDI AMC. A VDI Mixer / Amplifier / Multiplier Chain (MixAMC) requires a customer low frequency local oscillator. A VDI Receiver (Rx) integrates the LO drive oscillator with the Mixer and LO Chain for turn-key operation.

Standard AMCs and MixAMCs have been developed to provide high performance RF drive multiplication and downconversion for full waveguide band coverage. These systems can be used to extend traditional spectrum analyzers and signal generators into the THz and mm-wave ranges. VDI's standard AMC and MixAMCs offer various modes of operation. VDI AMCs can be operated in standard frequency mode (<20GHz, 10dBm nominal) or high frequency RF drive mode (<45GHz, 0dBm nominal). VDI MixAMCs can also operate in standard and high frequency LO drive modes. Customers also have the option to operate MixAMCs for block-downconversion (<20GHz IF) or as a spectrum analyzer extender. Standard AMCs and MixAMCs are available from WR15 (50-75GHz) to WR1.0 (750-1,100GHz).

VDI offers both narrow-band high-power and broadband low-power systems. High power systems use VDI's D-series X2 multipliers to achieve maximum multiplier efficiency and power handling. VDI has developed many high power systems for special customer applications, such as a novel multiplier based source with output power of 160mW at 200GHz.

Reconfigurable / modular AMCs are also available upon request.

EPR in Slovakia and Austria

Michal Zalibera[a], Vlasta Brezová[a], Erik Čižmár[b], Wolfgang Jantsch[c], Markus C. Scharber[d], Niyazi Serdar Sariciftci[d], Klaus Stolze[e], Lars Gille[e], and Georg Gescheidt[f]

[a]Slovak University of Technology, Bratislava, Slovakia
[b]Technical University and P. J. Šafárik University, Košice, Slovakia
[c]Institute of Semiconductor and Solid State Physics, Kepler University, Linz, Austria
[d]Institute of Physical Chemistry, Kepler University, Linz, Austria
[e]Institute of Pharmacology and Toxicology, University of Veterinary Medicine, Vienna, Austria
[f]Institute of Physical and Theoretical Chemistry, Graz University of Technology, Graz, Austria

This contribution presents an overview on the research, which has been carried out in Austria and Slovakia. The EPR community in both countries is relatively small. In Slovakia the group at the Slovak University of technology has a long history in EPR. Their activities are particularly oriented toward chemically relevant topics like (photo)catalysis and antioxidants. This group and that at the Graz University of Technology have been collaborating for several years in terms of joint projects, grants, student exchange, and meetings. The Physics groups in Košice and Linz perform research in the field of solid-state physics and develop custom-made devices. The Sariciftci group in Linz investigates and develops systems on solar-energy conversion and uses EPR-based techniques to follow photo-induced processes in the solid state. In Vienna, at the University of Veterinary medicine EPR is used for the identification of radicals *in vivo* (spin trapping). Owing to the limited number of EPR facilities in Austria and in Slovakia, there are several collaborations between these two countries, particularly in the field of radical chemistry.

Several young researchers have entered the field of EPR in both countries. Accordingly there is a good perspective for enhancing cooperations and projects and even the launch of a high-level bi-national EPR facility.

In the following sections the authors introduce key aspects of their institutions and research dedicated to EPR.

EPR at the Slovak University of Technology, Bratislava

The first connection between EPR and Bratislava actually dates back to the times prior to WWII. As Klaus Möbius tends to remind me [Michal Zalibera], in 1924 Bratislava was the birthplace of George Feher, the future inventor of ENDOR. George was forced to leave Bratislava due to the unfortunate situation in the Nazi-collaborating Slovak State, and finally made his way to the USA, where he pursued an outstanding research career. His recent passing away in November 2017 is a loss for the whole EPR community.

The authentic beginning of EPR in Bratislava is connected with the name of Alexander Tkáč and his work at the Slovak University of Technology (SUT). He deserves huge credit for the development of EPR spectroscopy in Slovakia. With the help of Czech colleagues, he built the first EPR spectrometer in Bratislava that was brought into operation in 1959 (Figure 1). Then later, in 1967, he succeeded in buying the first commercial Varian E-3 spectrometer, thus providing a sound basis for the development of the EPR group. In 1982, he managed to purchase a new X-band Bruker 200D model. His main research interests involved free radicals in chemical systems, ranging from Ziegler Natta catalysts to the detection of radicals using gas phase EPR, and in living organisms.

In 1971 Andrej Staško joined the EPR group. He settled in Bratislava after obtaining his PhD in Dresden (1967), and postdoc stays at the ETH Zürich, the University of Bern (1968/69), and the University of Keele (UK, 1969/71). Initially, he collaborated with A. Tkáč on Ziegler Natta catalysts and paramagnetic products formed in the reactions of organometallic compounds. After Tkáč's retirement, Staško became head of the EPR group and played a key role in upgrading the EPR facility with an EMX Bruker spectrometer in 2003, and he was also involved in the purchase of an X,Q-band cw EMX plus model in 2010. During his career he developed several independent research areas including spin labeling investigations of lipid and biological membranes (1980s), fullerene research (1990s), azo-based radical initiators (1990s), conducting polymers (1990s), spin trapping studies on radical scavenging properties of biologically active compounds (1990-2010), NO release and its interaction with metal complexes, as well as antioxidant properties of various foods and beverages, such as tea, coffee, beer, wine and honey (2000-2010).

For three decades starting in the 1970s, Andrej Staško was the key organizer of the

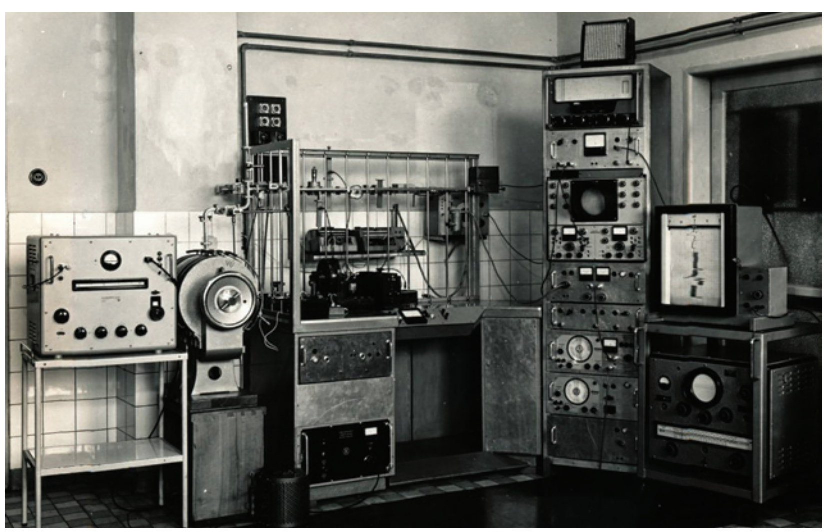

Figure 1. The first EPR spectrometer in Slovakia built in 1959.

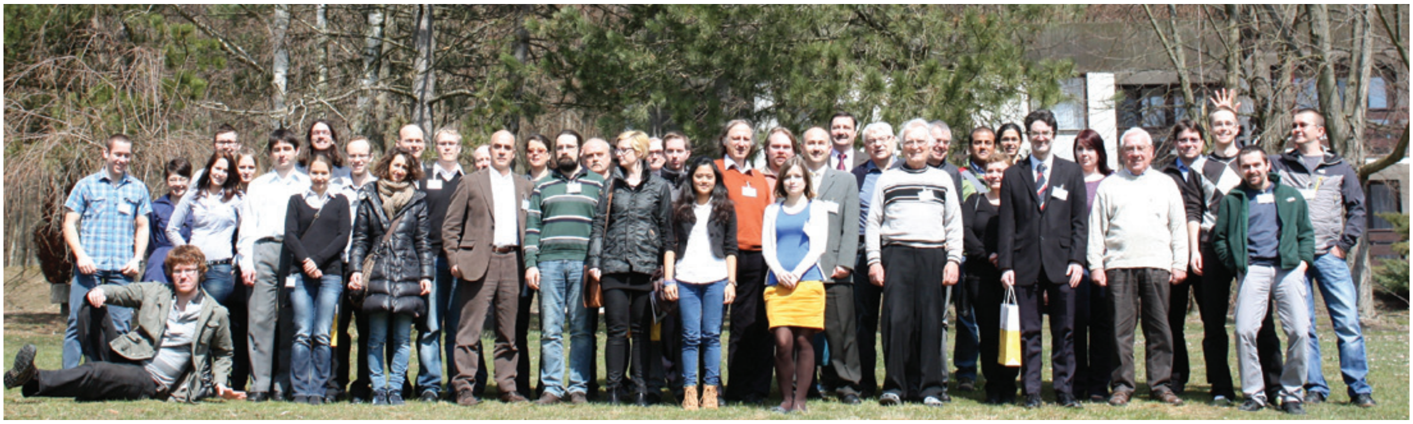

Figure 2. Group picture of the participants at the XXV International EPR Seminar in Častá-Papiernička, Slovakia, in 2013.

