

***Welcome to the March 2011 Newsletter of the ObservatoryNANO Project***

The ObservatoryNANO project continues to produce regular BRIEFING documents (information on the latest releases can be found on p2 and 3) together with ongoing analysis on EHS, ELSA, and Regulations & Standards.

An exciting development of the last quarter has been the launch of our '*ObservatoryNANO Online Census*', which has been collecting information from companies across Europe involved in nanosciences and nanotechnologies. If you are interested in contributing please go to [www.nano.org.uk/obsnano/](http://www.nano.org.uk/obsnano/)

The collected data, together with ongoing patent and publication analysis, will be the basis of our '*State of Nanotechnology*' report that will be launched at the ObservatoryNANO Workshop on 1st June at EuroNanoForum 2011 in Budapest. More details of the workshop can be found on p6

Expert engagement, along with scientific and economic desk analysis, remains vital to the ObservatoryNANO project activities. There will be a number of expert engagement workshops over the next year; for information on a recent workshop in the Environment sector see p4.

If you would like further information or to become involved in the ObservatoryNANO please contact the project coordinator Eleanor O'Rourke [eleanor.orourke@nano.org.uk](mailto:eleanor.orourke@nano.org.uk)

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### **BRIEFING No 10: Applications of Photocatalysis**

Both the technological and economic importance of photocatalysis has increased considerably over the past decade. Improvements in performance have been strongly correlated to advances in nanotechnology; for example, the introduction of nanoparticulate photocatalysts has tremendously enhanced the catalytic efficiency of specific materials. A variety of applications ranging from anti-fogging, anti-microbial and self-cleaning surfaces, through to water and air purification and solar induced hydrogen production, have been developed and many of these have made their way into commercial products. However, extensive research continues to further optimise this technology and to widen the spectrum of potential applications. Research and application foci include anti-stick or anti-fingerprint coatings, soil repellency, and decomposition of organic matter such as microbes or fat.

For further information please contact Leif Brand [brand@vdi.de](mailto:brand@vdi.de)

### **BRIEFING No 11: Nanosensors for Explosives Detection**

The spread of terrorist events over the globe in the last decade has emphasised the importance of detecting concealed explosives and led to calls for new advanced technologies to protect the public. Because most explosives release little vapour, it is not possible to detect them effectively by methods widely used on other chemicals. Detecting explosives is a very complex and costly task because of a number of factors,



such as the wide variety of compounds that can be used as explosives, the vast number of deployment means, and the lack of inexpensive sensors providing high sensitivity and selectivity simultaneously. High sensitivity and selectivity, combined with the ability to lower the production and deployment costs of sensors, is essential in winning the battle on explosives-based terrorism. Nanotechnology based sensors have strong potential for meeting all the requirements for an effective solution for the trace detection of explosives. This BRIEFING outlines the social and economical relevance of nano-enabled technologies for the detection of explosives in security applications, provides background information on the technology, and highlights further challenges to be addressed.

For further information please contact Sergey Gordeyev

[sergey.gordeyev@nano.org.uk](mailto:sergey.gordeyev@nano.org.uk)

**BRIEFING No 12: Organic Photovoltaics**

The development of clean alternatives to fossil and nuclear energy is vital for the growth of sustainable economies. One of the most attractive alternatives is photovoltaic (PV) conversion, the possibility to harvest solar energy. Among the different technologies already available to directly convert solar light into electricity, organic photovoltaics (OPV) - offer several possibilities such as a low weight and a high compatibility with flexible substrates. The fabrication process itself is potentially very versatile, low cost and compatible with mass production via printing processes. For now, the OPV market is at an early stage of development with the first products being commercialised for niche markets. The low efficiency and short lifetime of OPV hinders its competitiveness against inorganic solar cells. The European position is relatively good in the RTD landscape but also on the industrial side with the presence of several start-ups and large companies (especially chemical companies) focusing on certain segments of the value chain. However, Asian companies hold a strong position in the terms of Intellectual Property Rights (IPR). This BRIEFING will discuss the need for breakthroughs in PV, technology developments in OPV, their potential impacts on the economy, industry and society, and will also look at the challenges these technologies are facing.

