TWINFUSYON NEWSLETTER III

August 2017

Dear TWINFUSYON friends,

We are already halfway through the project and we would like to share with you our results during this time. Two schools and a workshop, as well as secondments and other cross-fertilisation activities helped us to improve the research capacity of the young institute CEITEC MU as well as advance research in the field of optronic biosensing.

We would also like to offer you several articles prepared by the TWINFUSYON project members on topics important for us, such as biofunctionalisation and measurements in biosensing, as well as place of women in science.

You can also find information about our plans for upcoming events during Autumn semester 2017 here.

TWINFUSYON team

CONTENT

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 692034. This Newsletter reflects only the author's view and the Research Executive Agency is not responsible for any use that may be made of the information it contains.

HALFWAY THROUGH THE PROJECT

During the first half of the project, the TWINFUSYON team, with their specific expertise in different fields, has contributed substantially to the performance of CEITEC mainly following three directions: (i) by direct transfer of knowledge via guest lectures at CEITEC, (ii) by performing joint research activities and trainings with CEITEC researchers in various laboratories, and (iii) by disseminating information about CEITEC and TWINFUSYON actions via various channels at international level. A number of results were already achieved, resulting in joint publications in international peer-reviewed scientific journals and presentation at international conferences.

TWINFUSYON has organised the School and Workshop on „New Frontiers in 2D materials: Approaches & Applications" and the school „Advanced School on Modelling and Statistic for Bioprocesses", which contributed to CEITEC research capacity, and also attracted students and researchers from various institutions across Europe. Engagements of general public has occurred through TWINFUSYON stands at the „Research Nights" events in various countries.

The research profile of CEITEC has been visibly raised by the activities of the consortium; within Czech Republic, this is best documented by the recognition reached at the prominent research institutions in the country (primarily Institute of Physics ASCR, and Faculty of mathematics and physics CU, Prague). The same is true for a number of excellent research institutions abroad that have been visited by researchers from CEITEC, and also by foreign scientists visiting CEITEC.

Furthermore, the collaborative links created in the scope of the TWINUSYON project have expanded the research profile of CEITEC towards novel research directions in current condensed matter physics, notably in 3D Dirac semimetals in cooperation with LNCMI-CNRS, in graphene and related materials and their biofunctionalisation in cooperation with CNR-NANOTEC and in plasmonics and new model analysis in cooperation with JKU.

Advancing CEITEC to an internationally acknowledged excellent research institution will consequently have a positive impact on overall research and innovation potential of the South Moravian region in the Czech Republic, which aims to become one of the high-quality innovation centres in Europe.

The social relevance of TWINFUSYON lies also in the establishment of a consolidated scientific and technical platform in the area of multifunctional nanomaterials for biosensing that can be exploited in various fields of food safety, security, environmental monitoring and life science, for a healthier society and for generating interest of companies with activities in the field of biosensing with consequent open opportunities of jobs for the trained young scientists.

WHAT'S UP IN BIOSENSING

Two Kinds of Masseless Carriers in Cadmium Arsenide

by Ana Akrap, University of Geneva and Milan Orlita, CNRS LNCMI, Grenoble

Instead of obeying Schrödinger equation, in some materials the low-energy excitations behave as massless Dirac particles. Three-dimensional (3D) Dirac semimetals represent one such class of materials, constitutuing the closest archetype of truly relativistic massless systems. Cadmium arsenide, Cd3As2, is the prime candidate for a 3D Dirac material that is stable at ambient conditions. Two stable Dirac cones are predicted to exist around the G point of the Brillouin zone. However, a conundrum appeared regarding the scale at which the Dirac cones appear, unresolved despite a large number of experiments. Different spectroscopies claimed different outcomes; most prominently ARPES indicated a large energy spread of Dirac cones (several hundred meV) while STM/STS measurements implied that a scale at least one order of magnitude smaller.

Our magneto-optical experiments lift the controversy of the electronic bands of cadmium arsenide. We show that two kinds of massless carriers can exist in this material, Dirac and Kane. In other words, the band structure includes not only one, but two types of conical features, see Fig. 1. We show that the large cone observed by ARPES is not a Dirac cone, but results in fact from the standard Kane model applied to a semiconductor with a nearly vanishing band gap. Our experiments explore the magneto-optical response of single crystalline cadmium arsenide, with two different orientations and two different positions of Fermi level. Applying a strong magnetic field, the system driven into the quatum limit. In such a case, electrons occupy only the lowest electronic Landau level and only the fundamental cyclotron resonance mode is active. Its specific character allows us to eliminate with certainty the Dirac carrier response. Moreover, no significant anisotropy is observed in the observed conical feature. These results can be quantitatively explained within the standard Kane model developed in the past for description of ordinary zinc-blende semiconductors, leading us to conclude the presence of massless Kane electrons in this material. While the symmetry-protected Dirac electrons may still be present as well, our experiments limit their range to a fairly small energy range (several tens of meV).

