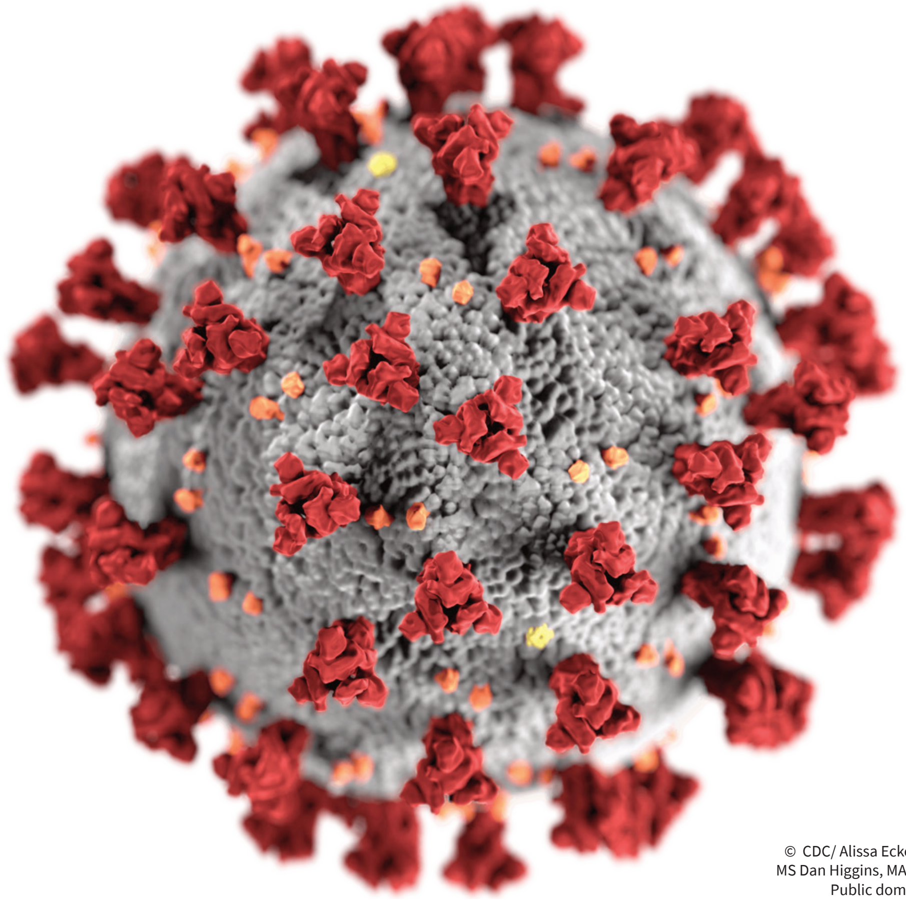
Issue # 3 - August 2020

Newsletter



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Updates from the RADIATE project

COVID-19: where are we now?

COVID-19, a disease caused by the by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was first identified in Wuhan, China in December 2019. By February, the virus had reached Europe and by March, the number of cases registered in Europe had become greater than those in China. In response, Europe started to slowly close schools, enforce social distancing and eventually lockdown.

Consequently, most RADIATE partners shutdown pausing on-going lab-based and experimental research. This has caused major delays to the transnational access program. Since the beginning of the pandemic in Europe, we have seen a rise in proposals asking for hands-off access, while already approved hands-on proposals are often turned into hands-off proposals, if possible. In May 2020, as Europe slowly re-emerged from the pandemic, European ion beam centers slowly re-opened, albeit with new social-distancing rules and restrictions regarding visitors.

The necessity for social distancing and self-isolation has led many face-to-face activities, such as meetings and conferences to be cancelled, postponed, or moved online. Two great examples are the Surrey Ion Beam Centre User's Day meeting, which was held through Zoom on 9 July 2020 and the RADIATE Executive Board meeting, also held through videoconferencing. As travel quarantine is implemented in some countries, other bigger meetings such as the upcoming International Conference on Nuclear Microprobe Technology and Applications (ICNMTA2020) will move to the virtual realm.

Whilst these are trying times, one must appreciate the resilience and determination of the many scientist around the world who have quickly adapted to this new, but hopefully short-lived, way of life. Many have re-focused their research and lent their expertise to help fight COVID-19. We must also not forget the dedication of all the frontline and healthcare workers during the pandemic. So for that, thank you!
Stay strong and stay safe!

In this edition read about:

RADIATE Contact

www.ionbeamcenters.eu

NEWSLETTER EDITORIAL

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Sign up for the bi-annual newsletter:
https://www.ionbeamcenters.eu/radiate/radiate-newsletter/

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AMS available again at HZDR's Ion Beam Center

Routine measurement operation of accelerator mass spectrometry (AMS) has restarted at HZDR's IBC. The newly established department of "Accelerator Mass Spectrometry and Isotope Research" will focus on the detection of the smallest traces of radionuclides for applications in geology, environmental research or nuclear astrophysics.

