

# **AN OVERVIEW OF ACTIVITIES RELATED TO NANOTECHNOLOGIES IN CENTRAL AND EASTERN EUROPE, CAUCASUS AND CENTRAL ASIA**

## **INTRODUCTION**

Although there is no universally agreed definition of nanotechnology, it is not an industry, nor is it a single technology or a single field of research. It consists of sets of enabling technologies applicable to many traditional industries. Therefore, nanotechnologies may also be referred to in the plural<sup>1</sup>.

Hardly any other technology have benefited from as much research and development (R&D) investment globally in such a short time as nanotechnology. Countries all around the world have been launching nanotechnology programmes and initiatives. At the European Union (EU) level most countries are involved, with a varied intensity, into nanotechnology research and development and have put in place a number of nanotechnology programmes. Governments of Eastern Europe, Caucasus and Central Asia (EECCA) have also been carrying out nanotechnology projects and integrating nanotechnologies in their governmental policies.

This paper intends to provide a snapshot of activities undertaken in the field of nanotechnologies in Central and Eastern Europe, Caucasus and Central Asia<sup>2</sup>. It does not cover the whole picture of nano-related activities, but rather highlights existing nanotechnology programmes and initiatives, provides information about important nanotechnology centres, institutions and organisations involved in nanotechnology research and development, nanotechnology networks as well links and references for additional information. It is a compilation of publicly available online sources.

## **1. NANOTECHNOLOGIES IN THE EUROPEAN UNION**

In 2004 the European Commission adopted the document “Towards a European Strategy for Nanotechnology”<sup>3</sup> and in 2005 announced the more detailed document “Nanosciences and Nanotechnologies: An action plan for Europe 2005 – 2009”<sup>4</sup>. This was followed by the Report on the European Commission’s Public Online Consultation “Towards a Strategic Nanotechnology Action Plan (SNAP) 2010-2015”<sup>5</sup>.

Through the multi-annual Framework Programmes for Research and Technological Development, the EU provides funding for research carried out at European level. The European Commission

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<sup>1</sup> Berger. M. “Nanotechnology A non-technical introduction” (2008) <<http://knol.google.com/k/nanotechnology#>>

<sup>2</sup> This paper does not cover Bosnia-Herzegovina, Kosovo, Albania, Montenegro and Macedonia.

<sup>3</sup> Communication from the Commission “Towards a European Strategy for Nanotechnology” (2004) <[ftp://ftp.cordis.europa.eu/pub/nanotechnology/docs/nano\\_com\\_en.pdf](ftp://ftp.cordis.europa.eu/pub/nanotechnology/docs/nano_com_en.pdf)>

<sup>4</sup> Communication from the Commission “Nanosciences and Nanotechnologies: An Action Plan for Europe 2005- 2009” (2005) <[ftp://ftp.cordis.europa.eu/pub/nanotechnology/docs/nano\\_action\\_plan2005\\_en.pdf](ftp://ftp.cordis.europa.eu/pub/nanotechnology/docs/nano_action_plan2005_en.pdf)>

<sup>5</sup> Report on the European Commission's Public Online Consultation “Towards a Strategic Nanotechnology Action Plan (SNAP) 2010-2015” (2010) <[http://www.eurosfair.prd.fr/7pc/doc/1274339444\\_strategic\\_nano\\_action\\_plan\\_2015\\_2015.pdf](http://www.eurosfair.prd.fr/7pc/doc/1274339444_strategic_nano_action_plan_2015_2015.pdf)>

supported a significant portfolio of nanotechnology projects already since the 4th Framework Programme. Currently, the total budget of the 7<sup>th</sup> Framework Program (2007-2013) is 50,521 million Euros with 3,467 million Euros dedicated to Theme Four "Nanosciences Nanotechnologies, Materials and New Production Technologies - NMP"<sup>6</sup>.

The European Research Area (ERA) is composed of all research and development activities, programmes and policies in Europe involving a transnational perspective. Together, they enable researchers, institutions and businesses to increasingly circulate, compete and cooperate across borders. The aim is to give them access to a Europe-wide open space for knowledge and technologies in which transnational synergies and complementarities are fully exploited. There are a number of fully integrated European-level structures and programmes: the EU RTD Framework Programmes, including the current Seventh Framework Programme, related European agencies and undertakings<sup>7</sup>. There are many projects in areas such as nanotechnologies.

The European Commission's Nanotechnology website <http://www.cordis.lu/nanotechnology/> provides an overview of nanotechnology-related activities across the European Union's research programmes. This includes information on projects and funding opportunities, information about the European Research Area and the Framework Programmes<sup>8</sup>.

A number of networks and centres of excellence are being created both at the European and pan-European level.

## **2. NANOTECHNOLOGIES IN EASTERN EUROPE, CAUCASUS AND CENTRAL ASIA**

Many countries in Eastern Europe, Caucasus and Central Asia (EECCA) have recognized the potential of nanotechnology to contribute to the scientific and socio-economic development. Some of them have identified nanotechnology and nanomaterials as a priority area of governmental policies. Others have been carrying out research projects for years and have patents at the international level.