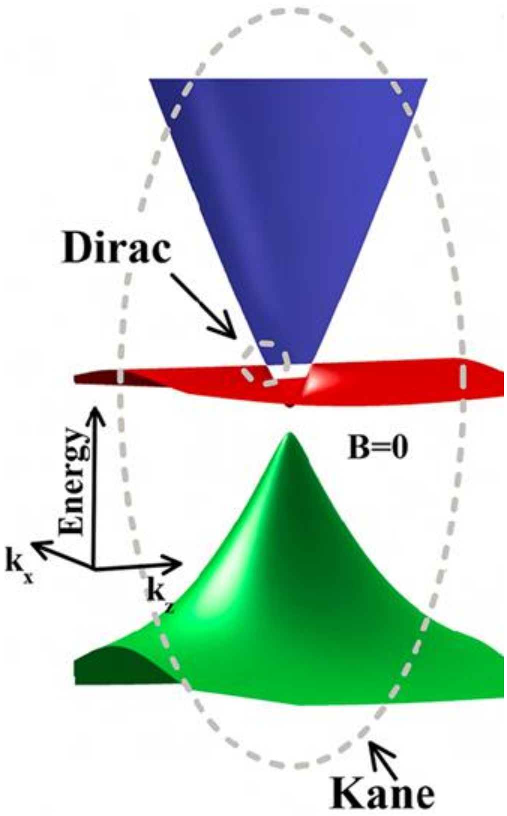


***Figure 1**: The schematic view of electronic bands in Cd_3As_2 with two types of conical features.*

Related publication:

Magneto-optical signature of massless Kane electrons in Cd3As2

A. Akrap, M. Hakl, S. Tchoumakov, I. Crassee, J. Kuba, M.O. Goerbig, C.C. Homes, O. Caha, J. Novak, F. Teppe, W. Desrat, S. Koohpayeh, L. Wu, N.P. Armitage, A. Nateprov, E. Arushanov, Q.D. Gibson, R.J. Cava, D. van der Marel, B.A. Piot, C. Faugeras, G. Martinez, M. Potemski, M. Orlita, Physical Review Letters 117, 136401 (2016).

Best-Practices for Biofunctionalisation of Innovative Materials

by Maria Losurdo, CNR Nanotec

The major challenge in developing biosensors is to provide a high specificity to target biomolecules through biofunctionalised probes of materials and nanoparticles that have a strong affinity for the target biomolecule while suppressing non-specific interactions.

Among the plethora of materials and nanostructures that are currently applied or investigated for bioapplications, functionalised graphene, graphene-based nanocomposites, novel 2D-materials as well as plasmonic nanoparticles are gaining increasing attention in biomedical applications because of their unique and highly enriched physical and chemical properties. Following graphene, an atlas of other 2D materials have emerged recently, and among the novel 2D-materials, semiconducting 2D TMDs transition metal dicalchogenides (MoS_2, WS_2, $MoSe_2$, and WSe_2) are gaining attention from scientific community.

In addition, inorganic nanoparticles, such as magnetic and plasmonic nanoparticles, can be grown on the surface of graphene and related 2D materials, enabling further expansion of functional 2D-based nanocomposites with interesting optical and magnetic properties that can be useful for multimodal technologies for biosensing, imaging and imaging-guided cancer therapeutic applications. Among the various nanoparticles, of particular interest are plasmonic gold nanoparticles (Au NPs) that offer a suitable platform for multifunctionalisation with a wide range of organic or biological ligands for the selective binding and detection of small molecules and biological targets.

Despite the explosion of interest in the development of 2D- and nanoparticle-based systems for bio-applications, the descriptions of procedures for biofunctionalisation of those materials vary from article to article. In this labyrinth of biofunctionalisation, various methods, practices, and procedures are given with the emphasis of papers being on the final biosensor performance.

Indeed, an important contributing factor toward that goal is making it clear just how biofunctionalisation of materials, transducers, or devices is carried out, highlighting the fundamental importance of ensuring that research is reliable, robust, and reproducible. Providing reliable information on the biofunctionalisation permits other researchers to both verify the validity of the research and repeat experiments to ensure that the results obtained are reproducible. Therefore, best-practices and protocols about how bioconjugates are made are highly needed.

