

Report on the “27th International Conference on Raman Spectroscopy (ICORS 2022), August 14 – 19, 2022

On August 14 – 19, 2022, ICORS XXVII took place in Long Beach, California, USA. The Long Beach Convention Center (Fig 1) - an ideal conference place for presentations as well as for instrumental exhibitions and posters - hosted this year’s most important meeting of the international Raman community.



Fig 1. The Long Beach Convention Center – Venue of ICORS 2022. Photo: by Wolfgang Kiefer (abbr. WK).

Since the inaugural conference in 1969, ICORS brings together Raman spectroscopists from diverse research fields to discuss the most recent developments and applications in Raman spectroscopy. Leading experts as well as junior researchers and graduate students exchange their new experimental and theoretical results. Whereas earlier editions of this conference series focused mostly on fundamental aspects of Raman scattering, current conference topics have expanded considerably to include new topics such as non-linear and time-resolved, surface-enhanced (SERS), and tip-enhanced (TERS) Raman spectroscopy. Other main topics of the present meeting were material science, applications in biology and biomedicine, novel techniques, analytics and applications. Based on these topics, the Program Chairs (Tullio Scopigno, Sapienza University of Rome, and Giulio Cerullo, Politecnico di Milano, both Italy) together with two Scientific Advisers (Martin Moskovits, University of California, Santa Barbara, and Shaul Mukamel, University of California, Irvine) had put together a most interesting program representing today’s state-of-the-art in Raman spectroscopy. The Local Organizing Committee (Fig 2), consisting of V. Ara Apkarian (University of California, Irvine), Judy Kim (University of California, San Diego), and Eric Potma (University of California, Irvine), arranged for a smoothly run scientific program, the excursions, and the conference dinner. This year’s ICORS meeting was supported by the Conference Service of the Materials Research Society, Warrendale, PA, USA.

Opening Ceremony

The Conference started with a welcome reception followed next morning with an Opening Ceremony with welcome addresses by the Local Organizers (Fig 2). A short video was shown commemorating former ICORS chairmen, who passed away since the last ICORS in 2018 (Fig 3).



Fig 2. The ICORS2022 Local Organizing Committee during Opening Ceremony; from left to right: V. Ara Apkarian, Judy Kim, Eric Potma. Photos: Extracted from a video taken by WK (abbr. PVWK).



Robin J.H. Clark 1935 – 2018	Anton M. Heyns 1939 – 2019	James R. Durig 1935 – 2020	Derek A. Long 1925 – 2020	Mitsuo Tasumi 1937 – 2021
ICORS XI, 1988	ICORS XVI, 1998	ICORS XII, 1990	ICORS II, 1970	ICORS IX, 19884

Fig 3. Former ICORS Chairmen, who passed away since last ICORS in 2018. Photos: PVWK.

Plenary Lectures

The first Plenary Lecture was given by Karen Faulds (Department of Pure and Applied Chemistry at the University of Strathclyde, Glasgow, UK), who spoke about “Multiplexed and Sensitive Bioanalysis using SERS and SESORS”. Unfortunately, the next scheduled Plenary Lecture about “Low-Wavenumber Raman Spectroscopy in Multilayer Graphene and Related van der Waals Heterostructures” by Ping-Heng Tan from the Chinese Academy of Sciences could not be given due to the Covid-19 situation. On the second day of the conference, Pavel Matousek (Science and Technology Facilities Council, Harwell, UK) gave the next Plenary with the topic “Spatially Offset Raman Spectroscopy (SORS)”, which was followed by a Plenary talk given by Janina Maultzsch (Friedrich-Alexander Universität, Erlangen-Nürnberg, Germany) on “Structural and Optical Properties of 2D Van-der-Waals Materials”. V. Ara Apkarian (University of California, Irvine, USA) in his Plenary Lecture spoke about “Atomic Limit in Microscopy & Photon Confinement”, whereas Philipp Kukura (University of Oxford, UK) reported on “Making Raman Spectroscopy Ultrafast”. Finally, the concluding Plenary with the topic “Stimulated Raman Scattering Imaging: The Next Frontier of Light Microscopy” was presented by Wei Min (Columbia University, New York, USA).

All Plenary Lectures were of very high quality and provided a perfect overview of current trends in linear and non-linear Raman spectroscopy.