Nanotechnology laboratories are being created at major scientific and technical educational establishments. Countries focus on requalification of specialists and attract students' and private sector's attention to science and innovation. This can be observed through establishment of boards for young scientists, development of educational courses on nanotechnology, organisation of competitions, Olympiads for nanotechnology projects as well as innovative science exhibitions, fairs and technological parks. International forums on nanotechnology are also organized annually. Nanotechnology networks, regional programs, partnerships and joint ventures are being put in place. There are also a number of international projects. Creation of networks that involve different actors may be observed at the level of governmental information web portals or public initiatives.

The Centre for High Technologies was established by the decision of the Eurasian Economic

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<sup>6</sup> CORDIS "Nanoscience and Nanotechnology in the EC Research Programmes" <[http://cordis.europa.eu/nanotechnology/src/ec\\_programmes.htm](http://cordis.europa.eu/nanotechnology/src/ec_programmes.htm)>

<sup>7</sup> European Commission "An open space for knowledge" (2010) <[http://ec.europa.eu/research/era/understanding/what/what\\_is\\_era\\_en.htm](http://ec.europa.eu/research/era/understanding/what/what_is_era_en.htm)>

<sup>8</sup> European Commission "Nanotechnology in the European Research Area"  
<[ftp://ftp.cordis.europa.eu/pub/nanotechnology/docs/leaflet\\_nano\\_new\\_20122004.pdf](ftp://ftp.cordis.europa.eu/pub/nanotechnology/docs/leaflet_nano_new_20122004.pdf)>

Community (EurAsEC)<sup>9</sup> Interstate Council of 4 February 2009. The Members of the High-Tech Centre are Republic of Belarus, Republic of Kazakhstan, Kyrgyz Republic, Russian Federation, Republic of Tajikistan and Republic of Armenia. The Centre's activity is aimed at creation of the EurAsEC common research area, development of joint scientific and technical programmes and innovative projects, cooperation, analysis of the normative legal framework, development of innovation systems, and strengthening of scientific and educative potential of EurAsEC states in the sphere of high technologies. It considers nanotechnologies to be one of its focus areas together with bio-, IT and energy-saving technologies<sup>10</sup>. Special attention is given to establishment of venture funds and to cooperation with the Eurasian Development Bank.

In 2009 the CIS countries signed an agreement to set up an International Innovation Centre of Nanotechnologies that will play a role of a "locomotive" for the formation of a common regional market of nanoindustry in the CIS space<sup>11</sup>. It is an instrument for integration of innovation activities of the CIS countries in a global process of nanotechnology development. The initiative was proposed by the Joint Institute for Nuclear Research and supported by CIS Interstate Fund for Humanitarian Cooperation <http://ininc.jinr.ru/>.

ECO<sup>12</sup> Nanotechnology Network was opened in 2009 with the aim to promote nanotechnology in the member countries, exchange technical experiences and improve the economical position of ECO in knowledge-based transactions <http://www.econano.org><sup>13</sup>.

### 3. AN OVERVIEW OF NANO-RELATED ACTIVITIES BY COUNTRY

The following pages will provide (in alphabetical order) an overview of state policies, national nanotechnology programmes and initiatives, research and development activities, nanotechnology centres and networks as well as challenges that countries are facing with regard to development of nanotechnologies.

#### Armenia

On the one hand, Armenia attempts to ensure a sustainable growth of basic economic sectors. On the other hand, it searches to establish a framework for development of innovative high technologies. Since 2002 a "Target Programme for Nanotechnology Development" was established in Armenia. The programme was initiated by the National Academy of Sciences (NAS) and is aimed at development of nanoelectronics, nano and semiconductor electronics. Several

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<sup>9</sup>The Eurasian Economic Community (EurAsEC, or the Community) is an international economic organisation created to effectively further the process undertaken by the Parties to form a Customs Union and Common Economic Establishment of EurAsEC and treaties in force within the Community. Space, as well as for the realisation of other goals and objectives related to enhanced integration in the economic and humanitarian fields. <[http://www.evrazes.com/i/other/EurAsEC-today\\_eng.pdf](http://www.evrazes.com/i/other/EurAsEC-today_eng.pdf)>

<sup>10</sup>Mansurov "The Stages of Development of the Eurasian Economic Community" (25.01.2010) <[http://www.wcoomd.org/files/2.%20Event%20files/PDFs/Euroasian\\_Economic\\_Community\\_presentations/Presentation%20-%20Eurasian%20Economic%20Community.pdf](http://www.wcoomd.org/files/2.%20Event%20files/PDFs/Euroasian_Economic_Community_presentations/Presentation%20-%20Eurasian%20Economic%20Community.pdf)>

<sup>11</sup>Международный Инновационный Центр Нанотехнологий стран СНГ <<http://ininc.jinr.ru/>>

<sup>12</sup> Economic Cooperation Organization (ECO), is an intergovernmental regional organization established in 1985 by Iran, Pakistan and Turkey for the purpose of promoting economic, technical and cultural cooperation among the Member States. In 1992, the Organization was expanded to include new members, namely: Islamic Republic of Afghanistan, Republic of Azerbaijan, Republic of Kazakhstan, Kyrgyz Republic, Republic of Tajikistan, Turkmenistan and Republic of Uzbekistan.