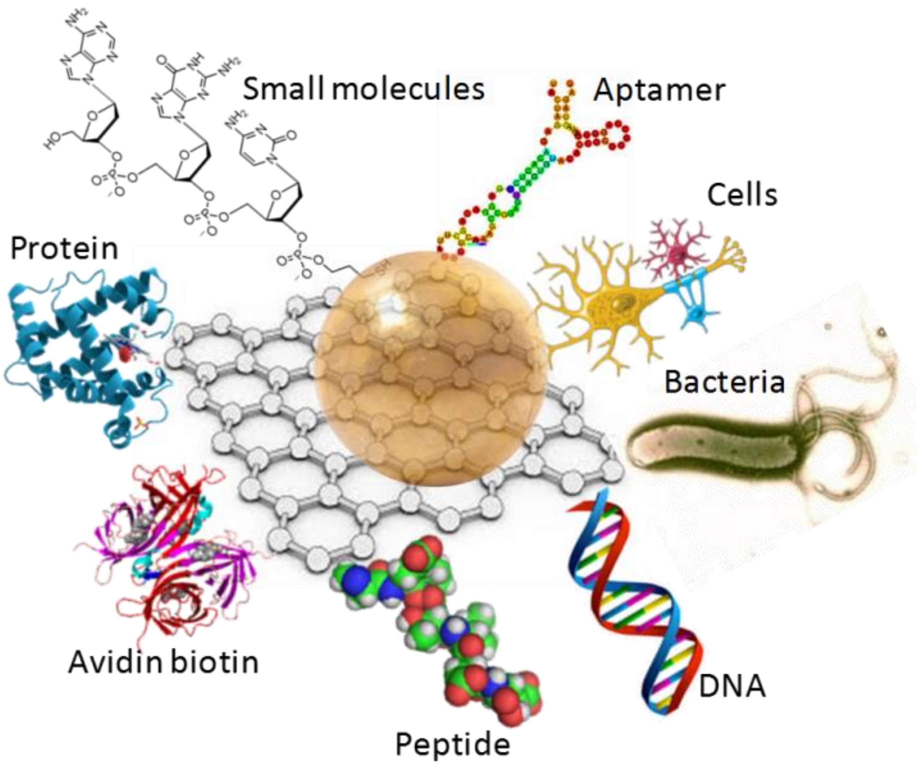


***Figure 2**: Plasmonic gold nanoparticle-Graphene conjugate functionalised with avidin–biotin, peptides, NAs, proteins, aptamers, small molecules, bacteria, and cells through physical adsorption or chemical conjugation.*

In order to grasp the complexity and variety of the practices in biofunctionalising surfaces, TWINFUSYON has been analyzing key obstacles still present to make plasmonic coupling of gold nanostructures on CVD graphene, MoS_2, WS_2 and their biofunctionalisation from small organic molecules to biomolecules such as proteins, DNA and enzymes nanoparticles-graphene bioconjugates for various biosensing applications, and a summary of this analysis has been published as booklet available on the TWINFUSYON website.

Firstly, consistency in the synthesis of these materials has not been completely achieved yet. There is currently no standard synthesis technique that can produce reproducible graphenes, functionalised TMDCs, and gold nanoparticles with well controlled dispersity, material properties, and dimensions, as well as uniformity in functionalisation across the material surface.

No universal biofunctionalisation strategy exists to cover the wide variety of surfaces and materials as well as of biomolecules available for this purpose. A functionalisation protocol that works well for one type of material and nanoparticle does not work well for another, since they could be very different in terms of surface termination, defects, charge, surface area, stability, and type of reactive groups, etc. Furthermore, biomolecules vary significantly in terms of size, chemical composition, 3D complexity, and location of its biological active site.

In absence of standard functionalisation protocols, each particular case material/biomolecule demands optimisation. Therefore, the development of “smart” multifunctionalisation strategies is vital focus and there exists both great promise as well as additional work to be carried out on the functionalisation of graphenes and TMDCs to make it a truly viable nanomaterial for biomedical applications.

Also, in most cases, the interaction between DNA and those materials has not been identified clearly, which should be addressed properly, so that the hybrid materials can be specifically selected for the appropriate application depending on the nature of interactions. Hence, considerable attention has to be paid to understand the reaction mechanism or chemistry of these hybrid materials.

The coming activities of TWINFUSYON will address what functionalisation can facilitate: can we produce large quantities of monolayers of graphenes and TMDs through functionalisation? Can we tune their electronic properties through functionalisation? Using biofunctionalisation, can we couple graphenes, TMDs and AuNps with other materials to develop multifunctional devices at the industrial level? Ultimately, after addressing these questions, we expect the exploitation of the biofunctionalisation of these bioconjugated will contribute to the widespread their application in biophotonics, drug delivery, and medical devices.

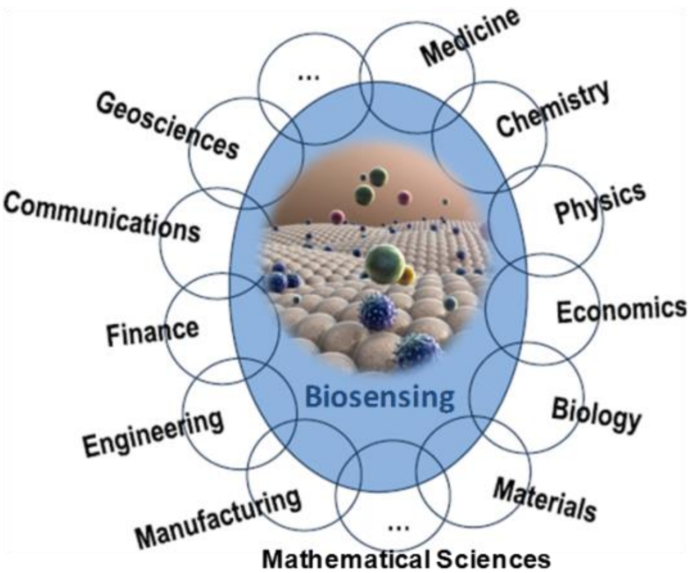
Find the full booklet here.

Analysis of needs and common problems with agreed solutions on significant parameter measurements for biosensing

by Kurt Hingerl, Johannes Kepler University, Linz

As in all technical and natural sciences, metrics and measurements are utmost important for the development of the scientific discipline. The same is true also for biology, and biologists aim at measuring, down to parts per billion, or parts per trillion measure with known sensoring techniques the occurrence of the following biological elements, the number, as well as their distinctive features:

- the concentration of chemicals chemicals (to judge poisoning);
- the concentration of trace elements (to judge well being);
- the concentration of enzymes (to understand their effects);
- the concentration and structure of antibodies (to understand signaling pathways in the body);
- the structure the nucleic acids (to understand genetic transcription);
- the (relative) number of (cancer, stem, tissue) cells (to develop techniques to reduce or enhance them).