For further information please contact Sébastien Berger [sebastien.berger@cea.fr](mailto:sebastien.berger@cea.fr)

**BRIEFING No 13: Nanostructured membranes for water treatment**

Potable water is a precious resource as without it human life is not possible. The increasing world population is a critical issue since it leads to higher water demand, increased wastewater production and increased stress on surface water. This challenge requires innovative solutions for the production of potable water, wastewater treatment and water recycling.

Membranes with nanosized pores have been in use by the water industry for decades and are an established method for the treatment of contaminated water and drinking water production. This BRIEFING outlines the most important application areas of nanostructured membranes (NSM), their economic and social impact, and challenges that remain to be addressed. It further points out open issues regarding the definition of nanostructured materials, which have direct implications for policy making and highlights the difference between nanostructured membranes and membranes incorporating nanoparticles.

For further information please contact Nicole Müller [nicole.mueller@empa.ch](mailto:nicole.mueller@empa.ch)



## Bax & Willems and Spinverse representing ObservatoryNANO at the ImagineNano conference in Bilbao 11th-14th April 2011

Two ObservatoryNANO consortium members will be present at the ImagineNano conference held mid April in Bilbao, Spain. At their stands on the exhibition floor you'll be able to get to know their team members involved in charting nanotechnology 's impact on European business and societal challenges. They'll also be able to explain to you which reports and briefings are due for publication in the upcoming months and of course to take note of your own opinions or insights. The objective of the ImagineNano participation is fundamentally to have dialogue with the nanotechnology community in Europe, so please feel free to drop by their stands!

For further information please contact Laszlo Bax [l.bax@bwcv.es](mailto:l.bax@bwcv.es)

## ObservatoryNANO Environment Workshop

### *"Nanofiltration and nano-enhanced membranes"*

This was the topic of the expert engagement workshop held in Zurich from 17th-19th January 2011 organised by EMPA, ObservatoryNANO partners responsible for the Environment sector. Ten experts from industry and research gathered to discuss the state of the art and future trends in research as well as current and future application areas and remaining challenges of nano-structured membranes and nano-enhanced membranes. The outcomes of the workshop will be published in two briefings. The first briefing (March 2011) addresses nanostructured membranes such as nanofiltration and ultrafiltration membranes. Among others, the question is raised whether these well established membranes should be considered as nanotechnology or not. In the second briefing the focus is on membranes with integrated nanoparticles called nano-enhanced membranes (briefing to be published in May 2011). Members of two other EU-projects (Nanotech, new ED) were present to pass on experiences from their work.

For further information on the ObservatoryNANO's analysis in the Environment sector please contact Nicole Müller [nicole.mueller@empa.ch](mailto:nicole.mueller@empa.ch)

In the first quarter of 2011, the ObservatoryNANO has been monitoring ethical and societal issues of nanotechnology resulting in several publications and participations in a number of events:

The 3<sup>rd</sup> Annual Report on Ethical and Societal Aspects of Nanotechnology – Nanotechnology, ICT, Privacy and Security, will be published by April 2011 on the website <http://www.observatorynano.eu/project/catalogue/4PS/>

The list of nanoethics and ELSA projects on the ObservatoryNano website <http://www.observatorynano.eu/project/document/3402> has been updated regularly. This list discloses current and finished projects in Europe and on an international level that focus on different relevant aspects. In addition to general Nanoethics and ELSA projects, projects are listed that organize communication or dialogue about nanotechnology with stakeholders or the general public. Projects that deal with particular issues such as ICT and Security, International Cooperation and Nanobioethics and Converging Technologies are listed separately. Some major activities related to nanotechnology in general and activities in EU Member and Associated States and at international level are also included.