<sup>13</sup> INIC "ECO Nanotechnology Network Opens in Iran" (2009.05.28) <<http://en.nano.ir/index.php/news/show/1285>>

scientific research groups and national research institutes are involved in the programme. The work is coordinated by the Academy. Most of the research in this field is related to theoretical part of developments but practical applied research is also taking place<sup>14</sup>.

Russian-Armenian Innovation Cooperation Centre was opened in April 2010 in Yerevan. The Centre will join innovative potential of the Russian Federation and Armenia. The aim of the Centre is to create additional conditions for promotion of joint development in the field of high technologies, including nanotechnologies<sup>15</sup>.

## Azerbaijan

The first Nanotechnology Centre was created at the Baku State University (SBU) in 2005<sup>16</sup>. When the university realized the magnitude of nanotechnology research it decided to prepare qualified specialists at the university and to qualify the lecturing desk. Consequently, a Nanotechnology Centre was created at the Aviation Academy and the Oil State Company. Many universities of the country integrated nanotechnologies in their courses<sup>17</sup>.

The first “International Conference on Material and Information Sciences in High Technologies” took place in 2007 in Baku. The outcome was a package of three documents proposing to open innovation laboratories in Azerbaijan. The President of the National Academy of Sciences underlined the importance to define state policy in basic development of nanotechnologies. In 2007 a group of scientists of the Baku State University developed a project for “State Programme of Nanotechnology Development”. Different ministries and committees provided a positive feedback on the project<sup>18</sup>.

Successful applications of nanotechnologies have been found in oil industry through results of joint research conducted by SBU and the State Oil Company<sup>19</sup>. In 2010 the State Oil Company of Azerbaijan launched a Programme "NANONEFT" for 2010-2015 that plans to apply nanotechnology in oil extraction, well drilling and petro-chemistry. The programme is divided into four parts: nanoextraction, nanowelldrilling, nanopetrochemistry and econanoil. This programme is a follow up on results gained in this field of research since 2005. The documents outlines measures necessary to address environmental issues linked to oil industry<sup>20</sup>.

## Belarus

Strategic goal of the “State Programme of Innovative Development of the Republic of Belarus for 2007- 2010” was aimed at building up the economy of Belarus to be innovative, competitive in the

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<sup>14</sup> Nano News Net “Нанотехнологии в Армении: весьма скромные масштабы” (3.09.2008)

<<http://www.nanonewsnet.ru/blog/nikst/nanotekhnologii-v-armenii-vesma-skromnye-masshtaby>>

<sup>15</sup> Mediantseva.S “Первый центр инновационного сотрудничества СНГ” (20.04.2010) <<http://ininc.jinr.ru/page.php?id=100>>

<sup>16</sup> Day.Az “Профессор БГУ о развитии нанотехнологий в Азербайджане” (5.03.2011) <<http://news.day.az/society/256439.html>>

<sup>17</sup> Ibid.

<sup>18</sup> Ibid.

<sup>19</sup> Aze.az “Нанотехнологии в Азербайджане – успешное начало” (10.03.2011)

<[http://www.aze.az/news\\_nanotexnoloqi\\_v\\_azerbayd\\_53501.html](http://www.aze.az/news_nanotexnoloqi_v_azerbayd_53501.html)>

<sup>20</sup> Echo-Az “ГНКАР приняла программу применения нанотехнологий” (15.12.2010)

<<http://www.echo-az.info/gnkar-prinyala-programmu-primeneniya-nanotexnologij.html>>

world market, science-intensive, resource saving, eco-friendly and socially oriented<sup>21</sup>. The next step of this process is a five-year programme. Nanotechnologies are one of the priority scientific research activities of Belarus. The government of Belarus put in place the first State Programme “Nanomaterials and Nanotechnologies 2003-2005”. Following that another programme was launched “Nanomaterials and Nanotechnologies 2006-2010”<sup>22</sup>.

The programme involved the National Academy of Sciences and the Ministry of Education and was implemented by the Institute of Solid State and Semiconductor Physics together with the Belarusian State University of Informatics and Radio Electronics<sup>23</sup>. A number of other universities and institutes such as the A.V. Lykov Institute of Heat and Mass carry out research activities in the field of nanotechnologies. Information about some organisations involved in research and development activities may be found at:

[http://www.belisa.org.by/pdf/2010/Catalog\\_RDorg\\_RB2009.pdf](http://www.belisa.org.by/pdf/2010/Catalog_RDorg_RB2009.pdf)<sup>24</sup>.

Belarus plans to open a biotech park “BelBiograd” that will comprise companies working in pharmaceutical, nano and biotechnologies. The project is regarded as part of the Programme “Socio-Economic Development of the Republic of Belarus 2011-2015”<sup>25</sup>. The “National Strategy for Sustainable Development for the Period to 2020 of the Republic of Belarus” also lists nanotechnologies<sup>26</sup>.