We deliberately present the list above in a bullet form, because the first part of the list always expresses the “natural science and engineering approach”, and the second part (within brackets) the intention of the biologist researcher.

All measurements involve to a rather large amount principles of physics, chemistry, signal processing, nano- or at least microtechnology, statistical techniques and stochastic modelling!

In real life at room temperature (in situ, in vivo, in the body) one governing principle (minimum of Gibbs energy) tells us that no chemical reaction proceeds with 100% conversion rate, and the smaller the energy difference between the reactants and the product is, Boltzmann’ distribution tell us that both (reactants and product) are always present. Furthermore, kinetic effects can and will play a major role; reaction kinetics can be speeded up by catalysts- (or enzymes), and in autocatalytic processes the speed up is even nonlinear.

Therefore, the challenge are:

1. *multidisciplinary*: Understanding bio responses – and their variabilities – to stimulation (electrical, photonic, mechanical, chemical, thermal, etc.);
2. *multidisciplinary*: Understanding biomolecule/cell-electron/photon interfaces;

3. *mainly stochastical*: Ability to collect and analyze essential data on the state of biomolecules and cells (chemical, physical, structural, functional);
4. *mainly chemical and physical*: Ability to monitor, in real-time, the bioevents, which requires comprehension of interaction between molecules;
5. *mainly engineering*: Ability to detect, identify, and quantify thousands of different biomarkers simultaneously.

So biosensing, for each specific problem, should rely at least on 4-5 disciplines in advance to assess:

- the accuracy,
- the precision,
- the repeatability,
- the systematic errors,
- the cross correlation in the case of more parameters,
- the confidence interval(s) of the parameters determined,
- given the number of measurements taken,

Biologists and physicians to trust the outcome of the measurement and the displayed value on the measurement device. Turning the problem around and letting the physicist, the chemist, the electrical engineer or the mathematician do the measurement, does not help either, because these disciplines have not developed an "heuristic feeling" on the correlations between a measured value and the biological effects of the surrounding or the exposure of the living species to the "ambient".

In order to test rather many biological / living species, researchers also will go (and have gone) the next (engineering) steps towards system integration, using microtechnological structuring techniques and fabricated:

- DNA chips,
- lab-on-a-chip technology,
- microfluidic devices,
- nano-biosensors and nano-technology used in biosensors, etc.

applied in

- medical research settings,
- environmental research settings,
- security and defence tasks,
- food production and processing industry, and
- drug and pharmacy research and production

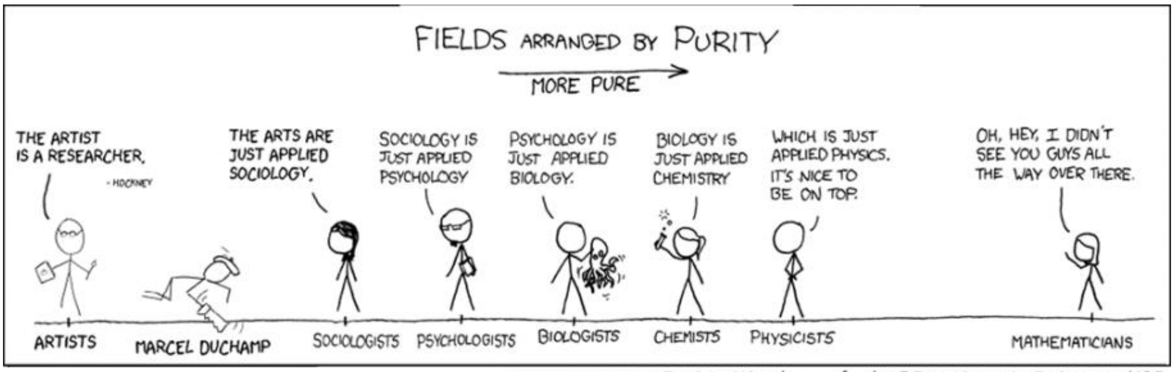
making the path how adhesion / interaction processes, chemical reactions, sensing signals, etc. are presented and their outcome is displayed as a numerical value, and then e.g. traced back to process parameters, even more "in transparent".

During the TWINFUSYON project we realized that the challenges and goals described above cannot be solved on technical scientific levels, but that the major impact arises from organizational grounds. Now the goal is to encourage

1. especially young scientists from biology/ medicine not to hesitate on presenting their experimental and theoretical studies in scientific journals in as much detail as possible, despite each study in the field is, due to its interdisciplinarity nature, always seen from the perspective of the authors – thus, imperfect;
2. to provide open scientific environments and places, where interdisciplinary teams can work together face to face and mutually learn during performing their common research work;
3. offer scientific questions (two very positive case studies are presented in the next section) where the need of common research work is becoming very clear.

A Prerequisite for Success: Interdisciplinary Teams and Environments!

The research on a new, ground breaking biosensing principle, the development of a new biosensor, is only feasible in open environments, where communication is easily and the representatives of each discipline, besides being creative, listen to each other. Academic and Industrial environments shall be set up like this, and there should be a platform, where an open flow of ideas (precompetitive) is allowed, possible, and even fostered. TWINFUSYON provides such a platform and will go on to provide one. Biologists and medical doctors shall not study chemistry, physics, optics, EE, or mathematics but make biology students talk to representatives of these disciplines by creating these open environments. An example which has been worked out and can really be recommended for all interdisciplinary approaches is the "***epistemologized physics class***".