ObservatoryNano has furthermore updated the list of nanoethics and ELSA experts <http://www.observatorynano.eu/project/document/2918/>. This list is a service to policy makers and others who would like to consult experts in different ethical and societal aspects of nanotechnology. The overview of databases with literature on nanoethics and ELSA issues has also been updated and includes links to some journals that publish articles about nanoethics and ELSA issues regularly: <http://www.observatorynano.eu/project/document/2685/>

Recent nanodialogues and other activities related to ethical and societal aspects have been reported on the Nanoforum website [www.nanoforum.org](http://www.nanoforum.org). In particular, news about the Dutch Societal Dialogue Nanotechnology including the final report to the Government has been reported there in the last few months. Professor Peter Nijkamp, President of the Committee for the Societal Dialogue Nanotechnology offered this report to State Secretary Atsma during the Nanofestival on 27 January: <http://www.nanoforum.org/nf06~modul~showmore~folder~99999~scc~news~scid~4190~.html?action=longview&>

The work on the 4<sup>th</sup> Annual Report on Ethical and Societal Aspects of Nanotechnology – Communicating Nanoethics will start in April 2011. This report will be finalized by March 2012. In addition, Observatory-Nano will publish a series of five interviews with opinion leaders on Communicating Nanoethics. The first interview with Professor Peter Nijkamp, president of the Dutch Committee Societal Dialogue Nanotechnology will be published by April 2011.

On 31 March, Ineke Malsch will attend the ETICA final workshop on Ethics of Emerging ICT at the European Parliament: <http://moriarty.tech.dmu.ac.uk:8080/index.jsp?page=10516>

### ObservatoryNANO Toolkit Presentations

WP4 Partner Alexei Grinbaum of CEA presented the ObservatoryNANO toolkit at a Canadian-Japanese workshop in Tokyo 'Nanotechnology and human future: an intercultural dialogue' on the 14th February 2011. The event looked at nanotechnology and human future from the perspective of three cultures provided by presentations from France, Canada (Quebec) and Japan and round table discussions.

Marc Pavlopoulos, also of CEA, has presented and discussed the main ideas of the Toolkit at a round-table at the Ecole Polytechnique, France (summary available at <http://x-recherche.polytechnique.org/>). He also presented the Toolkit at Fribourg University and at the Institute Adolphe Merklé (Switzerland). The Toolkit met with high interest on both occasions. The approach of the Toolkit, providing tools for reflection and helping the user to make and strengthen their own view, was very much appreciated.

For further information on WP4 activities please contact Ineke Malsch [malschtechnovaluation@xs4all.nl](mailto:malschtechnovaluation@xs4all.nl)



## ObservatoryNANO Workshop

# “Nanotechnology Innovation: Helping to address Europe’s Grand Challenges”

09.00-12.30 Wednesday 1st June

*Budapest Congress and World Trade Centre*



The purpose of the workshop is to present the findings of ObservatoryNANO’s **“State of Nanotechnology”** report. The report covers five grand challenges that face the European Union. These are the following:

- Intelligent, connected world
- Sustainable food and environment
- New energy economy
- Ageing population
- Improved resource-efficiency of industrial production

### Workshop outline

**Introduction:** This will give a brief description of ObservatoryNANO. It will highlight its goals and, in particular, introduce the **“State of Nanotechnology”** report and the five grand challenges that it will be addressing.

**The European Nanotechnology Landscape:** This section will firstly address the publication, patent and funding trend analysis carried out by the ObservatoryNANO before delving into data obtained from questionnaire sent to nanotech companies. It will explain how the data was obtained from contacts using an online census and provide an overview of how these results have furthered our knowledge of nanotechnology innovation in Europe.