EPR Seminars of the Czechoslovak Magnetic Resonance Group. More than twenty EPR Seminars provided a very intense source of information and exchange of experience among Slovak, Czech, and German (GDR) scientists, and also guests from other neighboring countries. The seminars fulfilled a very important mission during the period before the Velvet revolution (1989), when the possibilities for research contacts were limited. In the new millennium and after the split of Czechoslovakia (1993), the tradition of the EPR Seminar continued, and the Seminar has since transformed and grown into a truly international event. It is currently being organized with biennial frequency on a rotating basis among co-operating research groups from Slovakia, Austria and Germany. The last, XXVII International EPR Seminar, took place in April 2017 at the Center of Spectroelectrochemistry, of the Leibniz Institute for Solid State and Materials Research in Dresden. The two previous sessions were organized by the SUT group in Častá-Papiernička, Slovakia (XXV, in 2013, Figure 2) and by the Gescheidt group at TU Graz (XXVI, in 2015).

Andrej Staško retired from active research in 2016, but even today at the age of 80 (on September 1st this year), he still is the mentor and consultant for the current generation of EPR spectroscopists in Slovakia.

The work of Alexander Tkáč, and Andrej Staško was paralleled with the research of other colleagues who deserve to be mentioned. Ladislav Omelka was the member of the EPR group from 1971 to 2000 when he moved to the Technical University of Brno and founded an independent research group. His main research interests during his time at SUT Bratislava involved radical reactions in the coordination sphere of transition metal ions (1970s-80s), radical reactions of N-heterocyclic compounds (1990s) as well as oxidation of amines and azole compounds (1990s).

The theoretical support for EPR research was provided by Peter Pelikán who worked at the SUT from 1969 to 2002, when his sudden death brought a promising and excellent research career to a premature end. He developed a special interest in the quantum chemical studies of transition metal complexes particularly involving copper in various redox states, and in the investigation of sol-gel processes as well as superconducting materials.

The legacy of our EPR ancestors at SUT Bratislava is currently being followed by four full professors and their teams involving 6 researchers, 1 postdoc and 6 PhD students. Vlasta Brezová and her team, including Dana Dvoranová, Zuzana Barbieriková and the PhD student Michal Hricovíni, are involved in photochemical studies on radical reactions, particularly focused on photocatalysis involving TiO_2 and hybrid semiconductor catalysts. They are specializing in spin trapping studies of short-lived radicals, and reactions of singlet oxygen. Marián Valko and his team of 3 PhD students, Patrik Poprac, Miriam Šimunková and Júlia Kožíšková, study the role of transition metals in human disease, particularly enzyme mimicking complexes, and also focus on the interaction of redox active metals with drugs and natural substances.

Peter Rapta and/or the members of his team, Michal Zalibera, Lukáš Bučinský, Karol Lušpai, Michal Malček, Inga Puškárová, and the PhD student, Denisa Darvasiová, were previously involved in the studies of conducting polymers, fullerenes, and antioxidants. The group has a special focus on the application and development of spectroelectrochemical methods. Currently they cooperate on experimental and theoretical studies of donor-acceptor organic compounds, molecular grippers, and organometallic complexes with potential anti-cancer activity as well as on the investigations of homogenous catalysis reaction mechanisms. Last but not least, Milan Mazúr, has a special focus on the investigation of transition metal complexes, sol gel processes as well as quantitative aspects of EPR.

All in all, despite the fact that the EPR lab in Bratislava lacks state of the art technology (with only cw EPR machines currently available in-house), the EPR research is still pursued actively here.

This is well supported by the fact that the group is organizing the next XIth EF EPR conference, which will take place from 1-5 September 2019 at the Slovak University of Technology in Bratislava. The organizing committee, led by Peter Rapta, cordially invites all the readers of the *EPR Newsletter* to attend. With the start of the grape collection season in the vineyards at the slopes of the Little Carpathian Mountains, the late summer is a perfect time to visit Bratislava. We hope many of you will take this opportunity to visit Eastern Europe, and together we'll make the EF EPR meeting 2019 a memorable event.

The list of previous SUT group members still active in EPR business:

Ján Tarábek (Institute of Organic Chemistry and Biochemistry of the CAS, Prague, Czech Republic), Róbert Klement (Alexander Dubček University of Trenčín, Slovakia), Helena Švajdlenková (Institute of Polymers, SAS, Bratislava), Miroslava Lukešová (Institute of Macromolecular Chemistry CAS, Prague, Czech Republic).

EPR at the Slovak Academy of Sciences

A second group of EPR spectroscopists in Bratislava was active from the 60's until approximately 2001 at the Institute of Polymers of the Slovak Academy of Sciences (SAS). The first EPR spectrometer was also of a home-built design. Later on the group purchased a Varian E-4 model, which they maintained operational up to the start of the new millennium. EPR research was mainly concerned with the experimental work of Ján Plaček and Ferencz Szöcs, supported at the theoretical level by Jozef Tiňo. As the institute name suggests, the main research interests involved various aspects of polymers and polymerization, including free radicals and their reactions in irradiated and mechanically destructed polymers, spin probe studies of polymer dynamics, quantitative EPR, but also radicals produced by oxidation of saccharides and cellulose polysaccharides. F. Szöcs deserves special credit for the organization of the first and the second EPR Seminars in Slovakia, in 1976 and 1978, respectively, as well as for continuous support in maintaining the tradition since that time. Currently the group of Jozef Bartoš at the Institute of Polymers is still active in EPR investigations of polymer dynamics utilizing the facility at SUT.

In addition to these two groups, František Šeršeň at the Comenius University utilized EPR for studies of photosynthesis and conducting polymers and Martin Polovka at the Food Research Institute uses it in free radical and antioxidant studies of food products.

EPR at the Technical University and P.J. Šafárik University, Košice

The history of EPR in Košice is connected with the name of Matej Rákoš, a physics faculty member at the Department of Physics, Technical University in Košice and, between 1963 and 1967, also at the Department of Experimental Physics, P.J. Šafárik University in Košice. The first X-band EPR spectrometer (Carl-Zeiss Jena ER9) in Košice was installed at the Technical University in 1970. The research of M. Rákoš was devoted to the spectroscopic studies of transition-metal based oxides and polymers (using also nuclear magnetic resonance). He was also a member of the committee of Groupe AMPÉRE (1966–88). After the retirement of Rákoš in 1990, the interest in EPR was revived at the P.J. Šafárik University by the group of physicists led by Alexander Feher interested in the study of low-dimensional and molecular magnets. With the help of Aleksandr G. Anders from the Institute of Low Temperature Physics and Engineering in Kharkov (Ukraine) a home-built X-band EPR spectrometer with a low-temperature cavity (working down to 2 K, with sample rotator) was build in 2002. The tunable low-temperature cavity is shown in Figure 3. This instrument was replaced later in 2011 by a commercial Bruker ELEXSYS II E 500 spectrometer equipped with a flow-type helium cryostat, also working down to 2 K. The EPR laboratory at the P.J. Šafárik University, under the supervision of Erik Čižmár, contributes to the research in the field of low-dimensional magnets (magnetic anisotropy in planar magnets, organic-radical-based magnets), molecular magnets and nanomagnets or magnetic molecules deposited on polymeric substrates.

Figure 3. Home-built tunable low-temperature cavity working down to 2 K, with sample rotator.

In Austria, EPR-based research is mainly carried out at the Physics Department and the Department of Physical Chemistry of the Johannes Kepler University, Linz, at the University of Veterinary Medicine, Vienna, and at the Institute of Physical and Theoretical Chemistry at Graz University of Technology.

EPR at the Semiconductor and Solid State Physics, Kepler University, Linz

At the Institute of Semiconductor and Solid State Physics at the Kepler University, Linz, groups led by A. Ney, S. Müllegger, and A. Bonanni are performing EPR and FMR investigations on semiconductors. Wolfgang Jantsch began EPR in 1980 after his 2-year stay at the Max Planck Institut für Festkörperforschung in Stuttgart. In those years, the main interest of his group was the identification of deep levels in semiconductors and their electrical activity. Here, great support came from cooperation with the late Jürgen Schneider from the IAF in Freiburg and later with the late Zbyslaw Wilamowski from the Polish Academy of Sciences, Warsaw. The Jantsch group modified their Bruker X-band system continuously, implementing methods like constant photo-EPR, ODMR and finally also time-resolved experiments.

