The 13th Confocal Raman Imaging Symposium

"One of the most informative and interactive symposia of recent years," said WITec CEO Dr Joachim Koenen about the 13th Confocal Raman Imaging Symposium held from 26th to the 28th September in Ulm, Germany. The German microscope manufacturer annually invites researchers and specialists from widely ranging fields to the international conference to share ideas and hear about the latest developments in Raman microscopy. This year 78 scientists converged to discuss topics as diverse as life science, pharmaceutics and materials research.

With confocal Raman imaging the molecules of a sample can be chemically identified and their distribution can be imaged three-dimensionally. These benefits have recently gained recognition in biological, medical and pharmaceutical research. This trend can also be seen in the conference contributions: in addition to five talks almost half of the poster contributions originated from these fields.

Also a poster from the pharmaceutical field won this year's WITec Poster Award. Tatjana Lechtonen from Ruhr-University in Bochum was delighted to receive the award. She uses Raman imaging for the analysis of anti-cancer drugs. On her poster she explained the results of cell-response and resistance of cancer cells to Erlotinib and Neratinib. She concluded that Raman imaging shows great potential as an in-vitro analytical method for the evaluation of new anti-cancer drugs.

In pharmaceutical research Raman microscopy is a relatively new method that is still being established, explained Dr Duohai Pan from the pharmaceutics company Bristol-Myers Squibb in New Brunswick. However, in his company Raman microscopy is already being applied to clinical toxicology studies and the development of new drug formulations. Through Raman microscopy Pan gains information about the crystallisation and precipitation characteristics that influence the stability and solubility of the end product. Additionally the identification of polymorphs plays an important role, because even though the chemical composition of polymorphs are identical, they have different impacts on the human body. Pan investigates various samples with Raman microscopy such as emulsions, powders and even entire tablets.

Professor Dr Malgorzata Baranska is a researcher at Jagiellonian University in Krakow. During her talk she described her investigations of vascular diseases such as arteriosclerosis. Baranska is particularly interested in the combined microscopy techniques of Raman-, atomic force and nearfield microscopy. She and her colleagues use mainly cell culture models of the endothelium and liver and tissue samples. Through Raman microscopy she analyses stress- and drug-induced changes in the cellular processes and with nearfield microscopy she investigates living cells on the nanometer scale. The results are then compared to more established histological methods.

Dr Christian Matthaeus from the Institute of Photonic Technologies at Jena also investigates arteriosclerosis. He reported on his work on macrophages, which uptake and store lipids and contribute significantly to the establishment of arteriosclerotic plaques. Matthaeus analyses fatty acids and lipid transport proteins in the macrophages with Raman microscopy. Through the knowledge of the plaques' composition Matthaeus can classify the risk of those plaques causing thrombosis, strokes or heart attacks.

For some time now confocal Raman microscopy has played an important role in materials science for the development of new or improved materials. The topics of the talk and poster contributions in the materials sections ranged from cement to atom-thin 2D materials.

For thousands of years cement has been among the world's most important building materials. During production vast resources and a great quantity of CO2 are produced. Additionally, an immense amount of waste is generated through the demolition of cement buildings. Dr Biliana Gasharova from KIT in Karlsruhe seeks to develop a more ecologically friendly and energy efficient cement production. She investigates the effects of modified production factors such as pressure or hydrothermal conditions on the composition of the cement phases and their characteristics. To image and chemically identify the cement phases she uses confocal Raman imaging. Thus she can differentiate crystalline structures and polymorph domains to help refine the production process.

Completely different materials are analysed by Professor Dr Georg Duesberg and his research group at Trinity College in Dublin. They investigate new 2D materials that might one day be used in solar cells, transistors and electronic devices. 2D materials are single atom-thin layers of, for instance, nano-carbon, molybdenum disulphide, tungsten disulphide or platinum diselenide. Duesberg and his colleagues are interested in the production processes that could enable the use of these materials for industrial applications. Therefore it is important to acquire information about the number of atomic layers, possible defects in the layers and the conductivity of the produced material. Besides microscopy techniques such as atomic force microscopy, x-ray photoelectron spectroscopy and transmission electron microscopy, Raman microscopy is mainly used by Duesberg and his colleagues because it is very well suited to their investigations. Raman information in the low wavenumber range is particularly interesting for materials characterisation.

2D materials are currently the subject of great interest worldwide. This was shown by the talks of Professor Dr Nedjam Bendiab from the Institute Néel/CNRS at Joseph Fourier University in Grenoble (France), and Professor Dr Marcos Pimenta from Belo Horizonte University (Brazil). Bendiab introduced her work on strain, mechanical resonance and charge- and energy-transition in the nano-carbon material graphene. Pimenta described his work on atomic structures in different 2D materials and compared his results from Raman spectroscopy to results from theoretical simulations. Other fields of application suitable for confocal Raman microscopy were reviewed by Professor Dr Vladimir Shur from Ural Federal University in Ekaterinburg.

To assist the symposium attendees in following the talks from various specialist fields, Professor Dr Schluecker from the University of Duisburg-Essen refreshed their basic knowledge on the physical principles of Raman spectroscopy. Along with the theoretical background Schluecker explained special Raman techniques such as resonance Raman and surface-enhanced Raman spectroscopy (SERS).

Dr Johannes Ofner from the Technical University in Vienna explained how large data sets implemented in hyperspectral images can be efficiently analysed. Hyperspectral images contain information from different microscopy techniques such as electron microscopy, mass spectroscopy and Raman microscopy. Instead of analysing every image on its own, Ofner applies filters and algorithms to evaluate the images together. This facilitates the interpretation of the results.

At the end of the conference the feedback from attendees was overwhelmingly positive. Gomathy Sandhya Subramanian from the A*STAR Institute for materials research and engineering in Singapore said: "The specialty of the Confocal Raman Imaging Symposium is, that one meets experts in their fields but also system experts, from who you gain a lot of tips and tricks on how to apply Raman microscopy to your own sample." Johannes Ofner from the Technical University in Vienna highlighted that: "During the scientific and social program it is easy to get into contact with principle investigators and the WITec staff. So it was the ideal base to exchange knowledge and experience."

The 14th Confocal Raman Imaging Symposium will be held from 25th to 27th September.

Group picture of the attendees at the 13th Confocal Raman Imaging Symposium