Proposals for AMS can be submitted either directly to the IBC or through RADIATE's Transnational Access program. Applications for AMS sample preparations and measurements are possible through this activity as well.

Munich Tandem Accelerator closed down

Changes to RADIATE

The RADIATE consortium had to make amendments regarding the transnational access program as well as the training programs. RADIATE project Partner Universität der Bundeswehr München (UBW) is unable to offer any transnational access since mid-January 2020:

"Due to safety issues of the accelerator building, the laboratory of the 14 MV tandem accelerator situated in Garching/Munich has closed down from 16th January 2020. Negotiations have started whether and how the accelerator lab could be reopened. However, no trans-national access to the Munich tandem accelerator and its instruments can be provided by UBW at the moment. Thus, high resolution ERD, accelerator mass spectrometry of medium heavy ions, and the ion microprobe SNAKE for hydrogen microscopy or cell irradiation are not available within RADIATE from now. The ion beam community will be informed if situation changes."

Günther Dollinger, Universität der Bundeswehr München (UBW)

Universität der Bundeswehr München will, of course, remain a part of the RADIATE project and concentrate their efforts on RADIATE's joint research activities. As soon as the COVID-19 situation allows for it, UBW is organizing a data management workshop.

RADIATE Report Series

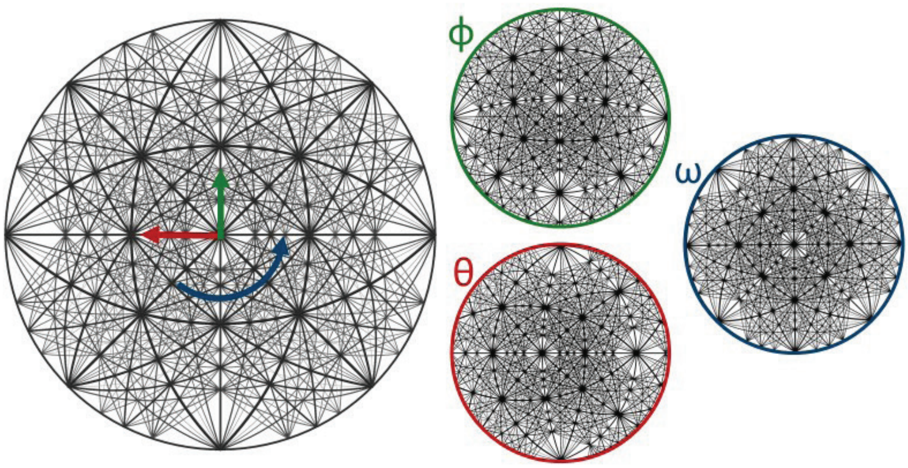
1st Report published!

This report describes CrystalDraw, a C# programmed developed by Professor Jonathan England at the Surrey Ion Beam Centre, UK.

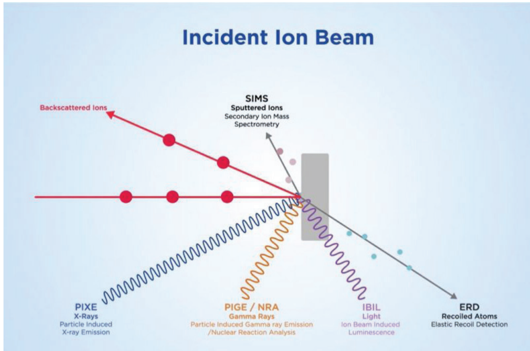
CrystalDraw has been written to produce models of crystal structures and their associated axial and planar channelling directions in three-dimensions and to generate their corresponding two-dimensional projections.

Visualisation of the models using bespoke specially written macros within Paraview illustrates how to orient and manipulate crystals for channelling measurements and guide interpretations of collected channelling data.

The report can be viewed at https://zenodo.org/communities/radiate. If you are interested in CrystalDraw, please contact Jonathan England https://www.surrey.ac.uk/people/jonathan-england



Stereographic projections in CrystalDraw that show the directions of movements of θ (red), Φ (green) and ω (blue) from the [001] alignment and the new projections produced. © J. England



Ion Beam Analysis explained!

New RADIATE Video Clip

One of RADIATE's main objectives is to disseminate ion beam technology to the masses (WP7).

As such, we have commissioned a short animated video clip on Ion Beam Analysis (IBA), explaining how it works and some of its main applications. The video, produced by SciAni (https://sciani.com), not only showcases the techniques of ion beam analysis, but also possible applications benefiting the public.