In addition to deep levels, the equipment was also utilized for the investigation of free carrier effects, including the Shubnikov-de Haas

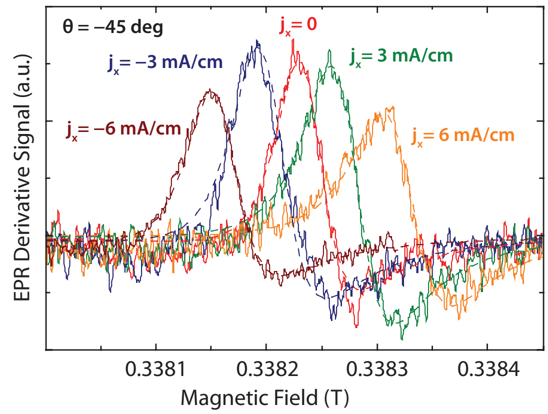

Figure 4. ESR spectra of a two-dimensional electron gas in a Si-quantum well under the effect of a dc current. (after Ref. 2)

effect, cyclotron resonance, Helicon waves, and spin properties of electrons in quantum wells, wires and dots. After his retirement in 2011, W. Jantsch is pursuing two projects from his earlier work: (i) spin properties of confined electrons in SiGe structures, and (ii) ferromagnetic resonance in a multiferroic system.

(i) Silicon, the dominant material of microelectronics, has also outstanding spin properties, with a very small spin-orbit interaction (SOI) for conduction electrons . Therefore their spin lifetimes are long and conduction ESR (CESR) can be observed in quantum wells due to the extremely narrow linewidths down to 0.01 G. The long spin lifetimes make Si also a candidate for the relatively new field of spintronics [1].

In spite of the small SOI it was possible to observe the so-called Rashba effect, which causes a momentum driven spin splitting. This allowed to demonstrate that this spin splitting is due to an electric current applied to the sample (see Figure 4), which constitutes a method to control the spin state [2].

In collaboration with colleagues from the University Milano Bicocca, the group has recently succeeded in observing the CESR in Ge quantum wells [3]. Ge has much higher spin-orbit interaction and therefore the Rashba effect should be much bigger. The Rashba effect exists, however, only in samples with broken mirror symmetry. Recently such samples were grown successfully by our Italian colleagues by one-sided doping of quantum well samples and we are searching now for manifestations of the Rashba effect in them. The use of Ge should allow for the possibility of conceiving new kinds of spintronic devices.

(ii) There is a new class of materials combining two kinds of solid-state phase transitions, the so-called multiferroics. In the case of $Ge_{1-x}Mn_xTe$, GeTe is a well-known ferroelectric, which becomes also ferromagnetic when doped with Mn. Here, in a collaboration of different groups using epitaxy, x-ray structure analysis, magnetic susceptometry and ferromagnetic resonance, we were able to demonstrate by FMR that the magnetic and ferroelectric properties affect each other [4]: Turning the magnetic field, the ferroelectric domain axes can be switched. In these experiments epitaxial samples grown on different substrates are used. At present we are investigating the role of substrate induced strain on this switching effect.

EPR at the Institute of Physical Chemistry, Kepler University, Linz

At The Institute of Physical Chemistry at the Johannes Kepler University, Linz, an X-band EPR spectrometer (Bruker EMX) is available. It is equipped with a broad-band bridge (200 MHz) for direct detection. Several cavities allowing optical access to the sample and a He-cryostat can be used to carry out EPR and light-induced EPR experiments from 4–400 K. Using a home-built microwave modulator unit, optically and electrically detected magnetic resonance (ODMR and EDMR) experiments can be performed. In recent years the spectrometer has been used to investigate photo-induced processes in organic semiconductor blends and photoactive catalysts. The nature of the photo-excited states, their decay and the photo-degradation of the organic semiconductors have been the focus of this research. ODMR and EDMR have been used to study the spin-dependent processes in opto-electronic devices including organic devices such as light emitting diodes and solar cells. Recently experiments were extended to perovskite semiconductor materials and related devices.

EPR at the Institute of Pharmacology and Toxicology, University of Veterinary Medicine Vienna

At The Institute of Pharmacology and Toxicology EPR-based research on biological systems is performed in cooperation with several research groups. The topics comprise the detection of oxygen-based radicals in cell culture models, the investigation of vitamin C radicals, transferrin, ceruloplasmin and NO (EDRF) in blood and plasma and the characterization of mitochondrial electron carriers. Moreover, the membrane fluidity of lipid membranes, cytostatic transition metal complexes and plant extracts has been elucidated [5].

Figure 5. The Gescheidt team 2017. Standing (from left to right): Georg, Philipp, Dimi, Eduard, Max, Christian, Anna, David; sitting (from left to right): Marion, Hilde.

EPR at the Institute of Physical and Theoretical Chemistry at Graz University of Technology

In Graz, EPR-based research has long been carried out by Günter Grampp, who has contributed to a deeper understanding of electron self exchange reactions combining kinetics derived from EPR line-width analysis and Marcus theory. Günter retired in 2016 but still remains active, continuing several collaborations. Presently the Georg Gescheidt group performs research in the field of radical chemistry using EPR, ENDOR, CIDEP and CIDNP spectroscopy. Moreover ns laser-flash photolysis measurements provide important kinetic data on radical reactions. With this combination of methods, the Gescheidt team (Figure 5) seeks to elucidate topics in the fields of antioxidants, catalysis, radical polymerization and radical-ion chemistry.

Photo-initiated radical polymerization has been a very successful technique in many fields, e.g., coatings, lithography, and dentistry. Together with several collaborators (Robert Liska, Wien University of Technology; Hansjörg Grützmacher, Kurt Dietliker, ETH Zürich; and Christopher Barner-Kowollik, Queensland University of Technology) we have been contributing to the development of novel photo-initiating systems for radical polymerization. A key issue concerns establishing the character of the primary radicals formed from the photoinitiator upon irradiation (Figure 6).

It is not only the (electronic) structure of these radicals which is decisive for their efficiency but also the kinetics for their addition to a double bond. This kinetic information can, in principle, be derived from time-resolved optical measurements. However, often the short-lived intermediate radicals do not possess well-distinguishable optical absorptions but they reveal distinct EPR signals (in some cases absorptions in the infra red region). Here CIDEP (Figure 7) is an asset.

Whereas it is hardly possible to obtain kinetic information from the decay of CIDEP

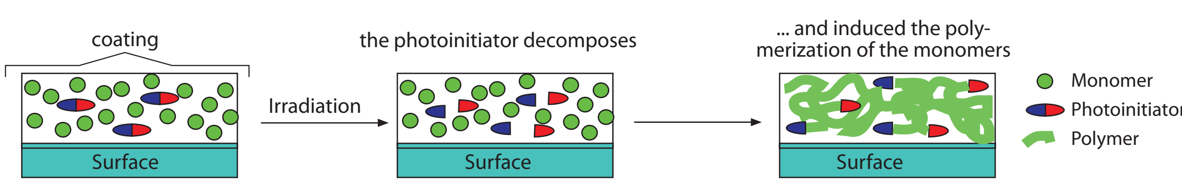

Figure 6. Photo-initiated radical polymerization. Irradiation leads to the generation of a radical pair (blue/red), which initiates the polymerization and leads to the formation of a polymer (curing).

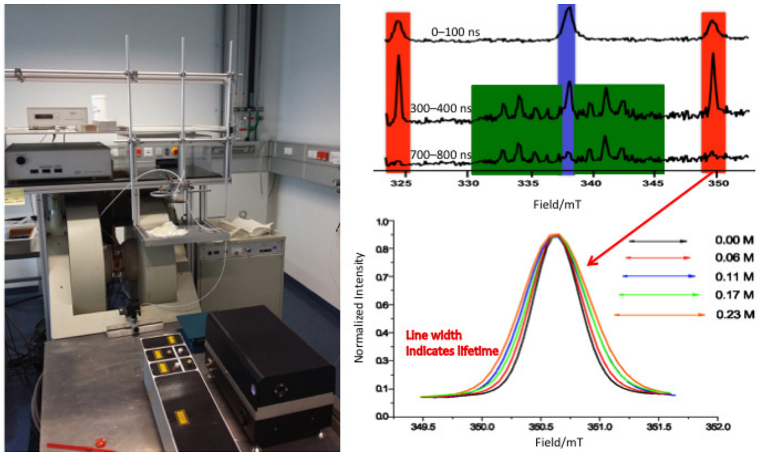

Figure 7. Our CIDEP setup; right top, CIDEP spectra taken within the first 800 ns of a photoinitiated radical polymerization; right bottom linewidth variations depending on the concentration of a polymerizable monomer (butyl acrylate).

signals (since their time trace is contaminated by radical-pair effects), line width analysis provides the desired kinetic data. Based on early work by David Bartels, (Univ. of Notre Dame)[6] and seminal contributions by Günther Rist (Basel) with substantial help by Anton Savitsky and Klaus Möbius [7], we and Nick Turro's group [8] could show that this approach yields valuable data, which otherwise would not be obtainable [9, 10]. Accordingly, we have been able to analyze the reactivity and structure of many photoinitiators using CIDEP in combination with CIDNP and optical measurements [11–13].

Another example of our work is the investigation of electron-transfer reactions leading to radical ions. Many facets of this topic were explored in collaboration with the group of François Diederich (ETH Zürich) and Michal Zalibera. We have, e.g., shown that several donor-acceptor compound undergo remarkable structural alterations upon oxidation or reduction (Figure 8) [14].