**The Grand Challenges:** Within this section invited policy makers from regional, national and European governments will firstly outline the needs that require to be addressed in these ‘Grand Challenge’ areas. The ObservatoryNANO partners will then highlight relevant nano-enabled developments, which offer promise in addressing these requirements, and examining potential barriers in terms of economic, EHS, ELSA or regulations issues.

**Conclusion:** Finally the preliminary conclusions of the report will be shared with attendees and will provide a basis for further discussion and analysis.

For further information on the workshop please contact Brian Winans

[b.winans@bwcv.es](mailto:b.winans@bwcv.es)



## FP7 NanoSustain Dissemination Event

12th May 2011, Glasgow



This event will provide an insight into the current nanosafety research and coordination efforts on both the UK and European levels and offer a chance for attendees to learn about the exciting preliminary results of the EU FP7 NanoSustain project. Speakers will include representatives of the UK Health & Safety Executive, UK University Safety and Health Association, and NANO futures initiatives, and NanoSustain Work Package leaders will report on their initial findings. Attendees will be encouraged to participate through a panel discussion on the current status of European nanosafety research and coordination and its future development.

The NanoSustain project is focusing on the development of innovative solutions for the sustainable design, use, recycling and final treatment of nanotechnology-based products. This will be based on a comprehensive data gathering, generation, evaluation and validation in relation to human health and environmental hazards and possible impacts that may occur during after-production life-cycle stages for selected nanomaterials and associated products. Although production of nanomaterials is rapidly growing, our knowledge about possible health and environmental effects associated with these materials is still rather poor. NanoSustain is specifically addressing the life cycle of carbon nanotube plastic composites, zinc oxide, titanium dioxide, and nanocellulose in a number of pure and and LCA relevant materials and products.

*If you would like to attend the event please contact Eleanor O'Rourke  
[eleanor.orourke@nano.org.uk](mailto:eleanor.orourke@nano.org.uk) or on +44 (0)141 303 8444.*



## ICPC NANONET

## ICPC 3rd Annual Workshop

24th-25th May 2011

St Petersburg



The Third ICPC Nanonet Annual Workshop takes place on 24th-25th May 2011 in St Petersburg, Russia and is organised by St Petersburg Electrotechnical University. This event coincides with the 125th anniversary celebrations of this institution. The workshop will showcase regional initiatives and developments, with a special focus on Eastern European and Central Asian N&N from the perspective of building mutually beneficial collaborations with the EU. Speakers from other ICPC regions will also present news of novel developments and address current themes, in particular biomedical and ecological applications of N&N.

Are you unable to travel to the event? Follow the proceedings online and be part of discussions in real-time through a free live webcast, giving you the opportunity to engage in a question and answer session with any speaker. You can also pre-order one of the limited edition DVDs of the whole event. Pre-registration is required to participate in the free webcast of the workshop and discussion group and/or to receive the free DVD after the event. The forms will be available from the ICPC website from March 28th.

For information and the current programme contact the project coordinator:

[lesley.tobin@nano.org.uk](mailto:lesley.tobin@nano.org.uk) or the local organiser Alexey Ivanov [asivanov@mail.eltech.ru](mailto:asivanov@mail.eltech.ru)

## Use nanotechnology for safety by design

*Interview with Professor Ashok Vaseashta, NUARI, USA*

Ashok Vaseashta is Director of the Institutes of Advanced Sciences Convergence and International Clean Water and has several other scientific and policy-advising assignments. His research interests include chemical and biological sensors, counter-terrorism, water safety & security, environmental pollution monitoring & remediation and green nanotechnology. He proposes to use TechFARM (Technology Foresight, Assessment and Roadmapping) for mapping trends in converging technologies (Nano, Bio, Info, Cogno). Ultimately, his aim is to let nanotechnology contribute to safety by design of new products and technological systems.