You can download the RADIATE IBA Video directly here: https://www.ionbeamcenters.eu/download/2571/

Partner news: personnel

Pietro Ottanelli recently joined the RADIATE project at INFN LABEC, Florence.

In March 2020 he obtained his PhD degree with a work focused on the study of isospin transport and pre-equilibrium emission in heavy ion collisions. Apart from the studies in the field of nuclear reactions, since his bachelor's degree he developed a deep interest in detector technology and acquisition systems, which he cultivated during both the master degree and the doctorate.

Inside the RADIATE project he will be involved in the development and characterization of a new fully digital acquisition system, specifically tailored for Ion Beam Analysis measurements, for the LABEC facilities in Florence available also to external users through RADIATE Transnational Access programme.

Janella de Jesus joined the Surrey Ion Beam Centre in 2019 as a Research Fellow.

Janella obtained her MChem in Chemistry at the University of Surrey and stayed on to do a PhD in collaboration with the UK's National Physical Laboratory (NPL) on investigating the feasibility on using ion beam analysis (IBA) and mass spectrometry imaging (MSI) techniques for multimodal imaging on a single sample.

Janella's interest include using PIXE for elemental mapping for biomedical applications as well as using PIXE in-conjunction with MSI techniques. Janella's most recent work is finding suitable substrates for the IBA-MSI analysis as well as finding the suitable workflows to analyse a single sample. Janella still has close links with her collaborators at NPL.

Chamseddine Bouhafs received his Ph.D. degree in semiconductor physics in 2016 from Institute of Technology at Linköping University, Linköping (Sweden). Since then, he pursued several post-doctoral positions at Linköping University (Sweden), University of Aveiro (Portugal), and the Italian Institute of technology (IIT) at the national enterprise for nanoScience and nanoTechnology in Pisa (Italy).

Since March 2020, Chamseddine, he joined the group of Ion Beam Laboratory at Laboratório de Aceleradores Tecnologias de Radiação - Instituto Superior Técnico (IST), as postdoctoral fellow, in order to develop next-generation radiation detectors based on Gallium Oxide.

Dr. Bouhafs is an international expert in graphene technology (growth, advanced characterization techniques). His research interests cover different aspects of semiconductors, 2D materials and nanotechnology:
i) synthesis of graphene and graphene-like materials and investigations of their optical, electronic, structural and interface properties using conventional surface science techniques and Raman spectroscopy,
ii) integration of graphene with conventional semiconductors for developing novel advanced electronics applications.

Dr. Bouhafs has been involved in several EU projects such as graphene flagship and Training network on Functional Interfaces for SiC in which he was awarded Marie Skłodowska-Curie fellowship.

Analytical Research Infrastructures as key resources for the 5 Horizon Europe Missions

Moon-shot missions, such as those of Horizon Europe, require exceptional solutions, and the world-leading Analytical Research Infrastructures of Europe (ARIEs) are one of the key places those solutions can be sought. The ARIE Joint Position Paper highlighting how the common, complementary approach will help address the societal challenges of the Horizon Europe Missions framework programme was presented today.

“The Analytical Research Infrastructures of Europe (ARIEs) provide unique windows into the workings of the world around us”, says Caterina Biscari, Chair of LEAPS and Director of the ALBA Synchrotron in Spain. “The cross-border cooperation within Europe allows for harnessing the power of its analytical research infrastructures collectively, to fuel the cutting-edge R&D required by the five Horizon Europe Missions. Nowhere else in the world is this readily possible.”

The ARIEs are centres of scientific and technological excellence, delivering services, data and know-how to a growing and diverse user community of more than 40,000 researchers in academia and industry, across a range of domains: the physical sciences, energy, engineering, the environment and the earth sciences, as well as medicine, health, food and cultural heritage. They include powerful photon sources, such as synchrotrons, laser systems and free-electron lasers; sources of neutrons, ions and other particle beams; and facilities dedicated to advanced electron-microscopy and high magnetic fields.

“Insights into materials and living matter made possible by their collective tools underpin the advanced research necessary for the success of the Horizon Europe Missions”, underlines Helmut Schober, Chair of LENS and Director of the Institut Laue-Langevin in France. ”The ARIEs provide free access to the scientific user community based upon scientific excellence and open data. Access to the ARIEs is equally being made simpler and smarter, more democratised and less reliant on travel. On the other hand we are also looking into the possibility of providing ‘challenge driven’ access in order to speed up the scientific output for societal relevant themes.”

To address the Missions, the transversal platforms of ARIEs will collaborate amongst themselves and with the Mission specialists at unprecedented levels. They will build and exploit open networks to share knowledge and skills, to coordinate access, to prepare samples, and to create the sample environments required for experiments under real conditions; in doing so, they will use the new European Open Science Cloud.