We have been mostly working on projects involving chemical conversions in fluid solution. Future developments will comprise reactions at interfaces and require pulsed methodology. This will further promote collaborations within the Austrian Slovak community and beyond.

Visit our websites, if you want to obtain a more detailed insight into our present work.

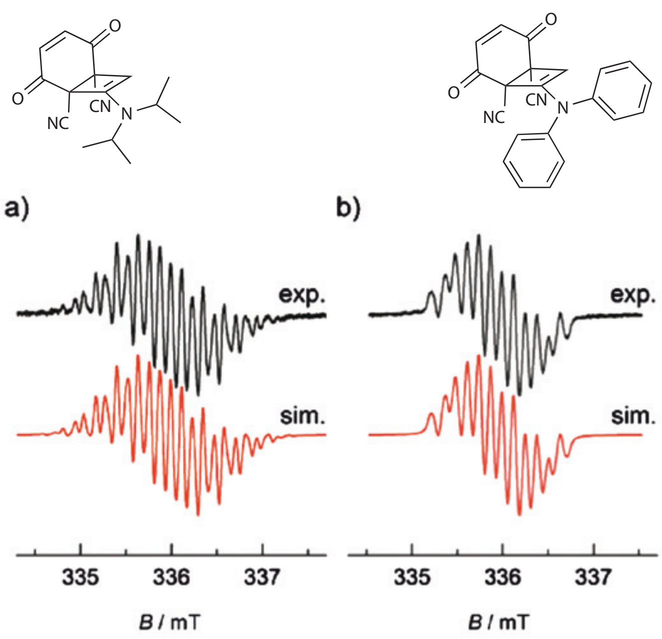

Figure 8. EPR spectra obtained upon heating of the donor acceptor compounds displayed above in toluene and the corresponding simulations (lower traces).

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Piotr Leśniewski (1943–2015)

In 2015 we prematurely lost one of the pillars of EPR instrumentation, Piotr (Peter) Leśniewski. It has taken us three years to get to the point where we can adequately share our thoughts with the community about the loss of this extraordinary person. Piotr was the intellectual foundation of the instrumentation of the EPR Center at Dartmouth and indeed for much of biomedical EPR. Following in the tradition of Ted Walczak, he continued and expanded the technical capabilities of in vivo EPR and also made fundamental contributions to the development of other EPR techniques, including the implementation of unique multi-quantum spectrometers. And, as great of an EPR instrumentalist as he was, he was an equally great person. His friendly demeanor and personal kindnesses were a treasure that we all miss. He responded warmly and effectively to everyone, treating all with respect and dignity. He was our bridge to many other laboratories where his combination of personal qualities and professional competence enabled very effective and pleasant collaborations to flourish. To me, Piotr was friend and confident and the rock of the technical competence of our group. I will forever be grateful for the opportunity to interact with him for so many years. I join with others in giving best wishes to his family and the entire EPR community as we celebrate his achievements, while mourning his loss.

To try to describe the scope of the person and the loss, I have asked for and received contributions from several other of his many colleagues and mentees, which follow.

Harold M. Swartz,
Professor Radiology and Radiation
Oncology at Dartmouth Medical School

* * *

Presentation given by at the occasion of Piotr Leśniewski's funeral

Tickets to the afterlife are paid
by our collective memory
Uncertain coinage. Every day
*some dead man's banished from eternity.**

I belong to one of the many people scattered literally around the world that of gratitude will bear, for many years, mentioned by the poet, storage costs to keep Peter in eternity.

I met Peter in 1968. He was employed at the Department of Biochemistry and Biophysics at the Jagiellonian University in the group of Stanisław Łukiewicz, an associate professor at the time. After graduation, I got an appointment as an intern at that department.

I was hired as an assistant intern with a salary insufficient to rent an apartment in Krakow, forcing me periodically to stay unlawfully at a dormitory called Żaczek. I mention this today because Peter helped me a lot in the survival of that period in Krakow, inviting me often to his apartment for dinner prepared by his wife Barbara. We got to know each other better, and Peter will always remain in my heart as a good and kind man, as a friend.

Also, we worked together professionally pursuing the idea of building a complete EPR X-band spectrometer, which at that time, in the absence of anything on the market, especially modern electronic parts, was a great challenge. If it was not for the knowledge, skills, ingenuity and persistence of Peter, who was a graduate of electronics at the technical university AGH, little would have come out of it. And so, we were successful, we created a functioning instrument, which we used to conduct laboratory exercises with students at the Institute of Molecular Biology at the Jagiellonian University.

In the seventies, our professional paths diverged. Peter moved to the Institute of Nuclear Physics in Krakow, where among other things he co-founded the laboratory of positron annihilation organized in 1977 by Professor Hrynkiewicz and dealt with construction of equipment at the Laboratory of Mössbauer spectroscopy. He designed a new Mössbauer spectrometer using an electromechanical vibrator placed in a cryostat, constructed by him, that allowed movement of the gamma-ray sources with constant acceleration or constant speed.

At the end of the eighties, he was invited by Professor Hyde to the Biomedical EPR Center in the Medical College of Wisconsin, returning to his professional roots of EPR spectroscopy. Professor Hyde is one of the world's most renowned scientists working in this field and hence his very positive opinion about the work and the originality of Peter's ideas is of particular importance.

After a few years in Poland, another famous scholar in the field of biomedical applications of EPR spectroscopy, Professor Harold Swartz invited Peter to his ESR Centre at Dartmouth Medical School, where he was employed until his retirement, serving in recent years as a Deputy Director of the Centre responsible for the development of EPR equipment.

Prof. Swartz highly valued Peter as his colleague, an expert in EPR spectroscopy. After the death of Dr. Walczak, Peter was his right hand in the construction of modern EPR equipment.

Peter could bring so much to the development of EPR spectroscopy because he understood the physics of this phenomenon, which is a rare ability to connect electronic knowledge with physical knowledge. A notable result of this ability is the number of scientific publications that appeared in internationally recognized scientific journals. Peter became a well-known and respected figure in the international scientific community involved in the applications of EPR spectroscopy in biomedical research. He was known not only as an excellent professional, but also as a man of exceptional modesty and kindness.

On behalf of myself and the entire EPR community, also at the request of Prof. Swartz, I want to express our deepest sympathy to his whole family. He departed as somebody who was very close to us, but to paraphrase the quoted words of Szymborska, we will gratefully pay tickets to the afterlife of Peter that he will remain forever in our human eternity.

And despite Szymborska's words, we will never pay for that with "Uncertain coinage".

Wojtek Froncisz,
Professor of Molecular Biophysics and Dean
at Jagiellonian University, Poland

* * *

I talked with Piotr in March 2015 over the phone a couple of minutes. It was my last conversation with him. During my short visit to

* From the poem Rehabilitation written by the Nobel Prize winner Wisława Szymborska. Translated from the Polish by Clare Cavanagh and Stanisław Barańczak.

Jagiellonian University, Krakow, Poland, I tried to meet him because Krakow is his hometown. But I could not have such an opportunity. In late 1990's and early 2000's, I often visited Hanover, New Hampshire to work with the folks in the EPR center at Dartmouth Medical School. Since my research area is EPR instrument development, I was fortunate to closely work with Piotr and another talented colleague, Tadeusz Walczak, who were in charge of EPR instrument developments at the EPR center. Piotr was always kind to me and other lab members. In 1999-2000, I spent a year at Dartmouth and I had a great time with Piotr at the EPR center. I remember that we had a dinner in my apartment on a summer day. He played with my daughters who were one and three years old. Also I remember that he always shared his new ideas for EPR instrumentation and ongoing developments regarding electronics and resonators with me. One of his impressive works was the development of an L-band multiquantum CW-EPR spectrometer. Using CW microwave irradiation but without magnetic field modulation, he was recording EPR absorption peaks from a test sample at 7th floor of Vail building. Piotr was always smiling, when he talked to me about his ongoing work and many stories in his life. Personally, I really enjoyed talking with Piotr and working with him in the EPR center. He was a wonderful friend and an extraordinary mentor to young researchers and engineers. His memory will live on forever in his colleagues, friends, and his family.

Hiroshi Hirata,
Professor of Bioengineering and Bioinformatics, Hokkaido University, Japan

* * *

Many word associations come to mind when I remember Piotr. A few special ones dominate:

- Gentleman (He displayed a gentle and unrelentingly respectful demeanor to all. While he could indeed exhibit a passionate side when he thought a discussion was intellectually wrong-headed, even then he spoke softly and without being dismissive or putting people down.)
- Mentor (He was a very creative and knowledgeable engineer who knew how to coax the best performance from a device as well as from his colleagues, as he freely taught us how to innovate and problem solve as well as how to apply the basic principles.)
- Friend (There are so many memories of Peter's thoughtfulness and generosity as my friend. Even a happy glass frog made by his daughter remains a treasured reminder of how much his presence made a difference in our lives. I am so grateful that his family was willing to share him and his many talents with us at Dartmouth, even though he too longed to spend more time with them in his beloved homeland.)