Under the header of Nanotechnology, ICT, privacy and security, ObservatoryNano aims to highlight technological and economic trends in nanotechnology for ICT and security applications with potential ethical and social implications. Simultaneously, current debates on relevant issues in nanobioethics among ethicists and social scientists, policy making circles and stakeholders are analysed and confronted with the issues emerging from the technical and economic trends. This way, emerging issues not discussed sufficiently can be identified and brought to the attention of policy makers in the third annual report on nanotechnology, ICT, privacy and security to be published online in the spring of 2011. The series of interviews with opinion leaders is intended to be a compilation of different views on the relevant issues currently in debate from the perspective of a social scientist or ethicist, a natural scientist, and stakeholders from industry and civil society.

**Ineke Malsch: You use TECHFARM to identify trends in converging (nano, bio, info and cogno) technologies. What is TECHFARM?**

**Ashok Vaseashta:** TECHFARM stands for Technology Foresight, Assessment and Road Mapping. We propose to use a variety of instruments for assessing, forecasting, and predicting technology developments in the near future and their potential societal implications. Currently, the future societal implications of nanotechnology are largely unknown. TECHFARM is a great tool for policy makers who need to make decisions based on scientifically validated information. In the first year of our study and we applied several methods towards defense applications of nanotechnology. This has resulted in a roadmap identifying which technologies should be developed into a prototype and considered for investment. In the second year we hope to expand further the scope of our study.

**Ineke Malsch: What are the main ethical and societal issues currently in debate on nanotechnology, ICT, privacy and security according to you? What is your view on those issues? How should they be addressed?**

**Ashok Vaseashta:** Inclusion of Information and Communications Technology (ICT) will play a significant role in safety, security, and overall situational awareness for safety and security personnel. Furthermore, inclusion of ICT will have a major impact on medical and sports industries. With introduction of every new technology, there is always a level of skepticism leading to debate on risk vs. benefits and societal concerns such as ethics and privacy. Having advantage of the latest technological tools at our disposal, we no longer have to deal with speculations. The scientific community has the ability to use the latest tools at their disposal to create "safety by design". A strong sense of ethics coupled with mandatory and not a "voluntary code of conduct" i.e. a set of guidelines that will allow us to reap the full benefits of new technologies.

The three main issues from a policy perspective are public perception of nanotechnology, neurogenetics and standardization. The primary concern is the perception of non-technical people. This is hard to quantify and it is difficult to make policy recommendations as how to deal with it. There are different levels of perception. Education is needed to overcome disconnect between scientists and end-users of products enabled by nanotechnology. New guidelines should be developed on the contents of the education to stimulate the right perception. For example, public perception on the self-replicating nature of nano-systems is not realistic. Although research to make

## Use nanotechnology for safety by design

self-adaptive, reflective, and healing materials is in progress, self-replicating nature of nanosystems is fictional at this point.

A related issue is the public perception of nano-neurogenetics and its ethical implications. Societal groups are concerned about new technologies enabling prediction and alteration of the potential of neural development and its neuropsychiatric manifestations of cognition, emotion and behavior. Nanomaterials could in the public imagination be used for enhancement of human performance. One of the ways discussed is altering the structure of DNA and the development of neuron pathways.

This could, in the public eye, influence human cognition and emotion. Another possibility discussed is to form an Avatar, or a better image of a person. In reality, nanotechnology is used for applications such as improvements of a soldier's uniform. Furthermore, addition of time and physiological-condition triggered drug-delivery systems embedded in soldier's uniform will enable the soldier to get out of harms' way, in an event of a serious injury in battle-field. This is a likely development that is not necessarily classified as performance enhancement.