More information including the whole position paper can be accessed and downloaded from ionbeamcenters.eu

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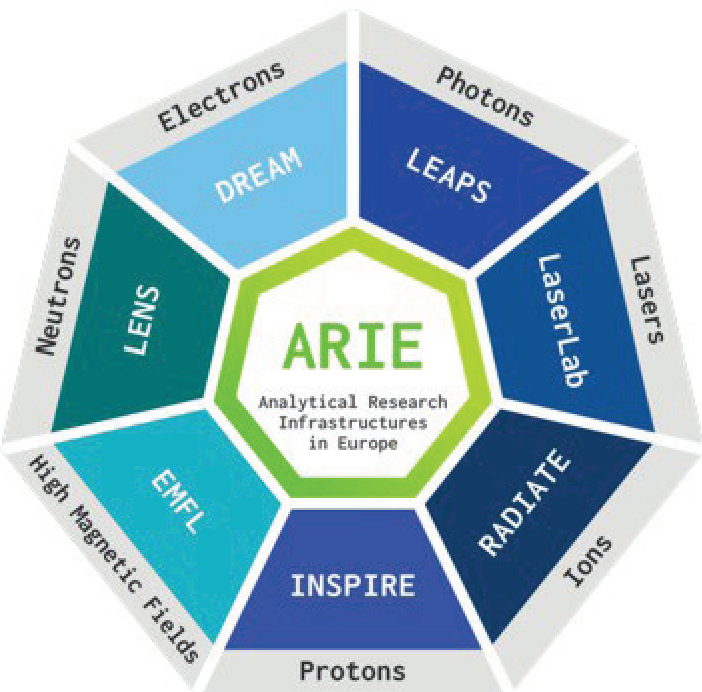

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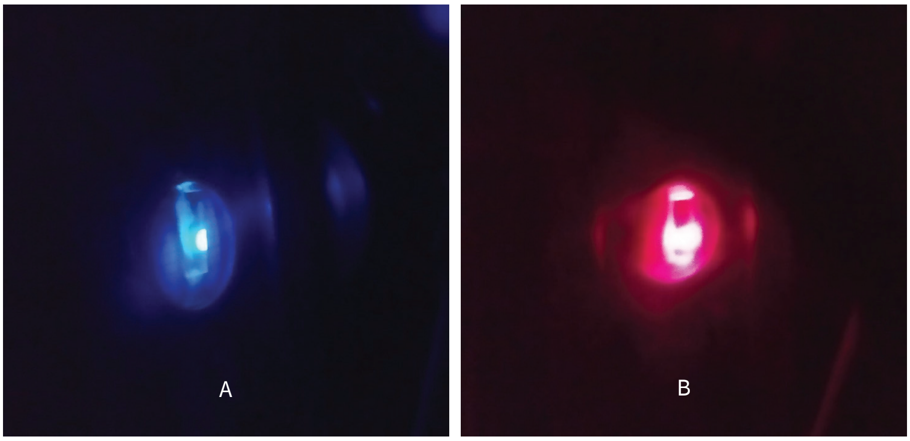
WP21 – Detectors and Electronics

Red emitting inorganic scintillation based on Ga_2O_3 doped with Cr by Eduardo Alves, IST, Lisbon

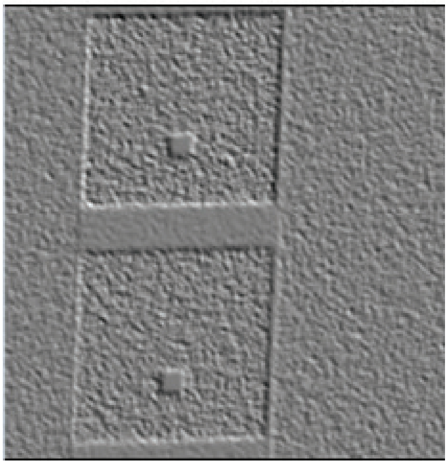


Ionoluminescence of a Ga_2O_3 crystal under 2 MeV proton irradiation (A) in a virgin sample (B) after proton irradiation to a fluence of $1x10^{15}$ ions/cm^2. © E. Alves / IST

Ga_2O_3 is a wide bandgap semiconductor with promising characteristics as a fast scintillator in the blue-UV spectral region. In order to extend the spectral response to longer wavelengths, scintillation properties of Ga_2O_3 crystals doped with Cr were studied by ionoluminescence using excitation with 2 MeV protons. Surprisingly, it was found that Cr^{3+} emission is almost absent in the as-grown samples which present the typical blue-UV luminescence of undoped Ga_2O_3 (Fig. a). Nevertheless, Cr^{3+} emission between 600 and 800 nm, assigned to the Cr^{3+} $^2E \rightarrow ^4A_2$ and $^4T_2 \rightarrow ^4A_2$ intraionic transitions, increases strongly with the irradiation fluence. The red emission reaches its maximum for a fluence around $1x10^{15}$ ions/cm2 (Fig. b). The activation process promoted by irradiation is reversed by thermal treatment at around 600 °C. These effects show the potential of Ga_2O_3 for different applications such as in radiation detectors and optical dosimeters.