I, as well as many others, remain enriched for having shared time with him.

Ann Barry Flood, Professor and Associate Director of Human Factors and Clinical Studies at the EPR Center at Dartmouth

* * *

Brilliant engineer, master of analog and digital electronics, not afraid to enter machine shop and make parts himself.

Will remain in my memory as excellent tutor and person of exceptional engineering skills; you could learn from him and he will not hesitate to pass this knowledge on you.

I was lucky to spend more than a decade working with him.

Maciej Kmiec, an engineer at Dartmouth who worked closely with Piotr

* * *

Usually we do not make many friends in adulthood. Our close friends come from our childhood. Nonetheless, due to his unique personality, Piotr became (it is very hard for me to say it in past tense) my very close friend. I learned a lot from Piotr despite the fact we were almost the same age. And these are not only his approaches to solving complex technical problems. Beautiful soul, kindness, intelligence, honesty, decency – these are the character traits that I tried to learn from Piotr well into my adulthood. Piotr left in my heart an unforgettable and very warm spot.

Oleg Grinberg, engineer, worked a long time together with Piotr at Dartmouth, several years sharing a house in Lebanon NH

* * *

On the first week into my first job out of college, I was surprised to see how often all the engineers gathered around Piotr to listen to his latest insights as he worked. Considered one of the world's leading experts in EPR instrumentation, Piotr had an uncanny ability to make sense of the complex interactions between the quantum world, the real world, and the electromagnetics that riddled and governed our applications and endeavors to come. It didn't take long for my mental mouth to be agape with incredulity. He made it sound elementary, but of course you would only come to the same conclusions if Piotr drew it in the air with unfounded enthusiasm, spoke in eloquent logic, booming Polish vernacular and volume, would throw in a dash of physics, corny jokes that he would repeat on a weekly basis, and that smile he would only break out for special occasions when he knew you were grasping an unfamiliar concepts for the first time. I got to know that smile well over the last four years that we spent working together. That smile always had me wondering what else I could learn from this man if I asked the right question, or piqued his curiosity, and consequently mine. His insight was a wishing well of knowledge that you'd throw pennies of curiosity into, only to realize that if you wanted that true treasure of understanding something, that you'd have to go down after it. I think that we made that connection when we were both overtaken with levels curiosity that drove us into late hours at the lab when we witnessed a phenomenon that had us both saying "Hmm… That's interesting…" That's really all it took for my mind to wander into the unknown, armed only with my curiosity to defend my still soft and naive mind, and for the desire to light that fire beneath me to try to become something close to who and what Piotr is.

Piotr Leśniewski passed away as a result of the disease, cancer, that he was developing instrumentation to investigate. Piotr was probably one of the most modest engineers and scientists I've ever had the pleasure of working with. I am one of the last people he mentored, and I am eternally grateful for all that he's done for me, with me, and to me. It is because of his mentorship in knowledge, curiosity, and the desire to advance science that Piotr has helped me to evolve to where I am today, that I've traveled to many international destinations, that I've advanced the field that I'm in, and that I've advanced as an engineer and scientist in the manner I have.

Always on the cutting edge of technology, Piotr Leśniewski will continue to be missed by many, but he will forever live on in the technological advancements he so elegantly undertook.

Piotr, I'll never really know what you saw in me, but I'm forever thankful that you did, that we shared your precious time together, and that you helped me to become who I am today.

Thank you for everything.

Wilson Schreiber, engineer, recalled his experiences with Piotr at Dartmouth

Monitoring Environmental Pollutants with Electron Paramagnetic Resonance (EPR)

Kalina Ranguelova and Ralph Weber

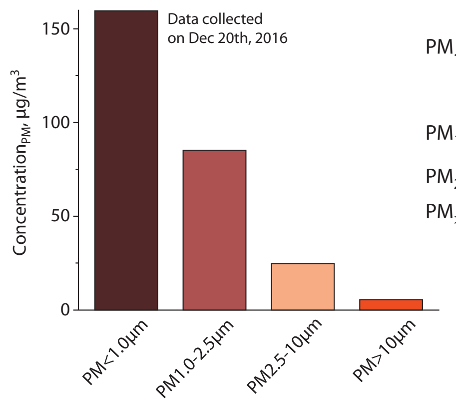
Bruker Biospin Corp., Billerica, USA

Electron paramagnetic resonance (EPR) spectroscopy is a technique that detects species with unpaired electrons – free radicals, transition metal ions, and defects in materials. Many compounds that exist within food, medicines and the environment have the ability to form free radicals. For example, oxidative stress occurs when an oxygen molecule is reduced to reactive oxygen species, and these radicals may enter biological systems. Inside the body, free radicals can attack biomolecules, thereby damaging cells, proteins and DNA and potentially causing diseases. Monitoring free radicals and other species with unpaired electrons in the environment is therefore of critical importance. Free radicals are typically short-lived, but long-lived species also exist, known as environmentally persistent free radicals (EPFRs). EPFRs can remain in the environment almost indefinitely, particularly when associated with the surfaces of fine particles [1].

I. Air pollution studies

Outdoor air pollution is a major environmental hazard that affects human health worldwide. The link between inhalation of ambient particulate matter (PM) and various adverse health effects is documented extensively by epidemiological and toxicological studies. Transition metals have been identified as crucial PM components, triggering hydroxyl radical (•OH) generation. This occurs via Fenton-like reactions, which result in the formation of •OH radicals from hydrogen peroxide and a transition metal catalyst. Short-lived reactive oxygen species (ROS) and reactive nitrogen species (RNS) are produced from polycyclic aromatic hydrocarbons (PAHs), which are frequently found in ambient PM and are known to have toxic and mutagenic effects in the body, as do their oxygenated derivatives [2]. EPFRs have also been observed in PM and have the ability to generate ROS in the body.

The results from a study on haze events in Beijing show that EPR detects EPFRs identified as semiquinone radicals in PM with different particle size, and that EPFRs are mainly persistent in the PM fraction of $d_{ae} < 1\ \mu m$, which are the most hazardous (Figure 1). The daily monitoring and quantifying of the EPFRs (spins/g) shows environmental changes that impact long-term effects on human health. Such monitoring can be used to enact counter measures to reduce health risks to the public.



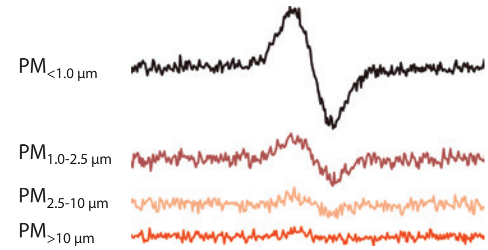


Figure 1: Electron Paramagnetic Resonance (EPR) study of airborne particulate matter (PM) in Beijing during haze events. The EPR spectra were recorded on a Bruker EMXplus spectrometer. The concentration was determined with the SpinCount module [3].

II. Soil pollution studies

Soil pollution can originate from a range of sources and impacts many environmental and agricultural processes. Toxins can be assimilated by plants and leach into groundwater, therefore distributing across landscapes and potentially entering food systems. Common soil pollutants originate from industrial waste and heavy metal by-products and from agricultural practices such as pesticide, insecticide, herbicide and fertilizer use.

All these pollutants are toxic and often participate in processes resulting in the formation of surface-stabilized EPFRs. EPFRs play a role in the further generation of toxic compounds and are additionally involved in radical processes that impact the formation of humic substances and carbon sequestration. Most common pollutants can be detected with EPR, which can help in the development of measures to control their distribution and to aid in clean-up strategies.

Detailed research is required to understand the impact of pollution from industrial and agricultural sources on the soil environment. Understanding the mechanisms and roles of the inorganic, organic and biological components of soil leads to effective strategies to neutralize toxic compounds. EPR works well in soil analysis as scientists can identify, quantify and monitor long-lived EPFRs in soil organic matter, short-lived ROS and paramagnetic heavy metals by analyzing an EPR signal.

Figure 2 details research on free radicals in Fe(III)-enriched clay [4]. Clay minerals act as a potential reservoir of transition metals and toxic organic pollutants. In this example, EPR demonstrates the catalytic role of transition metal centers (Fe^{3+}) in phenol-contaminated clay minerals in the formation

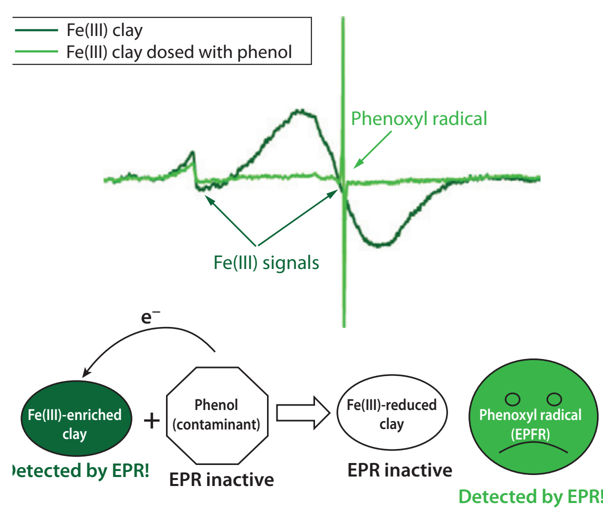


Figure 2: Free radicals in Fe(III)-enriched clay. The data were collected with a Bruker EMXplus EPR spectrometer [4].

of EPFRs. EPR monitors and quantifies the production of EPFRs via oxidation-reduction mechanism.