Many projects presented by Belarus have received support from RUSNANO. Two projects were directly financed by Russian Federation<sup>27</sup>. Computing Centre of the Union State of Belarus and Russia in Nanotechnologies will be created in 2012 within the framework of the joint Belarusian-Russian Program "Nanotechnologies – US" supported from the budget of the Union State of Belarus and Russia. This programme is aimed at developing nanotechnologies and nanocomponents of board computers of space apparatus, as well as nanosensors and nanotransmitters. In addition, new materials for electronics, medicine and transport will be developed. The Centre will include a database on nanotechnologies and computer resources for calculating characteristics of nanomaterials. Information about patents, companies and latest developments will be available for researchers and interested parties from different sectors of the economy of Belarus and Russia<sup>28</sup>.

## Bulgaria

The National Centre on Nanotechnology (NCNT) was established in Sophia in 1999 attached to

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<sup>21</sup> In 2010 Belarus implemented more than 700 high technology and innovative projects. 1000 projects are planned for the upcoming years. Three quarters of industrial production are certified in compliance with international standards.

<sup>22</sup> Nano News Net “Развитие нанотехнологий в Белоруссии” (25.03.2009)

<<http://www.nanonewsnet.ru/blog/nikst/razvitie-nanotekhnologii-v-belorussii-0>>

<sup>23</sup> БелИСА “Утверждена Государственная программа научных исследований, наноматериалы и нанотехнологии” (21.12.2005)

<<http://belisa.org.by/ru/news/stnews/official/b968aacfd112ebc5.html>>

<sup>24</sup> State Committee on Science and Technology of the Republic Belarus “Catalogue of the organizations of the Republic of Belarus, carrying out research and developments” (2009)

<sup>25</sup> Александр БЕНЬКО, «Р»Что нам надо для нано? <<http://respublika.info/5303/innovations/article48809/>>

<sup>26</sup> National Strategy for Sustainable Development for the Period to 2020 of the Republic of Belarus (2004) <[http://un.by/pdf/OON\\_sMall.pdf](http://un.by/pdf/OON_sMall.pdf)>

<sup>27</sup> Nano News Net “Беларусь: Время инноваций” (13.01.2011)

<<http://www.nanonewsnet.ru/blog/nikst/belarus-vremya-innovatsii>>

<sup>28</sup> IncrEAST “Computing Center of the Union State of Belarus and Russia in Nanotechnologies will be created in 2012” (12.02.2010)

<<http://www.increast.eu/en/827.php>>

the Bulgarian Academy of Sciences and advised by the National Expert Council on Nanotechnology. It is a national centre for excellence in nanoscience and nanotechnology for both the academic community and manufacturing industries <http://www.bas.bg/nano/activ.htm>.

The activities are essentially multidisciplinary and cover a wide spectrum of application in nanotechnology and precision measurements, involving the study of unconventional materials and manufacturing methods. By supervising the activity of the scientific community performing research in the field of nanoscience, NCNT helps the improvement and competitiveness of the efforts and promotes the transfer of innovations into the social and economic environment. Another goal of NCNT is to meet social objectives such as employment of young scientists.

With its experience in the field of research and education it has the capacity to act as regional centre for education and training in East and South-East Europe. Since 2002 the NCNT has developed the COSENT Initiative (Cooperation of Southeast European Countries in the Field of Nanotechnology) as a virtual network of scientists from South-East Europe who work in the field of nanoscience and nanotechnology. The NCNT includes a Consortium of Bulgarian Research Centres (and therefore also functions as a national network).

The other major infrastructure centre in Bulgaria is the University of Sofia (Monte Carlo Group, and Group of Nanoparticle Science and Technology)<sup>29</sup>.

In 2009 the IBM and the Bulgarian government announced their cooperation in the area of nanoscience. The Agreement defines the scope of cooperation between IBM and the Bulgarian government and ways to encourage industry, universities and the Bulgarian Academy of Science to work together in the field of nanotechnology. The government's three-year program is aimed at creating different nanoproducts, micromachines and microsystems. IBM technology and business consultants will also assist the Bulgarian government in establishing a new nanotechnology research facility, which will use state-of-the-art equipment to explore and develop new innovations in nanoscience. Bulgarian government intends to conduct applied research in microfluidics and nanofluidics, nanosystems for electronics and sensing as well as nanomaterials<sup>30</sup>.

## Croatia

The Ministry of Science, Education and Sports of the Republic of Croatia proposed the "Science and Technology Policy of the Republic of Croatia 2006-2010". The document was inspired by the Lisbon agenda and stressed the need to transform and to develop the education and science sector in order to increase investments in scientific research based on the following principles: scientific excellence, realignment of the science sector, support of young researchers, fostering scientific partnership, strong connections of science and industry and intensive participation of Croatian scientists in the EU Framework Programmes. The research priorities are oriented towards progress in biotechnology, new synthetic materials and nanotechnologies<sup>31</sup>.