WP22 – Software and Data Handling

3D Nanometrology by Jonathan England, SIBC, Surrey



An RBS map of two test die collected in the SIBC Nanobeam Chamber in preparation for measurements to be collected in the Broadbeam Chamber. The sides of each large square are 400µm long. Each die contains a small oxide pad and metal lines, which are unresolved because their widths (<1µm) are smaller than the primary beam size (10µm). © J. England

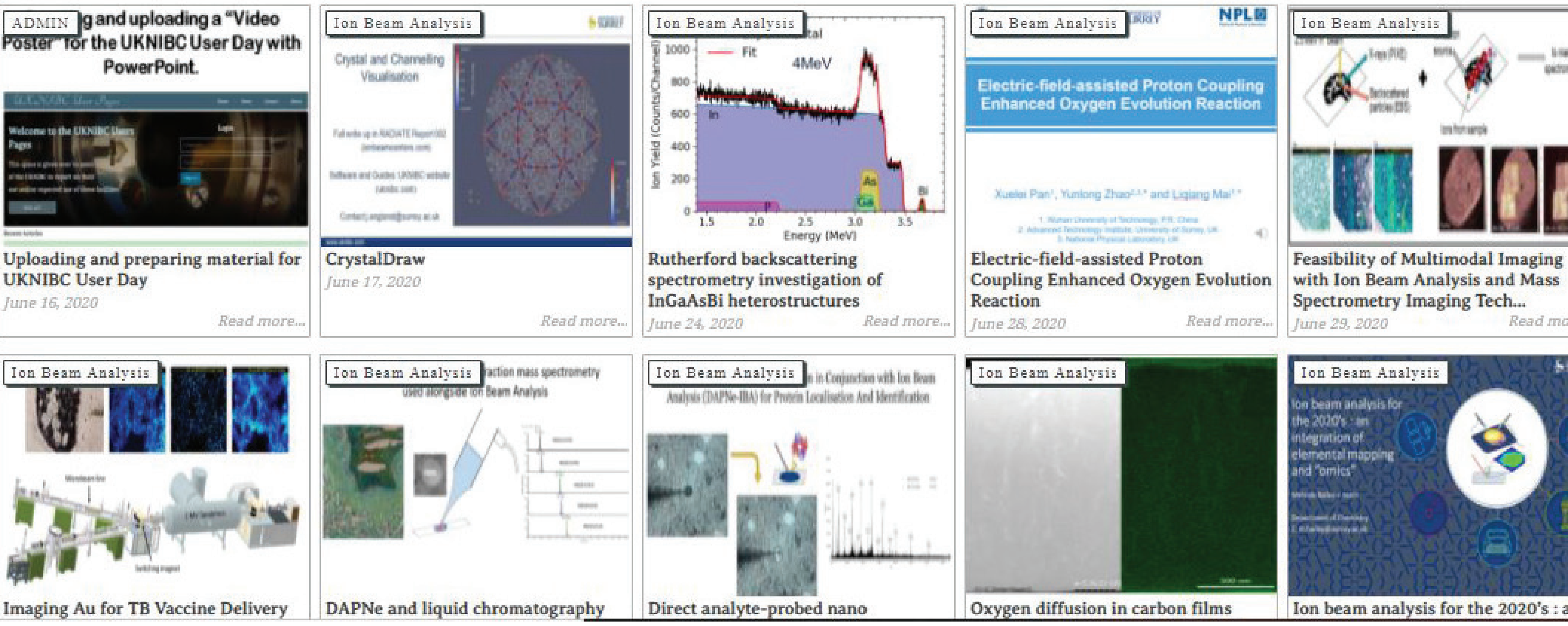
RADIATE Joint Research Activity (JRA Task 22.2) and Transnational Access (TA) for metrology of 3D structures has continued between Imec and Surrey Ion Beam Centre (SIBC). Following a first visit from Surrey to imec (see newsletter 1) and the recruitment of a PhD student, Niels Claessens, it was intended that Niels and Johan Meersschaut would make a TA visit to Surrey to witness the measurements of some 3D nanostructure samples ("FinFETs", metal lines and trenches which are part of several projects at imec). Although SIBC has continued operation throughout COVID-19 using a skeleton staff, transnational travel became impossible. Therefore, the samples measurements was followed and analysed remotely at Imec using local copies of the acquisition software. Regular video meetings were held to discuss progress.