III. Water pollution studies

Hazardous organic waste that is widely spread in water by industrial, military and domestic sources is a prevalent global pollution problem.

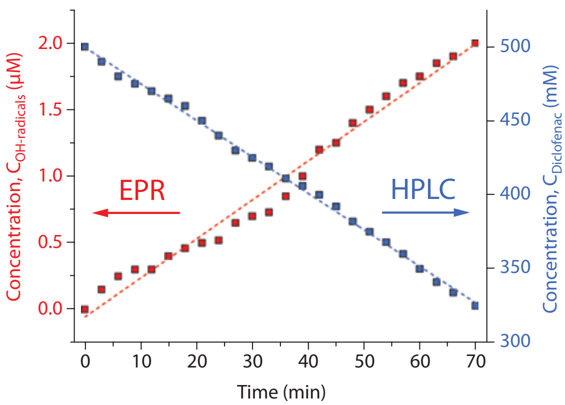


Figure 3: Advanced Oxidation Process (AOP) – pulsed corona plasma – electron paramagnetic resonance (EPR) study on pharmaceutical residues. The EPR experiments were performed on a Bruker EMXmicro spectrometer [5].

Advanced Oxidation Processes (AOPs) are efficient methods to remove these contaminants that are not biologically degradable. AOPs are based on the chemistry of hydroxyl ($^{\bullet}OH$) radicals, which are non-selective reactive oxygen species, and are able to oxidize water pollutants into inactivated end-products. AOPs decontaminate water through the destruction of organic pollutants, the neutralization of transition metals, and the inactivation of bacteria and viruses.

By using an EPR spin-trapping technique, the intrinsic generation of short-lived radicals such as $^{\bullet}OH$ produced during AOPs can be identified, quantified and monitored. In spin-trapping experiments, unstable radicals are converted to stable radical adducts by reactions with spin-trapping agents and are detected by EPR.

The design and optimization of AOPs depends on several parameters, including reagent dosage, additional reactants, and reaction time. The optimal conditions must be determined in order to achieve the most effective treatment and reduce operating costs. Hydroxyl radical is the most reactive species in AOPs and its interaction with the pollutants determines the efficiency of the oxidation process. It is therefore important to increase the yield of $^{\bullet}OH$ generated during AOPs. Recent research measured the degradation of seven resistant pharmaceutical agents (Diclofenac, Ibuprofen, Diazepam, etc.) decomposed by pulsed corona plasma generated in water. The degradation of Diclofenac measured by high pressure liquid chromatography (HPLC and GC-MS) is directly correlated to the increase in hydroxyl radical concentration over time. The study found that $^{\bullet}OH$ detected by EPR are responsible for the decomposition of pharmaceutical compounds (Figure 3) [5].

Future roles for EPR in environmental studies

The World Health Organization (WHO) estimates that nine out of every 10 people on the planet breathe highly polluted air, which kills seven million people each year [6]. This, in addition to increasing use of fertilizers and other agricultural chemicals, leaves the surrounding environment contaminated with potentially harmful free radicals.

Since its commercialization in the 1950s, EPR has become an increasingly valuable method in detecting free radicals, in material research and structural biology, as well as environmental contamination. The development of bench-top EPR systems, like the EMXnano, has combined a smaller instrument footprint with greatly enhanced ease-of-use, reduced cost of ownership and advanced capabilities.

In addition to the mentioned applications, EPR can now be used to detect the carbon-based radicals derived from roasting coffee beans or toasting bread, radicals from drug degradation, and even to detect antioxidants' radicals in vitamins. The importance of EPR as a detection tool is continuously evolving.

For information about Bruker EPR instrumentation, and to access live and on-demand webinars and other training materials please visit: www.bruker.com/products/mr/epr.html

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The European Magnetic Resonance Meeting EUROMAR 2018
July 1–5, 2018, Nantes, France

The European Magnetic Resonance Meeting (EUROMAR) was held in Nantes, France, July 1–5, 2018. The conference, hosted in Nantes Convention Centre located in the heart of the city, gathered more than 700 participants and was a stimulating forum for exchanging on the most recent breakthroughs in magnetic resonance, with an impressive scientific programme, a high level selection of invited lectures, promoted oral communications and posters.

The EPR portion of the meeting consisted of 4 invited and 6 contributed talks along with 24 poster presentations.

In addition to the above contributions, the meeting featured two plenary lectures with an EPR focus. The first, given by *Daniella Goldfarb* (Weizmann Institute of Science, Israel), focused on hyperfine spectroscopy and distance measurements to study ATP induced conformational changes. The lecture was sponsored by the French EPR association, A-RPE. Finally, *Eric McInnes* (University of Manchester, United Kingdom) presented his work on probing actinide–ligand interactions by EPR spectroscopy.

From left to right: Patrick Giraudeau, Peter Szirmai, and Fei Kong.

From left to right: Angeliki Giannoulis, Thomas Prisner, and Paola Guarracino.

The meeting featured two others EPR sessions including the following talks:
– Modelling the heterogeneous structure of a protein-RNA complex with distance distribution restraints *Gunnar Jeschke* (Switzerland)
– Magnetic resonance with quantum microwaves *Patrice Bertet* (France)
– Spin-dependent processes in organic solar cell materials *Jan Behrends* (Germany)
– Human and in vitro metabolomics in health research *Enrica Bordignon* (Germany)

The Journal *Magnetochemistry* offered two 200 € travel grants, awarded to young scientists who have submitted an outstanding abstract in the field of EPR at EUROMAR 2018.

The 2018 recipients are:
– *Peter Szirmai* (Ecole Polytechnique Fédérale de Lausanne, Switzerland)
– *Fei Kong* (University of Science and Technology, China)

The International EPR society offered two 200 $ poster prizes and a one-year free membership to the best posters in the field of EPR. The 2018 recipients are:
– *Angeliki Giannoulis* (Weizmann Institute of Science, Israel)
– *Paola Guarracino* (University of Padua, Italy).

The next EUROMAR & ISMAR Joint Meeting is scheduled on August 25–30, 2019 in Berlin, Germany.

Magali Lavillonnière

Annual International Conference "Moderm Development of Magnetic Resonance" (MDMR 2018)
September 24–28, 2018, Kazan, Russia

In September 2018, Kazan welcomed 122 participants from Austria, Belarus, Germany, Israel, Japan, Kazakhstan, Russia, Slovenia, Sweden, USA, and Turkey in order to discuss achievements and new tendencies in applications of magnetic resonance within the Annual International Conference "Modern Development of Magnetic Resonance 2018" dated to the Zavoisky Award 2018 ceremony. Professor R. David Britt (University of California Davis, USA) got the Zavoisky Award 2018. He is distinguished for the achievements in pioneering advanced EPR methodologies and their implementation in the study of biologically significant metalloenzymes like the oxygen-evolving complex in photosynthesis.

The conference was organized by the Zavoisky Physical-Technical Institute of the Russian Academy of Sciences and the Kazan Federal University under the auspices of the

From left to right: Vadim Khomenko, Vice-President of the Academy of Sciences of the Republic of Tatarstan, Aleksei Kalachev, Deputy Director of the Kazan Scientific Center of the Russian Academy of Sciences, Andrei Pominov, Deputy Minister of the Education and Science of the Republic of Tatarstan, David Britt, Zavoisky Awardee 2018, and Kev Salikhov, Chairman of the Zavoisky Award Selection Committee.

Groupement AMPERE. It included ten plenary lectures, 45 invited and oral talks, and seventy posters within the following sections: theory of magnetic resonance; low-dimensional systems and nano-systems; electron spin based methods for electronic and spatial structure determination in physics, chemistry and biology; molecular magnets and liquid crystals; spin-based information processing; strongly correlated electron systems; chemical and biological systems; medical physics; other applications of magnetic resonance;

modern methods of magnetic resonance; perspective of magnetic resonance in science and spin technology.

The Zavoisky lecture of David Britt "Solar fuels: nature's approach" was devoted to new results on the application of EPR methods to study the process of electron transfer in photosynthetic systems. Klaus Moebius in his lecture «High-field EPR studies of water-protein hydrogen bond interactions and their role for biological function" presented the current state of the knowledge of molecular mechanisms, which allow the reaction centers of some plants to withstand very long droughts and adverse temperatures. In these studies, EPR methods and optical methods make it possible to follow the structure and dynamics of the reaction center of photosynthesis. The plenary lectures of Sergey Demishev "ESR in strongly correlated topological insulator SmB6: Built-in mechanism of time reversal symmetry breaking and anomalous spin relaxation rate" and Yuri Kusraev "Optical orientation of magnetic polarons in diluted magnetic semiconductors" were devoted to the use of EPR for the study of solids.