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<sup>29</sup> Nanoforum "European Nanotechnology Infrastructure and Networks" 6<sup>th</sup> Report (2005)  
<<http://www.nanowerk.com/nanotechnology/reports/reportpdf/report54.pdf>>

<sup>30</sup> Colby A. "IBM and Bulgarian Government to Create First Nanotechnology Center in Central and Eastern Europe" (25.05.2009)  
<[http://news.soft32.com/ibm-and-bulgarian-government-to-create-first-nanotechnology-center-in-central-and-eastern-europe\\_7400.html](http://news.soft32.com/ibm-and-bulgarian-government-to-create-first-nanotechnology-center-in-central-and-eastern-europe_7400.html)>

<sup>31</sup> Erawatch "Science and Technology Policy of the Republic of Croatia 2006-2010"  
<<http://cordis.europa.eu/erawatch/index.cfm?fuseaction=policy.document&uuid=8BFB4324-93B6-EF18-36316D764CFC3658>>

Business Innovation Centre of Croatia BICRO, Ltd was founded by the Croatian government in 1998 in order to implement technology development and innovation support programmes. It is a central institution in the national innovation system for supporting innovation and technology advancement [www.bicro.hr](http://www.bicro.hr)<sup>32</sup>. The Centre carries out research and development activities in areas such as micro and nanotechnology.

University of Rijeka reached a strategic decision that the micro and nanotechnology is one of the priority areas of development. Projects are supported by the formation of the Laboratory for Surface and Materials and the Laboratory for Elemental Microanalysis at the Department of Physics (University of Rijeka) and the Laboratory for Precision Engineering and Technology of Micro-and Nanosystems (Technical Faculty in Rijeka)<sup>33</sup>. It has a Centre for Micro and Nano Sciences and Technologies. Ruder Boskovic Institute carries out research and development activities in the field of micro and nanotechnologies [www.irb.hr](http://www.irb.hr)<sup>34</sup>.

Systemcom<sup>35</sup> is developing the input interface chip for nanotechnology biosensors, by financial support of BICRO Ltd<sup>36</sup>.

## Czech Republic

Research of nanotechnologies, especially the basic research, started to develop in the second half of 1980s<sup>37</sup>. Today, R&D in nanoscience and nanotechnologies in Czech Republic are supported through different national and international programmes<sup>38</sup>.

CzechInvest and the Technology Centre ASCR organized meetings with the aim to bring stakeholders together and to create a Czech Nano Forum and a Nano Cooperation Programme, which could work as a network and provide information services<sup>39</sup>.

The Czech Society for New Materials and Technologies (CSNMT) <http://csnmt.cz/en/csnmt/> was founded in 1993. It is an association of more than 300 individual and collective members from academy, universities as well as industry of the Czech Republic. Since 1993 CSNMT has been a member of the Federation of European Materials Societies (FEMS) embracing 22 materials societies from 20 European countries. The Czech Society for New Materials and Technologies focuses on international cooperation with several professional societies.

The Programme “Nanotechnology for a Society” was enounced in 2005 by the Academy of Sciences of the Czech Republic (ASCZ). The main goal of the programme is to make significant progress in the advancement of research and practical utilization of nanotechnologies and

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<sup>32</sup> West Balkan Research Directory “Business Innovation Center of Croatia BICRO, Ltd”

<<http://www.westbalkanresearch.net/index.php?file=show.php&ref=943>>

<sup>33</sup> TSRC “Plans for the Development of Nanotechnology at the University of Rijeka” (15.06.2010) <[http://www.ts-rc.eu/index.php?option=com\\_content&view=article&id=200&Itemid=69&lang=en](http://www.ts-rc.eu/index.php?option=com_content&view=article&id=200&Itemid=69&lang=en)>

<sup>34</sup> West Balkan Research Directory “Ruder Boskovic Institute” <<http://www.westbalkanresearch.net/index.php?file=show.php&ref=936>>

<sup>35</sup> SYSTEMCOM Ltd. is fully integrated solutions provider and new products developer in information and communication technology (ICT).

<sup>36</sup> SYSTEMCOM Ltd. <<http://www.systemcom.hr/ic-design-service/?lang=en>>

<sup>37</sup> Kraus. L. & et al. “Nanotechnologies in the Czech Republic” (2005) <<http://csnmt.cz/getfile.php?type=file&IDfile=22>>

<sup>38</sup> Kubatova. J., Voseckova. A. “EU Nanotechnology Strategy and Situation in the Czech Republic” Nanocon (12.14.2010)

<<http://www.nanocon.cz/data/nanocon2010/sbornik/lists/papers/408.pdf>>

<sup>39</sup> Ibid.

nanomaterials. At the same time the programme sets a goal to make a platform including AVCZ, universities and industrial sphere in the Czech Republic, which will guarantee long-term development of this scientific field<sup>40</sup>.

A number of institutes of the Academy of Sciences of the Czech Republic and universities are involved in the nanotechnology research:

<http://www.nanotechnology.cz/view.php?cisloclanku=2007100011>.