A third main issue is the lack of uniform standards for nanomaterials. Most scientists and engineers follow a "voluntary code of conduct" as compared to a uniform set of standards. Standards organization must organize larger working groups to develop standards as soon as new nanomaterials are identified. Currently, material safety data sheets give information on the bulk material, not on nanoformulations of the same material. This is a problem because the nanoform of the same material can have very different properties than the bulk form. For nanomaterials, currently only Materials Safety Data Sheets exist for Carbon Nanotubes. For other materials as well, the dimensions of the materials and dimension-related properties should be included in these sheets. On 08 December, the US National Nanotechnology Initiative is organizing a meeting on this and other aspects in Washington DC. A Finnish delegation may also participate. They should discuss the allocation of resources to build up the knowledge base. This is important because nanotechnology will become a mainstream technology which needs to be standardized. In May or June I plan to organize an S&T meeting in Washington D.C., on foresight of applications of nanomaterials and societal as well as technological implications.

Another relevant issue is concern about integrity, authenticity, and privacy of data transmitted by nanosensors (employing TinyOS). Societal groups are concerned about quantity, quality, and integrity of data transmitted by the nanosensors. The sensors are developed to be incorporated in soldiers' uniforms to monitor their health status (e.g. blood pressure, heart rate) and be integrated in a data network. It is important for soldiers that their health is monitored by their commanding officers, so they have a better chance of surviving injuries. At some future time, such sensor-networks will enter the civilian market. Privacy sensitive data could be transmitted over open networks and may even be compromised. Eventually, Privacy Enhancing Designs including more sophisticated encryption algorithms will be required to improve privacy concerns with sensors networks.

Apart from these main issues, there are also other current issues (see annex). Most of these concerns can be addressed by appropriate dissemination of information, and emphasis on study of nanomaterials and its environment. During the Spring Meeting 2011 of the Materials Research Society I will address all these issues in an invited presentation at the 3<sup>rd</sup> Business of Nanotechnology session. That will be a good opportunity to raise the awareness of these issues among the business community.

**Ineke Malsch: Which societal groups (e.g. policy makers, business, natural scientists and engineers, social scientists and philosophers, NGO's, politicians) are currently involved in the debate? What role does each group play? Should the current stakeholders change their role and/or should other groups get involved?**

**Ashok Vaseashta:** In the USA, several federal government departments participate in this debate.

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The European Commission is also involved, and several projects funded from the EU Seventh Framework Programme for RTD offer platforms for the debate including ObservatoryNano, ICPC-NanoNet and NANOPLAT. In Asia, the Asia Pacific Economic Forum is tabling discussion of these issues. Relevant NGOs include standardization bodies such as ISO (International Standards Organization) and the American Society of Testing of Materials (ASTM). Furthermore in the USA, PIPS (Potomac Institute of Policy Studies) and C-PET (Center for Policy on Emerging Technologies) engage in the discussion from a non-governmental perspective. PIPS has a direct link with the PCAST President's Council of Advisors on Science and Technology and other policy makers in Washington DC. C-PET is playing a similar role. I will be working with PIPS in a newly created Center of Advanced Sciences Convergence, jointly with NUARI, to direct research on converging science and technologies. I am partially funded by a contract from the Department of Defense to advise DoD on technological aspects of scientific convergence and opportunity with PIPS will enable me to develop recommendations on policy aspects as well.

Government and Federal agencies should improve their interagency coordination and data sharing. My role on the boundary inside and outside of the government can serve to facilitate such coordination by organizing workshops by bringing all relevant and key-players together and avoid duplication of effort. Governments should also avoid lobbyists. By lobbyists, I mean representatives serving a very narrow with a specific agenda. The public interest should serve a broader goal, benefiting public-at large when nanotechnology enters the mainstream. All stakeholder groups should be represented. The NGOs I am aware of contribute to data mining using information in the public domain, including heuristic, in matter relating to the policy making discussion. I also recommend that politicians should have more involved interactions with the top scientists and futurists.