In connection with the development of quantum computing, the studies of spin dynamics (and electrons and nuclei), the search for spin systems, which are promising from the point of view of their use in quantum computing and quantum computer science, are relevant. A number of works on NV centers and defect centers in silicon carbide were devoted to this problem.

The conference revealed the continuing interest in the study of the dynamic polarization of nuclear spins. It is worth to note the lecture of Aleksandra Yurkovskaya "Light-induced nuclear hyperpolarization as a sensitive tool for detection of illusive radicals of biomolecules". The report "Peculiar features of the spectrum saturation effect when the spectral diffusion operates" by K. Salikhov demonstrated that the EPR theory continues to evolve.The conference manifested the enormous variety of fruitful applications of magnetic resonance in diverse fields of science.

The financial support of the Government of the Republic of Tatarstan, the Russian Foundation for Basic Research, Bruker BioSpin, ADANI Ltd., and Promenergolab Ltd. is gratefully appreciated.

Kev M. Salikhov
Co-Chairman of the MDMR 2018
Violeta K. Voronkova
Scientific Secretary of the MDMR 2018

The 57th Annual Meeting of the Society of Electron Spin Science & Technology (SEST 2018)
November 1–3, 2018, Sapporo, Japan

The 57th Annual Meeting (SEST 2018) was held from November 1st to 3rd, 2018, at the Conference Hall of Hokkaido University, Sapporo, Japan. Japanese EPR community has an annual meeting at various places in Japan. This year, Hokkaido University hosted the SEST 2018 meeting. Sapporo is the capital of Hokkaido, which is the foremost north island of Japan, and a major tourist destination. The total participants of the meeting were 173 including 56 graduate or undergraduate students. We had 51 oral presentations and 46 poster presentations in addition to 2 themed mini-symposia (totally 8 talks). We also had an invited lecture from abroad, Prof. Christopher Kay (University of Saarland, Germany) with the financial support from The Morino Foundation, Japan. As a special occasion, the award ceremony for IES Fellow 2018 was held; Prof. Hideo Utsumi (the University of Shizuoka and Prof. Emeritus of Kyushu University) received the certificate of IES Fellow and its citation from IES Vice President Asia-Pacific, Hiroshi Hirata, and Immediate Past President, Hitoshi Ohta. After the ceremony, he gave a special lecture entitled "ESR and Life-sciences."

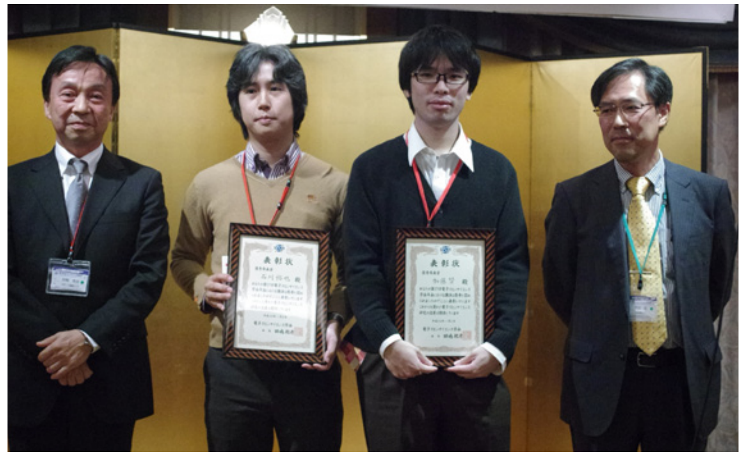
New IES Fellow, from left to right: Hitoshi Ohta (IES Immediate Past President), Hideo Utsumi (IES Fellow 2018) and Hiroshi Hirata (IES Vice President Asia-Pacific).

In the afternoon of November 2nd, the SEST member meeting was held. Members of the board of trustees of SEST reported the current status and plans of the society to the members. After the member meeting, we had award ceremonies for the SEST Award and Young Investigator Award. Prof. Toshikazu Tanaka (Tokyo Institute of Technology) received the SEST Award for his achievement entitled "Quantum Phase Transitions and Magnetic Excitations in Spin Systems." Assoc. Prof. Motoi Kimata (Tohoku University) received the SEST Young Investigator Award for his research entitled "Development of advanced ESR equipment and study of novel electron spin phenomena –Spin current relaxation mechanism in a highly doped conducting polymer film."

In the SEST meeting, we are encouraging young researchers (students and postdocs) to apply Excellent Presentation Award. This time, Excellent Presentation Award went to Ken Kato (Osaka City University) and Yuya Ishikawa (the University of Fukui). For the poster presentations, the committee of poster awards selected six graduate and undergraduate students who presented their research results and well-prepared posters. Poster Presentation awardees in SEST 2018 were Kouta Saito (Kyushu University), Nana Iwata (Saitama University), Tomohiro Kurose (Hokkaido University), Akinori Iwamoto (Osaka City University), Shota Ichise (Kyoto Institute of Technology), and Hiroki Hirano (Kanagawa University).

Two themed mini-symposia were organized by Prof. Wataru Sakai (Kyoto Institute of Technology) and Prof. Aki Hirayama (Tsukuba University of Technology). The first

Award winners, from left to right: Motoi Kimata (SEST Young Investigator Award), Toshikazu Tanaka (SEST Award) and Kunihiko Tajima (SEST President).



SEST Excellent Presentation Award winners, from left to right: Kunihiko Tajima (SEST President), Yuya Ishikawa, Ken Kato, Hiroshi Hirata (SEST 2018 Chair).

mini-symposium dealt with ESR applications in polymer research and development. Four speakers gave their talk regarding EPR applications of polymer-related study: Dr . Kazumi Nakayama (Chemical Evaluation and Research Institute), Prof. Wataru Sakai (Kyoto Inst. Tech.), Dr. Takuji Shimokage (Panasonic), and Dr. Junji Mizukado (National Institute of Advanced Industrial Science and Technology). The second mini-symposium dealt with ESR in a clinical situation. Also, four speakers gave the latest research results of ESR in clinical settings: Prof. Keizo Sato (Kyushu University of Health and Welfare), Prof. Takeshi Moritake (University of Occupational and Environmental Health), Prof. Hiroshi Ichikawa (Doshisha University), Prof. Aki Hirayama (Tsukuba Univ. Tech.).

In the very early morning of September 6th, almost two months before the meeting, an earthquake happened in the south and central regions of Hokkaido. Several towns and villages nearby the seismic center had severe damages for houses, roads, and infrastructures. Also, landslides happened in country hills. After the earthquake occurred, a large power station near the seismic center stopped its operation because of the severe damages of the power plant facilities. This accident triggered the power outage over Hokkaido. In Japan, we first experienced a blackout in Hokkaido that has 5.3 million populations. The power outage continued a day. It took several days for full recovery of power supply in Hokkaido. Some meetings planned in September in Hokkaido were canceled because of the shortage of many services of daily life and the damages of convention centers in Sapporo. The President of SEST, Kunihiko Tajima, and the chair of SEST 2018, Hiroshi Hirata, discussed the possibility of having SEST 2018. Since business and daily life in Sapporo were gradually backed to normal a week after the earthquake, the SEST board of trustees and the chair of SEST 2018 decided to have the annual meeting as planned. Fortunately, we did not have serious problems for the conference hall at Hokkaido University and local hotels that accommodate the participants.

In 2019, SEST will have an annual meeting in early November in Kawasaki, which is nearby Tokyo. You are invited to the forthcoming SEST 2019. Next year, the annual meeting of the NMR society of Japan will be held in the same conference center and the same days.

Hiroshi Hirata, Chair, SEST 2018
Professor, Graduate School of Information Science and Technology
Hokkaido University

The EPR community has available to it a list server. The address is epr-list@xenon.che.ilstu.edu.
To subscribe to the list, send the words SUBSCRIBE epr-list to majordomo@xenon.che.ilstu.edu.
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EPR Summer School Denver 2019
University of Denver, July 17–21, 2019

The International EPR/ESR Society (IES) and the NSF-supported SharedEPR Network are co-organizing an EPR summer school to be held at the University of Denver immediately preceding the 2019 Rocky Mountain Conference on Magnetic Resonance. The school will concentrate on introductory material and thus will be appropriate for researchers with little or no experience in EPR who want to gain both an understanding of the underlying principles as well practical experience in EPR. Instructors for the courses will be internationally renowned experts in the field of EPR from both academia and industry and will be available for extended question and discussion sessions. Lectures, tutorials and practical training will cover the basics of continuous-wave EPR and pulse EPR, the analysis of EPR spectra, and principles of metal ion and nitroxide EPR.

Further information will be made available at the websites of IES (www.ieprs.org) and SharedEPR (www.sharedepr.org). Questions can be emailed to Gary Gerfen at gary.gerfen@einstein.yu.edu.