Although nanotechnology is a young industry there are companies that have been working in this area for years. Information about centres for R&D, universities and companies can be found at [http://www.nanotechnology.cz/storage/nanotechnologie\\_Aj.pdf](http://www.nanotechnology.cz/storage/nanotechnologie_Aj.pdf).

Czech institutions and companies are participating in a number of EU projects targeted on safety such as NANOCODE, FRAMINGNANO, OBSERVATORYNANO, NAMETECH, NANOBAK, CAMINEMS, NANOBIOTOUCH, NANOLYSE, NANOFATE, FRACFIX, DINAMO, HIGHTECH EUROPE<sup>41</sup>.

## Estonia

In 2001, the Estonian parliament adopted a Research and Development and Innovation Strategy “Knowledge Based Estonia 2001–2006 ” that was followed by “Knowledge-based Estonia 2007-2013”. The strategy identified three key technologies for Estonia: information and communications technologies, biotechnologies and materials technologies (including nanotechnology)<sup>42</sup>. Within the framework of the strategy competence centres are created to boost the international competitiveness of Estonian business by enhancing cooperation between entrepreneurs and research institutions<sup>43</sup>. Information about the Estonian Materials Technology Programme may be found at: [http://www.mkm.ee/public/inno\\_15-MTP.pdf](http://www.mkm.ee/public/inno_15-MTP.pdf)<sup>44</sup>.

In 2004 Enterprise Estonia (EE) provided contracts for financing several competence centres including the Estonian Nanotechnology Competence Centre (ENCC) <http://encc.ee>. Estonian Nanotechnology Competence Centre is a consortium of industrial and science partners formed for performing common research in the field of nanotechnology, results of which will be bases for development of new products and/or new research of consortium partners. The Centre supports partners’ developments towards international competitiveness by performing R&D projects, educating high-level professionals and participating in basic research necessary to ensure the sustainable growth of the field.

There are two universities where the research in nanotechnology area is conducted on world level. These universities are University of Tartu <http://www.ut.ee/en> and Tallinn University of

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<sup>40</sup>Czech Society for New Materials and Technologies “Nanotechnologies in the Czech Republic” (2008)

<[http://www.nanotechnology.cz/storage/nanotechnologie\\_Aj.pdf](http://www.nanotechnology.cz/storage/nanotechnologie_Aj.pdf)>

<sup>41</sup> Kubatova, J., Voseckova, A. “EU Nanotechnology Strategy and Situation in the Czech Republic” Nanocon (12.14.2010)

<<http://www.nanocon.cz/data/nanocon2010/sbornik/lists/papers/408.pdf>>

<sup>42</sup> Consortium of the BEFORE Project “Best Practice Estonian Nanotechnology Competence Centre (ENCC)” (09.2008)

<[http://www.telecyl.com/Plataforma/BEFORE/web/micro\\_sites/4zS02P652ZmoMjciKNAj/pdfdocument.pdf](http://www.telecyl.com/Plataforma/BEFORE/web/micro_sites/4zS02P652ZmoMjciKNAj/pdfdocument.pdf)>

<sup>43</sup> University of Tartu “Competence Centres” <<http://www.ut.ee/en/entrepreneurship/competence-centres>>

<sup>44</sup> Kauhanen L., Ristinen T. “Feasibility Study for an Estonian Materials Technology Programme” (2011)

Technology <http://www.ttu.ee/en>. Tartu University is one of the leading partners in Estonian Nanotechnology Competence Centre.

The Estonian Nanotechnology Competence Centre is an essential link in the chain entrepreneurship – applied research (the Centre) – fundamental research (University of Tartu) in the field of material sciences and nanotechnology.

There are some enterprises active in nanotechnology in Estonia including Evikon MCI and Nanojet<sup>45</sup>.

## Georgia

The first “International Conference on Nanochemistry and Nanotechnologies 2010-NANO” took place in March 2010 in Tbilisi. During the conference participants proposed to consolidate joint efforts and intellectual resources of all scientists working in nanotechnology sphere in Georgia. The idea of initiation of activities through establishment of the initiative group was announced and accepted during round table discussions. Participants also acknowledged pre-existing Responsible Nanotechnology Centre, originated from 2005<sup>46</sup>. Short-term goals were outlined such as receiving governmental support<sup>47</sup>.

Some higher education establishments carry out research in nanotechnology and propose Masters and Doctoral programmes in this field. For example, the St. Andrew the First-Called Georgian University of the Patriarchy of Georgia provides Masters programme in technology of nanomaterials [www.sangu.ge](http://www.sangu.ge). Ilia State University offers Masters programme in nanophysics <http://iliauni.edu.ge/> and has competence in engineering, technology, design and manufacturability of advanced nanoelectronic components<sup>48</sup>. Technical University of Georgia proposes Doctoral programme in nanotechnologies and nanomaterials <http://www.gtu.edu.ge>. The Institute of Cybernetics (IC) (Division of Applied Mechanics and Control Processes of the Georgian Academy of Sciences) studies photoelectrical properties of nanostructures [www.cybernet.ge](http://www.cybernet.ge)<sup>49</sup>. Institute of Micro- and Nanoelectronics Iv.Javakhishvili of the Tbilisi State University [www.tsu.edu.ge](http://www.tsu.edu.ge) carries out basic research in micro- and nano-electronics<sup>50</sup>.