**Ineke Malsch: Is there a need for particular new regulation or voluntary measures to govern responsible development of nanotechnology in ICT and security technologies? At which level should such measures be taken (national, EU, global)?**

**Ashok Vaseashta:** New regulation or voluntary measures to govern responsible development of nanotechnology in ICT and security technologies is an interesting topic and will require several tiers of regulations. First of all – the measures should be global due to distributed nature of technology – so that the societal issues are addressed first rather than debates concerning its ownership. I foresee 2-3 different tiers of regulations – such as dealing with defense and security, emergency responders, and civilian use. The regulations are different in each tier. No public domain information should be available on regulations for defense and security applications. E.g. it will be necessary to develop regulations for sensors embedded in battle suits, but this can't be made public. For emergency responders and civilian use, regulations don't exist yet for applications of nanotechnology and converging technologies. For civilian use - new regulations to govern responsible development of nanotechnology in ICT and security technologies is much needed and will require a series of meetings to articulate such regulations.

**Ineke Malsch: How do you see your own role in the developments and discussions?**

**Ashok Vaseashta:** My personal role is towards technology foresight and assessment. Coupled with my own background in science and technology, I use a series of cross-cutting tools, synergy, and scientific methodologies for developing future trends in nanotechnology and how science convergence may provide new technological tools. I also raise awareness to use the technology in a way that society is comfortable with its use. I promote the discussion by identifying technology gaps, suggesting ways to fill the gaps, and promote dialogue between scientists and society.

My main interest is in interactions of nanotechnology with its environment. In my communications, I discuss how nanotechnology interacts with the human body. It depends on the physiological condition of the person and his environment. This is the least understood subject. I also try to

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raise awareness of the fate and transport and life-cycle analysis of nanomaterials, e.g. how the nanoparticles originate and how they are transported in the environment. In my position, I try to educate the public to understand the issues by combining my work as a scientist, educator and as policy advisor. The main objective is to shift the perception from risk dominated paradigm to “safety-by-design” applications of nanotechnology.

### Professor Ashok Vaseashta

*Director Institutes of Advanced Sciences Convergence and International Clean Water  
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Ashok Vaseashta is Director of the Institutes of Advanced Sciences Convergence and International Clean Water. In addition, he is visiting professor at 3 Nano-SAE Research Centre, University of Bucharest, Romania: <http://www.3nanosae.org/> and visiting scientist at Helen & Martin Kimmel Centre of Nanoscale Science, Weizmann Institute, Israel: <http://www.weizmann.ac.il/kimmel-nano/>. He holds a special assignment with the U.S. Department of State. His research interests include chemical and biological sensors, counter-terrorism, water safety & security, environmental pollution monitoring & remediation and green nanotechnology. He proposes to use TechFARM (Technology Foresight, Assessment and Roadmapping) for mapping trends in converging technologies (Nano, Bio, Info, Cogno).

### Relevant recent publications and projects

By Ashok Vaseashta:

- 4 Books on Nanotechnology, Chem.-Bio Sensors
- Over 200 research publications.
- Grants/Contracts: as PI: over 1.5 Million US Dollars.
- As Co-PI: over 5 Million US Dollars.
- Over 90 Keynote, Invited, memorial lectures
- Director: 3 NATO Advanced Study Institutes.

Representative references related to policy aspects:

1. NNI Strategic Planning Stakeholders' Workshop, 13-14 July 2010, Arlington VA. Draft Workshop Report - 24 November 2010.
2. Societal Dimensions Research in the National Nanotechnology Initiative, Gunston, D. H. CSPO#10-02. 21 May 2010.
3. Nanomaterials – Applications, Risks, Ethics, and Society, Vaseashta, A. in Nanomaterials Risks and Benefits by Linkov, I. and Steven, J. Springer 2009.
4. Nanotoxicology and Ethical Conditions for Informed Consent, Shrader-Frechette, Kristin. Nanoeconomics, Vol. 1, pg. 47-56, 2007.
5. Potential Toxicity of Nanomaterials and their Removal, Zhu, X. et al. International Perspectives on Environmental Nanotechnology – Applications and Implications. EPA 905R09032 Nov 2009.
6. Nanomaterials Nexus in Environment, Human Health, and Sustainability, Vaseashta, A. Silicon Vs. Carbon – Fundamental Nanoprocesses, Nanobiotechnology, and Risk Assessment by Magarashek, Y, Kozyrev, S. and Vaseashta, A. Springer 2009.
7. Advanced Sciences Convergence for Defense and Security. Vaseashta, A. et al. Vol. 1209 MRS-Business of nanotechnology II (2009).