Source: *http://www.tomforth.co.uk*

WOMEN IN/OUT OF THE STEM[1] FIELDS/FOCUS

1. "STEM" is the current shorthand for "science, technology, engineering and mathematics"

by Maria Losurdo, Director of Research at CNR-Nanotec, Bari

At the Solvay Conference on Physics in 1927, the only woman in attendance was Marie Curie (bottom row, third from left): that was the face of Science almost a century ago... and it is still difficult to change that face!

What a Famous Picture!

Following are the recipients of the 2016 National Awards administered by the American Chemical Society. Once again, gender inequity and lack of diversity are glaringly apparent: "95% of awardees are men"! Time to play "spot the women"!

Source: http://www.stemwomen.net/2016/01/

The Nobel Prize is by many regarded as the most prestigious award given for intellectual achievement in the world, yet between 1901 and 2014 only 3% of all Nobel awardees in Medicine, Physics or Chemistry have been women. Between 2011 and 2015, only 12 % of patent applications in the EU were filed by women compared to 88 % by men. All that quantifies the magnitude of gender-based disparities and tracks their progress over time. The warning cry sounds loud and clear throughout the science community and well beyond to make the STEM face evolving! See the Global Gender Gap report 2016 published by the World Economic Forum for information for 2016.

It is enough claimed worldwide that talent and technology together will determine how the Fourth Industrial Revolution can be harnessed to deliver sustainable economic growth and innumerable benefits to society. Yet half of the world's talent, including women and diversity in general, is not integrated. Worldwide proactive initiatives, meetings organizations are blooming to provide evidences and reflections and a temporal perspective on how barriers to women in STEM are faced and are changing, e.g.:

- The Association for Women in Science (AWIS);
- The European Platform of Women Scientists, The Voice of Women Scientists in EU Research Policy;
- The European gender portal;
- Women in Science key theme in Horizon magazine.

Periodical report "She Figures" by the European Commission investigates the level of progress made towards gender equality in research & innovation (R&I) in Europe, and it is the main source of pan-European, comparable statistics on the representation of women and men amongst PhD graduates, researchers and academic decision-makers.

In an attempt to make science a more attractive career option for women, policymakers are trying first to understand and change those factors that have historically kept women out of the field. Differences in the education and socialization of women, the lack of female scientist role models, women scientists receiving lower salaries than their male counterparts, women scientists obtaining fewer tenured positions at universities than men scientists, and the difficulty for some women of balancing a career in science and having a family are some of the reasons why women make up only 15 percent of all scientists today. And though there has been some progress in addressing these issues through legislation and through special pro-

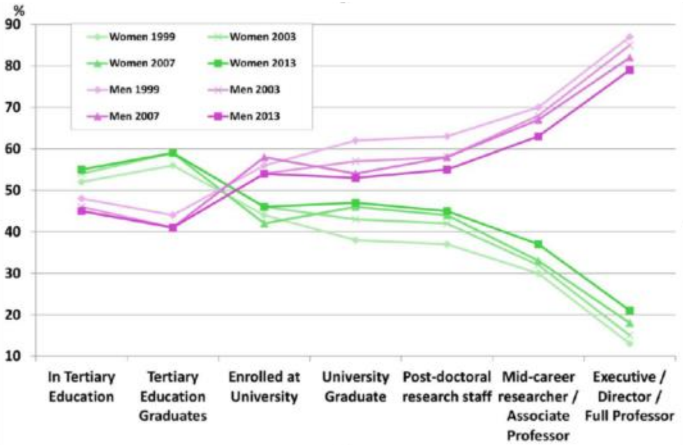


Figure 3. Proportion of women and men in a typical academic career, students and academic staff, EU-28, 1999-2003-2007-2013. Source: Women in Science database, DG Research and Innovation and Eurostat – Education Statistics and http://ec.europa.eu/euraxess

grams developed by federal funding agencies, foundations, universities, and industry, such as grants for visiting professorships and career advancement and prizes, the struggle to get more women in science still has a way to go.

In terms of career advancement, in 2013, women made up only 21% of the top-level researchers, showing a slow progress compared to 2007 (18%). At the lower levels the gaps between men and women are progressively smaller and smaller. This pattern evolves to a point where the gender distribution even changes it sign: more women than men among students and graduates in Bachelors or equivalent educational levels. This kind of effect is well-known as the "gender scissors diagram" and highlights the fact that barriers increase going up in career.

We all face those barriers but our careers as senior scientists also speak of persistence, resilience and a deep belief in our capacity to pursue a scientific career, let's also speak of gratitude to previous generations of women who forged a path to us in Science. We, in turn, are grateful to all those who independently of gender continue to widen and smooth this path providing younger women with inspiration and role models.

Today, I would say:

- to the policy makers: pay attention not to fill the gender gap by force majeures, which can create a new prejudice: "we get a career only because we are women"!
- to all young scientists: follow your passion and the direction that most interests you. Value your exceptions, be open to alternative explanations and do not hunt by expectation. The road will not be smooth, but there will be magic in it.

To conclude: 'Yes, we science!'