The measurements turned out to challenging and it has taken several iterations to collect good results. Like many nano-electronic device samples, the 3D patterned regions of interest (ROI) are within 400um squares on wafers that are mirror like with poor visible contrast. The requirement was to take measurements at several primary beam incidence and scattering angles so that the spectra could be analysed to reveal atomic concentrations in different parts of a 3D structures.

SIBC made PIXE maps of the samples using its standard Nanobeam Chamber because this chamber accommodates um sized beams and its compact chamber has a close working distance microscope that allows small ROI to be optically found. However, its rudimentary sample holder (soon to be upgraded) does not allow angle control and its compact chamber only contains a single scattered particle detector. We wanted to measure some of the samples in our Broadbeam Chamber using the three scattered particle detectors and its six-axis goniometer for accurate sample alignment in angle and position. This large chamber normally accommodates mm sized beams, but an upgrade of the focussing ability of the primary beam allowed the ion beam size to fit totally inside the regions of interest. The lack of sample contrast and long working distance of the optical viewing system meant that visual location of the ROI was a challenge. A combination of applying location marks on the wafer and the use of an x-ray detector in addition to visible imaging allowed the beam to be placed within the ROI using beam steering and goniometer movement.

Measurements were carried out by liaison fellow Pierre Couture with a large support from Vladimir Palitsin, Geoff Grime and Alex Royle to overcome the extra challenges of simultaneously commissioning our new digital data acquisition electronics and changing the Broadbeam Chamber software to OMDAQ (to match that used on the Nanobeam Chamber). The measured data is now being analysed by Niels at Imec with the support of Matthew Sharpe (modelling officer) at SIBC. The results will complement earlier IBA measurements taken on some of the samples at Imec and guide future measurements using a new multiple detector system being installed at Imec. The technique is also being explored with other users at SIBC.

We are looking forward to resuming visits in person and will look forward to welcoming Johan and Niels at Surrey as soon as conditions allow.



Screenshot showing some of the contributions for UKNIBC's first virtual users' meeting © UKNIBC and respective authors (see website)

UKNIBC Virtual Users' Meeting

Online - 9 July 2020

The quick spread of COVID-19 around globe has lead to the cancellation and postponement of many international conferences. However, conference organisers have employed videoconferencing platforms to host online meetings. The UK National Ion Beam Centre (UKNIBC) hosted its first virtual User's Meeting on the 9th July through Zoom.

On the day, the three UKNIBC facilities – the Surrey Ion Beam Centre, the Dalton Cumbrian Facility and the Microscopes and Ion Accelerators for Materials Investigation (MIAMI) and Medium Energy Ion Scattering (MEIS) facilities at the University of Huddersfield – gave an overview of their facilities and future direction.

Current and prospective ion beam users were invited to submitted a 5-minute virtual poster to the website, which can be viewed and commented on by other users.

Contributions ranged from topics like facilities, ion beam analysis, ion implantation and irradiation, modelling and simulation. In total, participants contributed with 74 virtual posters which touched on subjects ranging from COVID-19 to aerospace applications.

The live session and poster contributions are available here:
http://uknibc.co.uk/UserDay/index.php

Upcoming Conferences

7th International symposium NIBS'20 (Negative Ions, Beams and Sources)
Online, 1-11 September 2020
https://indico.inp.nsk.su/event/28/overview

17th International Conference on Nuclear Microprobe Technology and Applications
Online, 14-15 September 2020
https://www.icnmta2020.org/en/default.asp

2021 Spring Meeting of the European Materials Research Society (E-MRS)
Strasbourg, France, 31 May - 1 June 2021
https://www.european-mrs.com/meetings/2021-spring-meeting-0

29th International Conference on Atomic Collisions in Solids (ICACS) & 11th international symposium on Swift Heavy Ions in Matter (SHIM)
Helsinki, Finland, from 13 - 18 June 2021
https://www.helsinki.fi/en/conferences/icacs-shim-2020

COSIRES 2021 : The 15th conference of COmputer Simulation of IRradiation Effects in Solids
Porquerolles, France, 27 June – 2 July 2021
https://sites.google.com/view/cosires2020/home

22nd International Conference On Ion Beam Modification Of Materials (IBMM)
Lisbon, Portugal (dates to be announced)
http://www.ctn.tecnico.ulisboa.pt/IBMM-2020/

International Conference on Ion Implantation Technology 2020 (IIT 2020)
San Diego, CA, US, 12-16 September 2021
https://www.mrs.org/iit2021

International Conference on Secondary Ion Mass Spectrometry (SIMS 23)
Minneapolis, Minnesota, US, from 26 September – 1 October 2021
https://sims23.avs.org/

25th International Conference on Ion Beam Analysis (IBA-2021) and 17th International Conference on Particle Induced X-ray Emission (PIXE-2021)
Toyama, Japan from 9-15 October 2021
http://ion-beam.jp/iba2021/

Statistics

RADIATE's Transnational Access program started in April 2019, a few months into the project. In the past 15 months, a total of 110 proposals have been accepted by RADIATE's User Selection Panel. Of these, 67 proposals have been hands-on and 43 hands-off access.