## Additional Information

Apart from the main issues identified by Ashok Vaseashta, he is also aware of the following other issues. Most of these concerns can be addressed by appropriate dissemination of information, and emphasis on study of nanomaterials and its environment.

- Adverse impact of interaction of nanomaterials with human body: Insufficient experimental evidence exists in literature to indicate that nanomaterials pose sufficient risks to humans. More specifically, delineation of interaction of nanomaterials produced in a controlled environment vs. generated incidentally (or by nature) is necessary to be addressed.
- Potential use of nanomaterials as biological agents and for genetically modified biological structures (synthetic biology): No comment at this time due to security reasons.
- Bio-accumulation of nanomaterials within human body: dimension of nanomaterials vs. bioaccumulation onset needs to be studied in much more detail.
- Use of nanomaterials for Human performance Enhancement (HPE): There is a growing concern on this issue, especially in sports. Research efforts towards enhancing battlefield capability of soldiers are in progress.
- Societal outlook when nanotechnology becomes mainstream: Due to ongoing debate and lack of sufficient accurate information, there is a growing societal concern about use of nanomaterials once the nanotechnology becomes mainstream
- Ownership and hence liability of nanotechnology: Societal concern as who owns a specific technology and should something undesirable occurs – who is liable.
- Risk/benefit analysis of use of nanotechnology: Insufficient information about interaction of nanomaterials of its environment furthers societal concerns due to lack of cost/benefit and risk/benefit analysis.
- Interaction of nanotextiles with human: Interaction of nanomaterials with biological cells and other surrounding mediums needs to be studied in greater detail to address this societal concern.
- Use of nanobased products for domesticated pets: Same as above.
- Distinction of engineered, incidental, and nature produced nanomaterials – and their interaction with human and domesticated pets. Classification and characterization.

List of groups pursuing societal implications of nanotechnology:

### US

NSF – National Science Foundation

EPA - Environmental Protection Agency

DoS – U.S. Department of State

DoJ – Department of Justice

NNI: National Nanotechnology Initiative

NNCO: National Nanotechnology Coordination Office

### Europe:

EU/CORDIS

### Asia

APEC: Asian Pacific Economic Forum

### NGOs

ISO: International Standards Organization

ASTM: American Society of Testing of Materials

PIPS: Potomac Institute of Policy Studies

C-PET: Center for Policy on Emerging Technologies

### FP7 Projects

ObservatoryNANO

ICPC NANONET

NANOPLAT

# The ObservatoryNANO Project

The ObservatoryNANO project aims to present reliable, complete and responsible science-based and economic expert analysis, across technology sectors, to European decision and policy makers regarding the benefits and opportunities of nanotechnology developments, balanced against barriers and risks, allowing them to take action to ensure that scientific and technological developments are realised as socio-economic benefits for an innovation-driven Europe.

The ObservatoryNANO collates and analyses data regarding scientific and technological (ST) trends (including peer-reviewed publications, patents, roadmaps, and published company data) and economic realities and expectations (including market analysis and economic performance, public and private funding strategies). The ST and economic analysis is further supported by assessment of ethical and societal aspects, impacts on environment, health and safety, as well as developments in regulation and standardisation.

The project consortium is made up of 16 partners and is coordinated by the Institute of Nanotechnology. For further information please contact the project coordinator, Dr Eleanor O'Rourke, at [eleonor.orourke@nano.org.uk](mailto:eleonor.orourke@nano.org.uk) or on +44 141 303 8444.