Fig 4. ICORS 2022 Plenary Lecturers. Photos: PVWK.

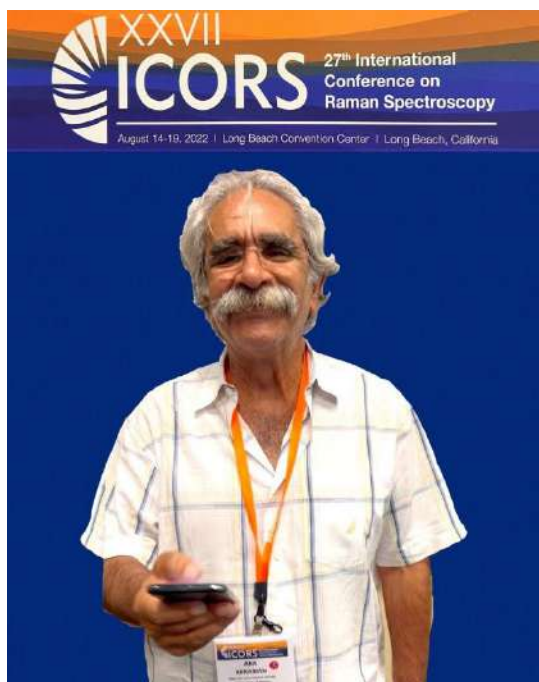
Excursions and Conference Banquet

Wednesday afternoon and evening are traditionally reserved for excursions and the Conference Dinner, respectively. This time, the ICORS participants could visit the “Aquarium of the Pacific” - home of sharks, frogs, sea otters and more - or experience an exciting whale watching journey to view one of the largest animals on the planet. Figure 5 shows some of the whales observed by many most jubilant ICORS excursion participants.



Fig 5. Whale Watching Tour during ICORS 2022. Photos: PVWK.

The Conference Banquet was arranged in the Long Beach Convention Center at “The Cove”, Southern California’s premier street party venue. This open-air event in the Cove was perfectly arranged also in regard to Covid-19 prevention. At the banquet, delicious food and drinks were offered during a most pleasant evening. Besides an amusing Marionette show, one of the Local Organizing Committee Members presented a special poem on Raman scattering (Fig 6). Photos: PVWK.



RAMAN SCATTERING

When Mr. Raman saw the light
I doubt that he foresaw the nights
Of sleepless hours dragging on,
Exploring his phenomenon.

Did he know that after he was dead,
At times when we should be in bed,
With lasers on, and room lights dim,
We would be here lauding him?

I wonder if he realized
That he would sometimes be despised;
For some nights when it's very late,
I find I don't appreciate.

How odd that after all these years
He still can cause such joy or tears;
For it's not fair to only blame,
He gives us much more joy than pain.

How sad that he could not have known
The scattering that he had shown,
Would fill so many's days and nights
Investigating Raman light.

Fig 6. Left: V. Aran Apkarian reading a “Raman Poem” during Conference Banquet; right: Poem about Raman Scattering - the author is Alice B. Apkarian; the poem appeared in her Ph D thesis.

Exhibition and Posters

Since ICORS V, 1976, in Freiburg, Germany, exhibitions by instrument makers have been an integral part of the conference. Whereas at its inception only companies, who produced complete Raman spectrometers, exhibited, more recently also laser and detector companies, accessory firms and component manufacturers related to Raman spectroscopy as well as journal companies presented their new products. Some of them offered generous contributions by funding the conference and earning the distinction of Platinum, Gold or Silver Sponsors. In total, there were 17 exhibitors in the Grand Ballroom of the Conference Center, which was also location of the poster sessions. Approximately 160 posters about the various areas of Raman spectroscopy were presented, out of which seven received an Award (*title*, main author):

“High-speed time-domain Raman spectral imaging with compressed sensing”

Kotaro Hiramatsu, The University of Tokyo, Japan

“Point of care detection of drug induced liver injury using SERS based LIFA device”

Benjamin Clark, University of Strathclyde, Glasgow, United Kingdom

“Spectral characterization of high-speed SERS fluctuations”

Makayla M. Schmidt, Bethel University, Mishawaka, USA

“Transfer of chirality from chiral capped silver nanoparticles to achiral adsorbate evidenced by SERS optical activity”

Moumita Das, Academy of Sciences, Prague, Czech Republic

“SERS-based detection of SARS-CoV-2 through in-situ one-pot electrochemical synthesis of 3D Au-lysate nanocomposite structures on plasmonic electrodes”

Iris Baffour Ansah, University of Science and Technology, Seoul, Republic of Korea

“Dynamic DNA origami/gold nanoparticle hybrid device for distance-controlled dimer assembly”

Helene Giesler, University of Duisburg-Essen, Germany

“Development of dual SERS substrates silver nanoshells and two kinds of graphene quantum dots”

Han Yeong Lee, Kangwon National University, Republic of Korea.