RADIATE has committed to providing at least 15.800 hours of transnational access during the project's run time of four years. Up to now, 6288 hours have been allocated to the facilities offering transnational access. Of these, 3175 hours have been delivered.

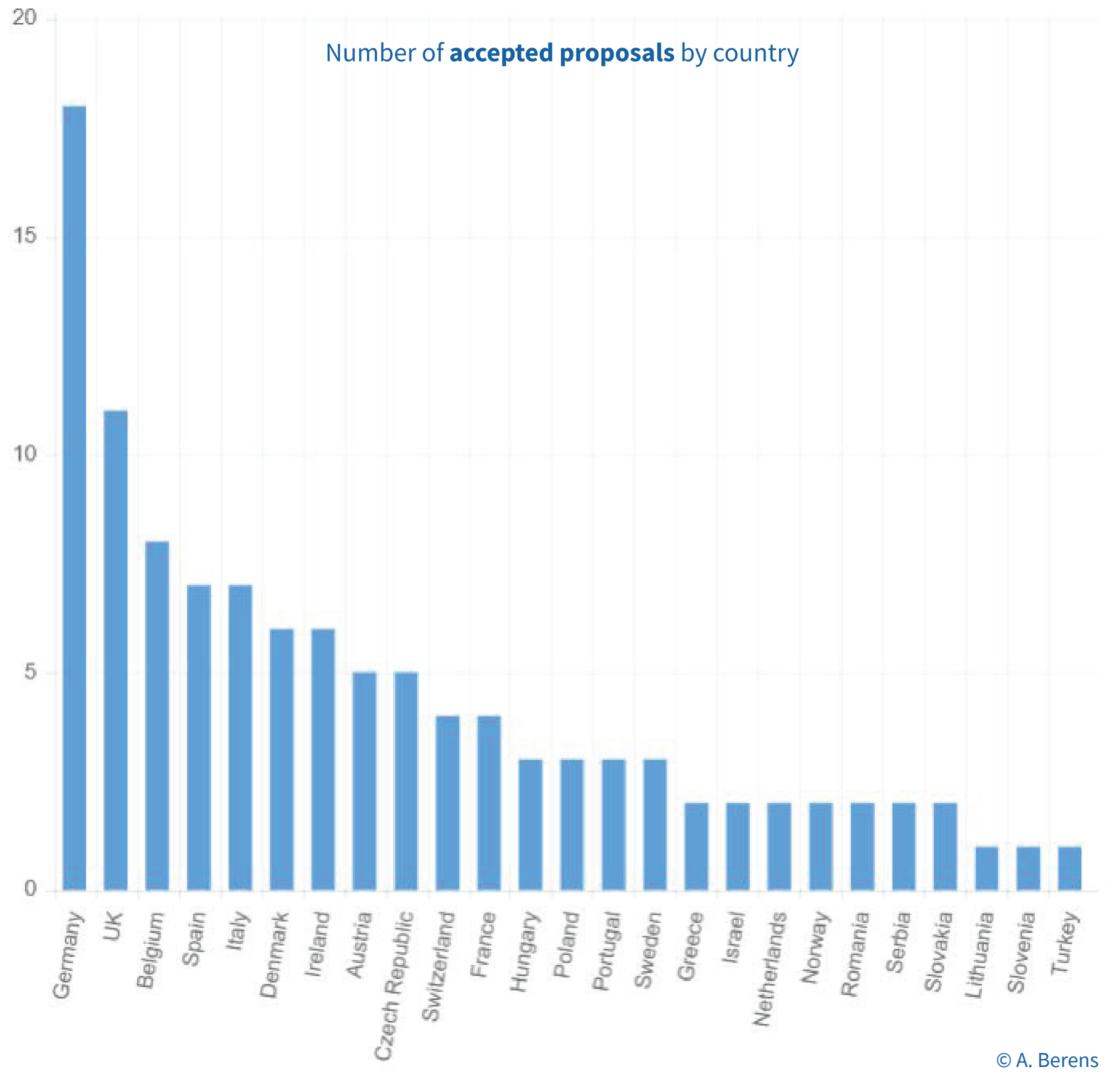
COVID-19 has caused major delays to the transnational access program due to travel bans and lab shutdowns (see front page of newsletter). Some partners still have no constant access to their facilities and are still working remotely and/or cannot allow visitors to their labs.