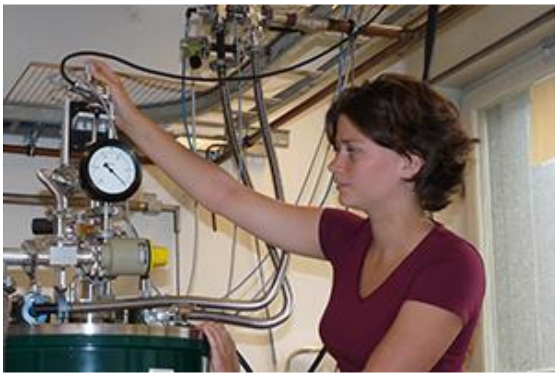
Perspective by a woman Post Doc in physics

by Iris Crassee, Post Doc mobility Fellow
SNF, CNRS LNCMI, Grenoble

During the time of my PhD, at the University of Geneva I received numerous invitations to join special events and programs targeting young women to promote their chances of a career in science. Yet, I did not feel overly concerned being a woman, even though for a few years I was the only woman in the group, in a man-dominated environment, so I did not participate in these events. The day of my defense came and I remember hoping that the little girl I was expecting would not only attend my defense that day, but perhaps one day I would in return attend hers.

I left the group and took 4 months to settle in my new role as a mother before starting a new position as a postdoc in a different physics department. It was then that I realized that these workshops and meetings could have taught me the odd thing here and there about combining an academic career, motherhood and a demanding prof. Frankly, I had difficulty juggling everything that I expected from myself, and disappointment in myself was the dominant feeling. Luckily, I got a proposal granted with which I got an inter-group position for a collaboration between the University of Geneva and the University of Bern and all the experimental work moved to Bern. We simply had so much fun in that lab; I trust every scientist knows that feeling. At the same time, I finally joined the woman-mentoring program at the University of Geneva. I got a mentor assigned who was both at the CNRS (French research) and a Prof at the University of Geneva. We spoke about career advancement, grants, projects, mobility, discrimination, kids, husbands, bosses and colleagues, either in a group or privately. Via the Bern position, I also got the chance to participate in a 'negotiation workshop', where I was astonished to learn that the techniques that I witnessed during interactions with some very senior people are actually 'accepted' negotiation techniques, or at least, they are on the list of recognized tactics. There we also learned – although of course, we unwittingly knew already – how little boys fight and are best friends and time reversal symmetry is conserved, but little girls are best friends and then fight and unfortunately, time reversal symmetry is broken. Thanks to that workshop, I was able to observe much better what was happening in meetings and discussions and thanks to my mentor, I took the step to apply for a 2 years mobility grant.

After I had my second child, I started, with the mobility grant, a post doc in the fantastic team of the high magnetic field lab in Grenoble where I am now. However, before arriving in Grenoble, I more than once doubted my choice to stay in academia; due to my experience of recent years too often linked to equality related issues, due to the lack of female non-workaholic role models and due to the many times I had to defend myself and the happiness of my kids as a working mother. At the same time, I learned a great deal from every small or large hurdle, I learned what is important to me and that satisfaction should be prioritized. So one day I want to be that independent leading scientist and on the way I will keep working for equality which is so important for our young boys and girls. Fortunately, I have no say in whether my daughter will defend a thesis, either way my dominant feeling will be the one of proudness.



My experience of going to a technical college and studying technical physics

by Carola Emminger, PhD Student, Johannes Kepler University, Linz

Starting at the age of fifteen, I have studied and worked in male-dominated environments for more than one decade. I went to an engineering-focused secondary school where I was one of two girls in a class for construction engineering and after that I started studying technical physics.

As one of only a few girls in a technical college one cannot avoid attracting the attention of teachers and other scholars. This can be either an advantage or a disadvantage. However, from discussions with my female colleagues I can tell that this is not what women working in technology want. We want to be treated equally to our male colleagues without any benefits or drawbacks.

I believe, as long as the percentage of female students is that low the situation will not change a lot. In branches like construction engineering, where one can choose between structural and civil engineering, the number of female scholars is much higher than in branches like electrical engineering or mechatronics, where girls are real exceptions. If one wants to increase that number, I do not think that motivating girls at the age of thirteen or fourteen, when they have to decide if they want to visit a technical college or not, helps a lot. It would rather be necessary to draw their interest and to support their talents much earlier. This also requires the contribution of parents and society to think outside of existing role models.

It is not possible to draw a general picture of how it is to study or work as a woman in a male-dominated environment since situations vary a lot from person to person. For me, all in all it was a good experience to go to a technical college, although there were also some difficult situations I had to deal with. Over time I got used to the conversational tone of boys at that age and I learned how to deal with the one or other sexist comment from male colleagues or sometimes even from teachers.

As for my experience, the situation at university differs a lot from that in school. First, this is because the percentage of women in scientific or technical studies (with some exceptions) is higher. Second, the male colleagues at university are more mature and usually show a lot of respect for their female colleagues. I could not feel any discrimination at university, neither from my colleagues nor from teachers or professors. Nevertheless, a woman in science still finds herself in a special position, but maybe more for the outer world than for the colleagues.

I hope that there will be good or even better chances for women in science and technology in the future. In my opinion, we should not only try to motivate women to start studying but also to keep them in science after graduation. Therefore, it is necessary to create a more family friendly environments and support women to retain and to continue a career after maternity leave, for example. Thanks to many women who have been and still are successful in science, I believe the situation nowadays is better than a few decades ago.