Raman Quiz

For the first time during an ICORS, a Raman Quiz was organized by Sebastian Schlücker (University of Essen-Duisburg, Germany). More than 40 participants were present at this new session held on late Thursday afternoon. They used the audience response system (ARS) “eduVote” directly via their browser (<https://eduvote.de/en/>) or by downloading the corresponding app. In this ARS software questions can easily be integrated into PowerPoint slides.

Five advantages of an ARS are: 1. Activation of students, 2. Anonymity, 3. Feedback on state of knowledge, both for the participants and the organizer, 4. Internal comparison with participant peer group, and 5. For the organizer: reflection on learning objectives and focus.



Fig 7. Sebastian Schlücker performing the “Raman Quiz”. Photo: PVWK.

What type of quiz questions can be asked? Examples of categories are: 1. Definitions (technical terms, physicochemical quantities), 2. Qualitative understanding (concepts), 3. Quantitative understanding (equations/proportionalities), and 4. Estimations (mental arithmetics). The Raman quiz questions were on the following topics: intensity of Raman scattering as a function of laser excitation wavelength, selection rules for vibrational Raman scattering, resonance Raman scattering (RRS), surface-enhanced Raman scattering (SERS), coherent anti-Stokes Raman scattering (CARS), and basic group theory for molecules incl. their normal modes. Questions and results can be downloaded under this URL: <http://mint-lernen.de/raman/> without registration.

Raman Awards

Besides the Poster Awards, also the following Raman Awards - established during ICORS 2014 in Jena, Germany – were issued: The “Raman Lifetime Award”, the “Most Innovative Technological Development Award”, and the “Best Junior Researcher Award”. Since the Members of the 2022 Steering Committee voted equally for two persons to receive the “Most Innovative Technological Development Award”, the Committee decided to exceptionally present two awards. The awardees are shown in [Fig 8](#).



[Fig 8](#). ICORS 2022 Raman Awardees (from left): Sebastian Schlücker (first “Most Innovative Technological Development Award”), Wei Min (second “Most Innovative Technological Development Award”), Larry Nafie (“Raman Lifetime Award”), Giovanni Batignani (“Best Junior Researcher Award”). Photo: PVWK.

The “Kiefer-Raman-Family”

One of us (WK) has been lucky to have participated in all hitherto 27 ICORS meetings - in 1969 for the first time as a young PhD student. Since then, a “Kiefer-Raman-Family” has grown up and some of the “scientific” children and grandchildren are shown in [Fig 9](#) together with their “scientific” father or grandfather, respectively. They are from the following cities in Germany: Essen (UDE, University Duisburg-Essen), Jena (FSU, Friedrich-Schiller University), Stuttgart (DLR, German Aerospace Center), and Würzburg.



Fig 9. Some members of the “Kiefer-Raman-Family” participating in ICORS 2022.

Upper row from left to right: Till Reichenauer (grandson, UDE); Frank Duschek (child, DLR); Wolfgang Kiefer (father/grandfather, Würzburg); Sebastian Schlücker (child, UDE); lower row: Namhyun Choi (postdoc with SeS, UDE), Dana Cialla-May (granddaughter, FSU), Lisa Dreier (DLR), Helene Giesler (granddaughter, UDE), Luca Supovic (grandson, UDE), Daniel Schäfer (grandson, UDE), Roland Grzeschik (grandson, UDE), Vikas Kumar (postdoc with SeS, UDE). Jürgen Popp (child, FSU) who also participated in ICORS 2022 is not on the photo. Photo: Giulio Cerullo.

For all of us, this great ICORS meeting will be remembered for a long time including its wonderful local environment (**Fig 10**).



Fig 10. Sunset in Long Beach during ICORS 2022. Photo: WK.

Acknowledgements

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