In June 2008 Ministers of Education of Armenia and Georgia signed an agreement on cooperation in the field of education 2008-2011. The cooperation is focusing among other topics on nanotechnologies<sup>51</sup>.

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<sup>45</sup> Consortium of the BEFORE Project “Best Practice Estonian Nanotechnology Competence Centre (ENCC)” (09.2008) <[http://www.telecyl.com/Plataforma/BEFORE/web/micro\\_sites/4zS02P652ZmoMjciKNAj/pdfdocument.pdf](http://www.telecyl.com/Plataforma/BEFORE/web/micro_sites/4zS02P652ZmoMjciKNAj/pdfdocument.pdf)>

<sup>46</sup> Chachibaia T. “Georgian National NanoInnovation Initiative” (2005) <<http://www.gnni.com.ge/Aliance%20union%20GEO.pdf>>

<sup>47</sup> Georgian National NanoInnovation Initiative <<http://www.gnni.com.ge>>

<sup>48</sup> EU-Eastern Europe and Central Asia (EECA) Competence Platform “Ilia Chavchavadze State University” <<http://eeeca-noheader.istok-soyuz.eu/organisations/58>>

<sup>49</sup> EU-Eastern Europe and Central Asia (EECA) Competence Platform “Institute of Cybernetics” <<http://eeeca-noheader.istok-soyuz.eu/organisations/60>>

<sup>50</sup> EU-Eastern Europe and Central Asia (EECA) Competence Platform “Tbilisi State University - Institute of micro- and nanoelectronics Iv.Javakhishvili” <<http://eeeca-noheader.istok-soyuz.eu/organisations/63>>

<sup>51</sup> News Nano Net “Армения и Грузия развивают сотрудничество в сфере образования и науки”

<<http://www.nanonewsnet.ru/blog/nikst/armeniya-i-gruziya-razvivayut-sotrudnichestvo-v-sfere-obrazovaniya-i-nauki>>

## Hungary

Nanotechnology has been emphasised as one of the major growth opportunities towards the knowledge based economy in the Hungarian government's "Mid-term Science, Technology and Innovation Policy Strategy" (2007-2013)<sup>52</sup>. Several dedicated public funding schemes have supported research within this area<sup>53</sup>.

Within the framework of the strategy, several development poles have been defined with specific priority fields of science and sectors of industry including "Technopolis" for nanotechnology, chemical industry, mechatronics as well as renewable and alternative energies in Miskolc.

The Bay Zoltan Foundation (BZF)<sup>54</sup> is the largest research foundation in Hungary <http://www.bzlogi.hu/>. The Foundation comprises six research institutes (as of 2009)<sup>55</sup> including the Research Institute for Nanotechnology (BAY-NANO) with a focus on nanocomposites, nanodeformation, nanodispersion, nanomedicine and nanometrology. The main goal of BAY-NANO is to create new knowledge, know-how and intellectual property in the field of nanoscience and nanotechnologies. This is done with the purpose to produce additional value in companies producing materials. Due to its analytical equipments, BAY-NANO also serves as a laboratory to meet nanometrological needs of small and medium enterprises of the North-Eastern region of Hungary. BAY-NANO is at the same time the background research institution of Department of Nanotechnology of the University of Miskolc [http://www.bzaka.hu/bzaka/bzaka\\_angol.head.page?nodeid=307](http://www.bzaka.hu/bzaka/bzaka_angol.head.page?nodeid=307).

In 2006 a Research and Training Centre for Nanotechnology has been established at the Szeged University<sup>56</sup>. Other settings involved in nanotechnology research include Research Centre, Dept. of Surface Modifications and Nanostructures; Chemical Research Centre, Laboratory for Nanostructured Metal Catalysts; Hungarian Academy of Sciences - Nanotechnology Department; Hungarian Academy of Sciences Chemical Research Centre; Hungarian Nanoscience Network; International Society for Molecular Electronics and BioComputing (ISMEBC); MTA MFA Budapest - Nanostructures Laboratory<sup>57</sup>.

The Research Institute for Technical Physics and Materials Science of the Hungarian Academy of Sciences is hosting the National Technology Platform for Integrated Micro/Nanosystems (IMNTP). The IMNTP is a Hungarian open multidisciplinary precompetitive joint initiative for companies and institutes working on micro and nanoelectronics and photovoltaic R&D&I field [www.imntp.hu](http://www.imntp.hu).

