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**Renishaw’s inVia is used at the University of Duisburg, in Germany, to study two-dimensional materials**

The Department of Experimental Physics at the University of Duisburg in Germany uses Renishaw’s inVia confocal Raman microscope to study two dimensional materials such as graphene and molybdenum disulphide.

Dr Oliver Ochedowski recently completed his PhD, working as a member of the Experimental Physics Group of Professor Marika Schleberger (<https://www.uni-due.de/physik/schleberger/>). The group’s main goal is the investigation and quantitative characterization of energy dissipation processes during and after high energetic ion irradiation. In recent years, their work has been focused more on two-dimensional materials like graphene and MoS2. Highly energetic ions can effectively be used to alter the morphological and physical properties of these materials. µ-Raman spectroscopy is a powerful tool to locally analyse these nanoscale modifications.

They prepare their atomically thin crystals using the mechanical exfoliation technique which results in samples covered with graphene/MoS2 flakes of different thicknesses. For many 2D materials, Raman microscopy is the quickest method to unambiguously distinguish single layer, bilayer and several layer crystals (3 or more). In the case of graphene, it has been shown that Raman microscopy can be used to characterize the amount and nature of defects, the strain applied to the graphene, as well as chemical doping. Discussing the work, Dr Ochedowski said: “As we are irradiating graphene with ions, the inVia is used to learn about the defects we are creating. In the case of single layer MoS2, the inVia is not only used for Raman spectroscopy (which gives information about layer thickness, stress and doping) but it can also be used to perform µ-photoluminescence measurements. The transition of MoS2 from an indirect to a direct band-gap from the bulk to a single layer semiconductor can be observed in a strong photoluminescence signal for single layer MoS2.”

The inVia Raman microscope used by the group is located within the microscopy centre of ICAN (<https://www.uni-due.de/cenide/ican/index_en>) at the university of Duisburg-Essen. The group is one of many that use the microscope. The user-friendly software and the full automation of the microscope is especially beneficial for such shared use. Additionally, the exceptional Raman mapping properties are of great importance to Dr Ochedowski and his colleagues. He said: “The inVia allows us both very large mappings (>10 mm × 10 mm) with a high accuracy in the position of the point spectra taken, as well as small mappings with a very small step size of 100 nm and a high degree of detail.”

Examples for this can be seen in several papers published by the group. Kozubek *et al*1, includes Raman mapping data of a CVD graphene on a SiO2/Si sample which has been irradiated with 6 MeV I6+ ions. This experiment shows that large area CVD graphene, in combination with a Raman microscope, can be used as an ion beam detector. In another example 2, the effect of the supporting substrate on the Raman spectrum of single layer MoS2 is investigated. Reactive ion etching is used to alter the roughness of the SiO2 substrate; it is found that the difference in the position of the two most prominent Raman modes in the MoS2 is slightly increased in the etched regions.

Please visit [www.renishaw.com/invia](http://www.renishaw.com/invia) for further details of Renishaw’s inVia confocal Raman microscope.

Image: The inVia confocal Raman microscope

**References**1 Kozubek *et al*: “Application of HOPG and CVD graphene as ion beam detectors”, *Nuclear Instruments and Methods in Physics Research B* 340 (2014) 81–84.
2Ochedowski *et al*: “Effect of contaminations and surface preparation on the work function of single layer MoS2”, *Beilstein J. Nanotechnol.* **2014,** *5,* 291–297. doi:10.3762/bjnano.5.32

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**About Renishaw**

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The Renishaw Group currently has more than 70 offices in 33 countries, with over 4,000 employees, of which 2,700 people are employed within the UK. The majority of the company's R&D and manufacturing is carried out in the UK and for the year ended June 2015 Renishaw achieved sales of £494.7 million of which 95% was due to exports. The company's largest markets are the USA, China, South Korea, Germany and Japan.

The Company's success has been recognised with numerous international awards, including eighteen Queen's Awards recognising achievements in technology, export and innovation. Renishaw received a Queen’s Award for Enterprise 2014, in the Innovations category, for the continuous development of the inVia confocal Raman microscope. For more information visit [www.renishaw.com](http://www.renishaw.com)

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