On the way to open, international, fair and friendly working environment

by Daria Kucharova, Eliska Handlirova, CEITEC MU, Czech Republic

In its Strategy 2020, CEITEC MU formulates a vision to become an institute with open, international, fair and friendly working environment. A strong part of this vision is connected with having modern HR policy incorporating principles of gender equality and support of diversity.

CEITEC at Masaryk University (CEITEC MU) is actively involved in promoting gender equality in research. Together with its partners in EU-Life consortium, it took part in Horizon 2020 call for promoting gender equality in research and innovation (GERI) in 2014. As a result, CEITEC MU is one of the partners in the *Leading innovative measures to reach gender balance in research activities* (LIBRA) project (started in October 2015) which aims to “increase the representation of women in science and their participation at management positions”. Achieving gender equality in science and research is a complex issue that requires a multidisciplinary and integrated approach. It is necessary to focus on (sub)conscious prejudices based on gender, the work environment, management and decision-making positions, stereotypes relating to male and female scientists and science in general, as well as scientific content, research priorities, etc.

For the CEITEC MU, participation in the LIBRA project represents an excellent opportunity to establish and implement modern HR development policies. CEITEC MUis able to become acquainted with good practice examples in co-operation with twelve other leading institutions in the field of life sciences and is to update practices such as recruitment procedures, work organisation processes or support of young scientists at the beginning of their professional careers.

As a part of the LIBRA project, CEITEC MU is implementing a Gender Equality Plan and carrying out key activities in four pre-defined areas: 1. recruitment, 2. career development, 3. work -life balance and 4. sex/gender dimension in research.

As a start point to be able to evaluate impact of the Gender Equality Plan implementation, CEITEC MU started regular and proper monitoring of gender segregated data (including all stages of recruitment process). Since November 2016, when the Gender Equality Plan has been approved by the Management, it is too short period to see any impact on data (e.g. % of female group leaders remains on 26 %, % of female core facility heads increased from 12,5 % to 20 % as one new (female) core facility head has been hired in reported period Feb 2016 – Jun 2017) – however the launch of gender segregated monitoring enables regular reporting of "leaky pipeline" phenomena at CEITEC MU and brings an important factor of taking aspect of gender diversity into account.

So far, among the main perceived outcomes of the Gender Equality Plan implementation, we can identify increased awareness of the involved stakeholders that is closely related to change in internal actors' attitudes – the gender equality issue is perceived as a standard issue to be solved by the management and to be pushed also by employees by bottom-up initiatives. Among more tangible outcomes, CEITEC MU has for example issued several internal norms mainly in HR agenda (find out more here), installed nappy changing tables and organized an international workshop to promote awareness on work-life balance in research and training on usage of gender sensitive language that was closely linked to an analysis of CEITEC MU web presentation from the perspective of gender.

TWINFUSYON NEWS

Winter School and Workshop New Frontiers in 2D materials: Approaches & Applications

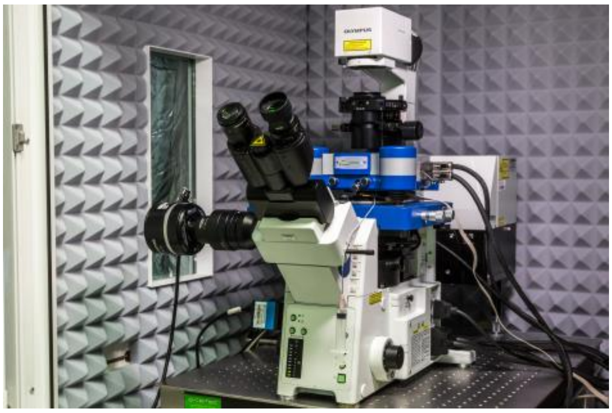
The Winter School and Workshop New Frontiers in 2D materials: Approaches & Applications was organized within Work Package 3 by TWINFUSYON partners from 15th to 20th January 2017. The winter school and workshop brought together young researchers - master/doctoral students as well as postdocs – involved in the developing field of novel 2D materials. Almost 90 participants (including 16 invited speakers) coming mostly from European countries (France, UK, Germany, Czech Republic, Poland…), but also outside Europe (Brazil, USA) took part in the event.

The school and workshop covered theoretical, experimental but also technological aspects of current research on novel 2D materials (graphene, silicene, transition-metal dichalcogenides, topological insulators & semiconductor nanostructures) and other emerging systems (multiferroics, materials for spintronics, semiconductor quantum dots and quantum fluids in polariton structures). The talks by selected renowned invited speakers introduced the participants to the specific areas of current research in this fast expanding field and provided an overview of recent progress. At the

same time, participants could present their own research results during a dedicated poster session. All information on the school and workshop including the programme and list of posters presented by participants is available for school participants on the event website.

TWINFUSYON secondment

CEITEC MU researcher Jakub Rozboril visited CNR from February 27th to March 3rd 2017 , as part of his training. He practiced in methods of graphene preparation, the CVD deposition of graphene in particular, and preparing samples for other scientists at CEITEC (e.g. Jiri Novak and Filip Munz) who will be using those samples to practice and investigate at CEITEC TERS effects of graphene, testing the TERS equipment of CEITEC.