As an EU Horizon2020 project, RADIATE is committed to providing transnational access predominantly to researchers working in EU countries. Of the 110 accepted proposals, 100 were submitted by researchers in the EU. 42 proposals were submitted by female researchers as the main proposer and 68 by male researchers.

Proposals have been **submitted** by scientists from 34 countries:

Austria, Australia, Belgium, Brazil, Canada, Czech Republic, Denmark, Egypt, France, Germany, Greece, Hungary, Ireland, Iran, Israel, Italy, Japan, Lithuania, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Singapore, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Turkey, Uganda, and the United Kingdom.

Use the QR code to go directly to RADIATE's Transnational Access website



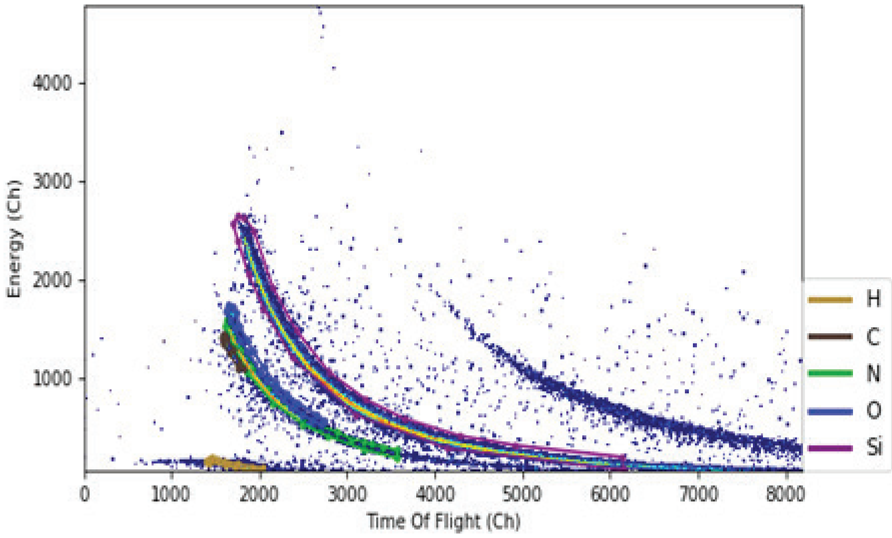
© A. Berens

Multi-elemental/isotopic analysis (especially H + D) of polymer and metallic samples using ToF-ERDA (20001994-ST)

by Jonathan England, SIBC, Surrey

In January, Jonathan England, Vladimir Palitsin and Richard Smith from Surrey Ion Beam Centre (SIBC) visited Jyvaskyla University, Finland under a RADIATE Trans National Access grant to witness some elastic recoil detection (ERD) measurements. Hosted by Timo Sajavaara, Mikko Laitinen and Jaakko Julin, the group measured a range of samples using a time of flight (ToF) ERD system developed at Jyvasklya.

ERD is particularly valuable in measuring depth profiles of light mass species that are not easily measured by any other method. It uses a primary ion beam to knock light atoms out of a sample surface whose energies are measured by a particle detector; the spectrum of recoiled particle energies can reveal the elemental depth profiles. In the "traditional" stopping foil method currently used at SIBC, the intense beam of scattered primary ions is blocked from hitting the solid state detector as it would overwhelm the recoil atom signal and quickly damage the detector. The foil thickness must be carefully chosen so that only the recoils can travel through the foil. The foil degrades the depth resolution and produces spectra from which the different isotope signals can be difficult to separate. The ToF method has the great advantage of measuring all recoil secondaries and scattered primaries. A particle's velocity is measured by its time of flight into a gas filled detector where its energy is measured. "Banana" (energy vs velocity) plots of all events easily allows ERD signals from recoiled elements and isotopes to be separated and even the primary ions' RBS spectrum to be simultaneously collected.



A "banana plot" of a hydrogen implanted silicon nitride sample. The recoil signals from the different elements in the sample are clearly resolved and can be analysed to give the elemental concentrations and depth profiles. © J. England

The group successfully measured hydrogen and deuterium in a large number of polymer samples, hydrogen in implanted Si and silicon nitride H standards and H in surface layers of Mo based samples for use in the energy sector. The effect on the achievable isotopic resolution of changing the primary beam conditions in a range spanning Cl/6MeV to I/15MeV was investigated. Based on this experience, SIBC has now ordered a TOF-ERD system from Jyvaskyla to upgrade its current ERD capabilities.

Sign up for the RADIATE newsletter here:
https://www.ionbeamcenters.eu/radiate/radiate-newsletter/

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