EUROMAR / ISMAR 2019
Berlin, Germany, August 25–30, 2019

Web: https://conference.euroismar2019.org/event/1/

EUROISMAR 2019 is an international conference on magnetic resonance, organized under the auspices of the AMPERE Society and ISMAR. It combines EUROMAR 2019, ISMAR 2019, and the 41st GDCh FGMR annual meeting.

EUROISMAR 2019 will showcase a wide range of research related to the inherent physics of magnetic resonance and its applications in chemistry, biology and medicine. Individual sessions are devoted to new NMR, EPR and MRI methods, applications in material science and biomedical research, dynamic nuclear polarization and other methods for achieving hyperpolarization, quantum computing, in-cell NMR and EPR, as well as applications of low-field NMR, to name a few.

Chairman: Prof. Hartmut Oschkinat

If you need support, you can contact the following email address: euroismar2019@fmp-berlin.de

XIth EFEPR Conference
Bratislava, Slovakia, September 1–5, 2019

Web: https://efepr2019.conference.fchpt.stuba.sk/

This conference is organized by EFEPR, Slovak Chemical Society and Slovak University of Technology in Bratislava.

EFEPR is an informal organization which gathers 14 national groups from European and extra-European Countries. EFEPR periodically organizes an international conference that covers the main aspects of Electron Paramagnetic Resonance spectroscopy, including new experimental and theoretical methodologies.

The poster competition will be organized to award the best poster presented by PhD. students.

The International EPR (ESR) Society (IES) has selected the EFEPR 2019 as this years' main symposium. The IES Annual General Meeting will be organized within the conference and some of the traditional IES Awards and Award lectures will be delivered in Bratislava.

Scope: EPR of Organic and Inorganic Systems • Advanced Materials • Biophysical, Biochemical and Biomedical Applications • DNP and Emerging Applications of EPR • Emerging Techniques and Methodologies

• EPR Imaging and Microscopy • Spin Trapping and Spin Labeling Chemistry • Theoretical Chemistry and EPR • EPR in Catalysis • Low-dimensional magnetism
Contact: Slovak Chemical Society
E-mail: efepr2019@fchpt.stuba.sk

International Conference "Magnetic Resonance – Current State and Future Perspectives"
Kazan, Russian Federation, September 23–27, 2019

Web: https://epr75.kpfu.ru

The Conference is devoted to the 75th anniversary of the EPR discovery. It is organized by the Kazan Federal University and the Kazan Physical-Technical Institute. The conference includes the Zavoisky Award 2019 ceremony.

A special session is devoted to the 30 years of the International EPR/ESR Society.

Scope: Theory of magnetic resonance • New methods and techniques • Spin Technologies and Devices • Low-dimensional, nanosized, strongly correlated electronic systems • Structure and Dynamics of chemical systems • Spectroscopy and Imaging of Biological systems • Other applications of magnetic resonance and related phenomena.

Contact: Alexander.Dooglav@kpfu.ru

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Aharon Blank, ab359@technion.ac.il

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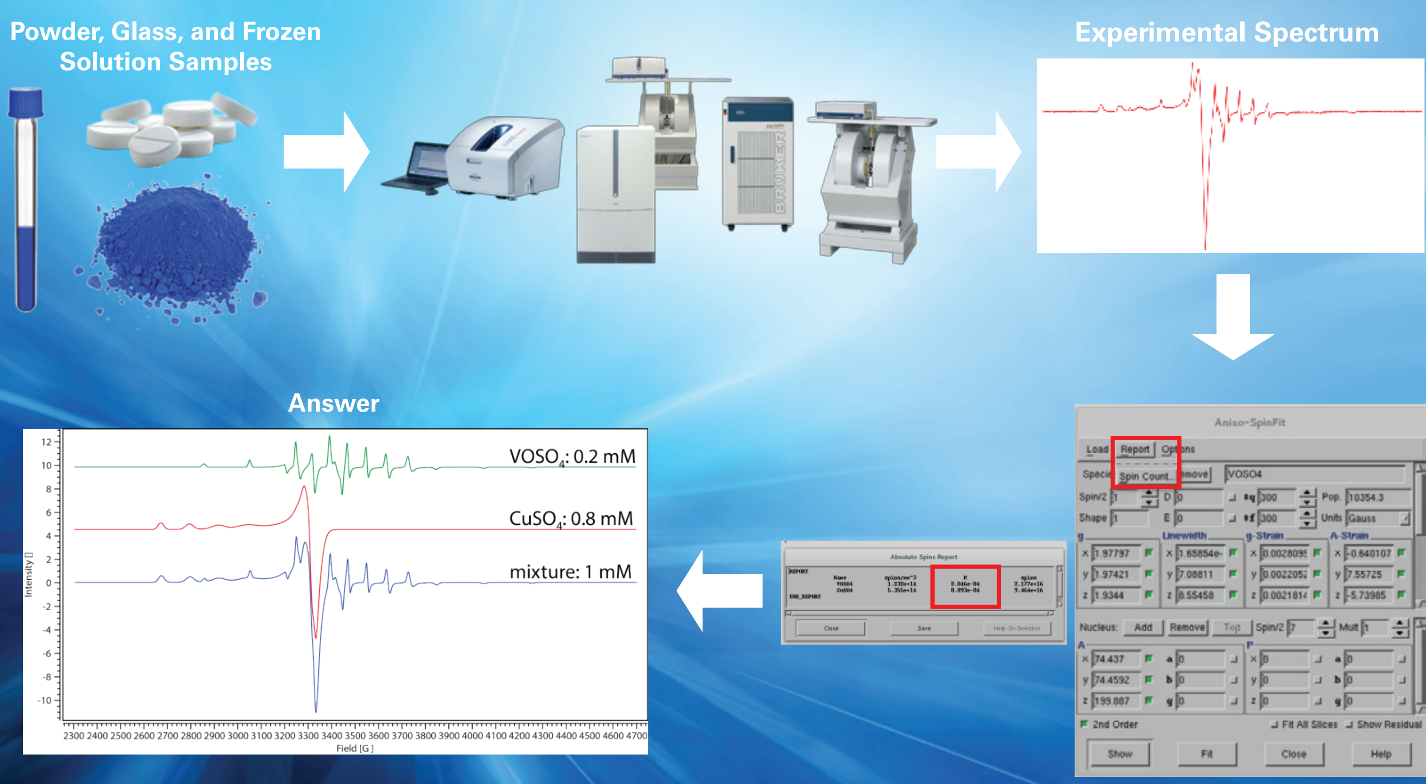

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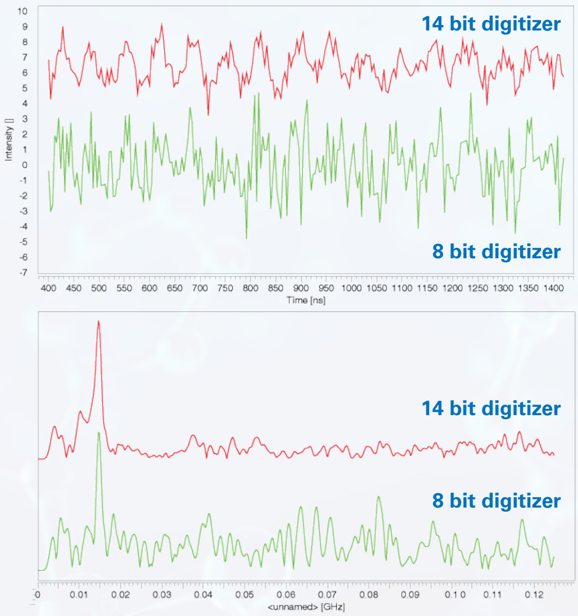

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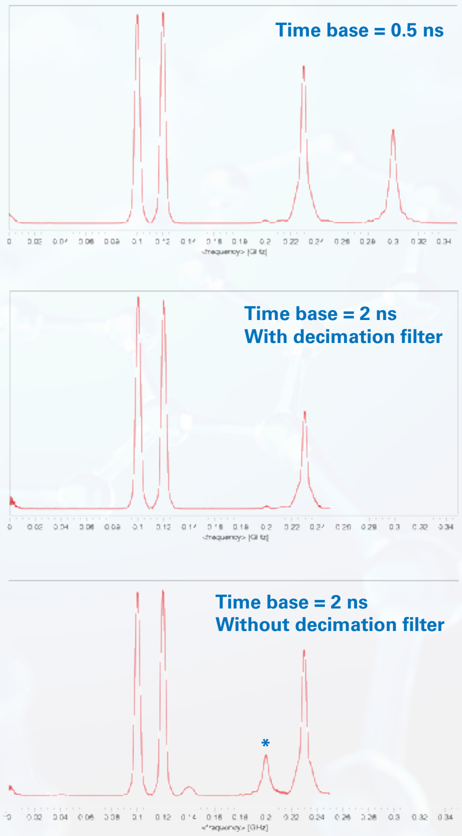

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