UPCOMING EVENTS

FROM Structures to Optical functions: LAYERED Materials serving biosensing

WHEN: 21—25 October, 2017

WHERE: CEITEC, Brno, the Czech Republic

TOPIC: The school will focus on fundamentals of optical response of bulk materials and layered systems.
Introductory lectures will be devoted to the optical properties from THz range to ultraviolet; information obtainable from the grazing-incidence reflectivity of X-rays will also be discussed.
Advanced lectures will cover important aspects of the optical spectroscopy of layered structures exhibiting plasmon resonances, exploitable in biosensing. A special lecture on traceable metrologic procedures of thin-film parameter determination will be included. Experimental procedures using transmittance, reflection and ellipsometry will be covered.

SPEAKERS: Kurt Hingerl (JKU), Maria Losurdo (CNR-Nanotec), Milan Orlita (CNRS LNCMI), Tom Tiwald (J.A. Woollam Co.), Josef Humlicek, Ondrej Caha, Jiri Chaloupka, Vaclav Holy, Petr Klenovsky, Jiri Novak, Jakub Rozboril (CEITEC MU)

More information will be available in the school website.

EPIOTICS-15 International School of Solid State Physics (co-organised)

WHEN: 13—19 July 2018

WHERE: CNR, Rome, Italy

TOPIC: The school/workshop will bring together researchers from universities and research institutes who work in the fields of (semiconductor) surface science, epitaxial growth, materials deposition and optical diagnostics relevant to (semiconductor) materials and structures of interest for present and anticipated (spin) electronic devices. The school is aimed at assessing the capabilities of state-of-the-art optical techniques in elucidating the fundamental electronic and structural properties of semiconductor and metal surfaces, interfaces, thin layers, and layer structures, and assessing the usefulness of these techniques for optimization of high quality multilayer samples through feedback control during materials growth and processing. Materials of particular interest are silicene, Collective Excitations in Advanced Nanostructures semiconductor-metal interfaces, semiconductor and magnetic multilayers and III-V compound semiconductors.

More information will be available in the Upcoming events.

PROJECT DISSEMINATION

TWINFUSYON has also been actively present, disseminating its activities and networking at the International multi-track event **SELECTBIO Lab-on-a-Chip & Microfluidics 2017** that featured three tracks:

- Biosensors, Microfluidics and Lab-on-a-Chip Technologies,
- Point-of-Care Diagnostics, and
- Organ-on-a-Chip Europe.

The conference addressed a variety of topics relevant to development of innovative biosensors and the TWINFUSYON contribution “Sinergy of graphene with plasmonic nanoparticles for a novel class of label-free biosensors” got of visitors coming to see and experience the innovative concepts of label-free biosensing developed by TWINFUSYON.

Among the many activities, STRATEC booth and in particular, Dr Iris Bergmair, member of TWINFUSYON Advisory Board, hosted TWINFUSYON demonstrators and leaflets. She was disseminating within the industrial community in biosensors the benefit and the novelty of the TWINFUSYON project.

TWINFUSYON partners have also been communicating to attendance presenting the rich educational programme of schools and workshops and diagnostic tools and expertise we make available in 2D-mterials and plasmonic systems serving biosensing, which all young researchers can benefit from.

TWINFUSYON participants also gave talks and presented posters at various other conferences, for example European Graphene forum, E-MRS Spring Meeting and Exhibit 2017, or APS March Meeting 2017. CEITEC administrative staff also presented TWINFUSYON together with its other TWINNING projects at Information day on TWINNING in April 2017 in Prague.

TWINFUSYON looks forward to meeting you at next event!

INTERESTING PUBLICATIONS

Thermally stable coexistence of liquid and solid phases in gallium nanoparticles.
Maria Losurdo, Alexandra Suvorova, Sergey Rubanov, Kurt Hingerl & April S.
Brown Nature Materials 15, 995–1002 (2016) doi:10.1038/nmat4705

Magneto-optical signature of massless Kane electrons in Cd3As2.
A. Akrap, M. Hakl, S. Tchoumakov, I. Crassee, J. Kuba, M. O. Goerbig, C. C. Homes, O. Caha, J. Novak, F. Teppe, W. Desrat, S. Koohpayeh, Liang Wu, N. P. Armitage, A. Nateprov, E. Arushanov, Q. D. Gibson, R. J. Cava, D. van der Marel, B. A. Piot, C. Faugeras, G. Martinez, M. Potemski, M. Orlita
Phys. Rev. Lett. 117, 136401 (2016) doi:10.1103/PhysRevLett.117.136401

Laser-patterned functionalized CVD-graphene as highly transparent conductive electrodes for polymer solar cells.
Luca La Notte,a Enrica Villari,a Alessandro Lorenzo Palma,a Alberto Sacchetti,b Maria Michela Giangregorio,b Giovanni Bruno,b Aldo Di Carlo,a Giuseppe Valerio Bianco and Andrea Reale.
Nanoscale, 2017, 9, 62-69 doi:10.1039/C6NR06156G

Experimental validation of the partial coherence model in spectroscopic ellipsometry and Mueller matrix polarimetry.
M. Miranda-Medina, E. Garcia-Caurel, A. Peinado, M. Stchakovsky, K. Hingerl, R. Ossikovski.
Applied Surface Science https://doi.org/10.1016/j.apsusc.2016.11.128

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