Several companies are active within nanotechnology research and application including Thales

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<sup>52</sup> Erawatch "ERAWATCH Research Inventory Report for: Hungary" (2010) <<http://cordis.europa.eu/erawatch/>>

<sup>53</sup> Innovation Norway "Potentials in the Hungarian Biotechnology Sector" (2009) <[http://www.norbiobase.no/filestore/Pdf-files/INBDP\\_reports/ReportontheHungarianbiotechsector-June09.pdf](http://www.norbiobase.no/filestore/Pdf-files/INBDP_reports/ReportontheHungarianbiotechsector-June09.pdf)>

<sup>54</sup> Bay Zoltán Alkalmazott Kutatási Alapítvány

<sup>55</sup> The Institute for Biotechnology (BAY-BIO), the Institute for Material Science and Technology (BAY-ATI), the Institute for Applied Telecommunication Technologies (BAY-IKTI), the Institute for Nanotechnology (BAY-NANO), the Institute for Plant Genomics, Human Biotechnology and Bioenergy (BAY-GEN), and the Institute of Logistics and Production Systems (BAY-LOGI).

<sup>56</sup> Bbj.hu "Hungary's first nanotechnology center opens in Szeged" (13.12.2006) <[http://bbj.hu/politics/hungarys-first-nanotechnology-center-opens-in-szeged\\_20465](http://bbj.hu/politics/hungarys-first-nanotechnology-center-opens-in-szeged_20465)>

<sup>57</sup> Nanowerk "Nanotechnology Research -Directory" <[http://www.nanowerk.com/nanotechnology/research/research\\_country.php?country=Hungary](http://www.nanowerk.com/nanotechnology/research/research_country.php?country=Hungary)>

Ltd. [www.thalesnano.com](http://www.thalesnano.com), Genetic Immunity Ltd. [www.geneticimmunity.hu](http://www.geneticimmunity.hu), Femtonics Ltd. [www.femtonics.eu](http://www.femtonics.eu), TactoLogic Ltd. [www.tactologic.com](http://www.tactologic.com)<sup>58</sup>.

## Kazakhstan

Already in 2003 nanotechnologies were determined as a priority area of the Fundamental Research Programme coordinated by the Ministry of Education and Sciences of the Republic of Kazakhstan. The government of the Republic of Kazakhstan determined in 2006 the Strategy to enter 50 top competitive countries of the world. Promotion of scientific research and creation of domestic competitive innovation technologies is seen as a condition to achieve this goal. Within the framework of this innovation process nanotechnologies are defined as a priority area together with information-space, hydro carbonic, mountain metallurgical, nuclear, renewable energy technologies and biotechnologies. Specific programmes were developed for every priority area. The first programme “Development of Nanoscience and Nanotechnology in the Republic of Kazakhstan” was established for the period 2007-2009. Thirty departments participated in the programme including nine universities. The focus is on energy, metallurgy, chemistry and electronics<sup>59</sup>. Kazakhstan has a number of scientific groups and laboratories undertaking research in nanotechnology and related disciplines.

For example, a National Laboratory for Nanotechnologies was established in 2008 in Chimkent city in order to implement the state policy in the sphere of nanotechnology. The laboratory plans to create conditions for leading scientists of the world to carry out research and development activities and possibility to train highly qualified domestic experts. Breakthrough projects in the sphere of nanotechnology on the basis of raw materials of Kazakhstan will be developed within this laboratory. One of the laboratory’s tasks is to integrate information streams of achievements of all engineering laboratories on one platform <http://www.nanofab.asia>.

The Science Centre for Earth Sciences, Metallurgy and Enrichment was defined by the Ministry of Education and Sciences as a key organization of the programme “Development of Nanoscience and Nanotechnology in the Republic of Kazakhstan 2007-2009”. In 2008 a State Company National Nanotechnology Laboratory of Open Type was established at the Al-Farabi National University. The objective of the open laboratory is to establish scientific-technological and educational infrastructure (with input from international partners) for development of nanoscience, nanotechnologies and nanoengineering in the Republic of Kazakhstan and to draw applied nanoscience closer to manufacturing and business.<sup>60</sup> An agreement on innovation-educational consortium in the field of nanotechnology was signed by the Al-Farabi National University and the Centre for Earth Sciences, Metallurgy and Enrichment.

Engineering Mountain Metallurgical and Oil Laboratory at the Kazakh National Technical University K.I. Satpaev carries out activities aimed at preparation of highly qualified engineers and development of nanomaterials<sup>61</sup>. Engineering Regional Laboratory of IRGETAS carries out at the

<sup>58</sup> ITDH “Nanotechnology in Hungary” (2009) <<http://www.atomki.hu/nanotech.pdf>>

<sup>59</sup> Akimbaeva A.M. et al. “Оценка научно-технического потенциала в области нанотехнологий” ISSN 1681-7494 (29.07.2011) <[http://www.rae.ru/use/?section=content&op=show\\_article&article\\_id=7785810](http://www.rae.ru/use/?section=content&op=show_article&article_id=7785810)>

<sup>60</sup> Ibid.

<sup>61</sup> Ibid.

D.Serikbayev East Kazakhstan State Technical University research on natural nanomaterials. A Laboratory for Nanoengineered Methods of Research was created at Taraz State University. It carries out research activities for the development of a new generation of nano-enabled foods to enhance their nutritional capacity and application of nanotechnologies and biotechnologies in textile production.

Kazakhstan and Russia have signed an agreement on intentions to organize the scientific-educational innovation partnership in the sphere of nanotechnology. RUSNANO, Kazyna Capital Management, VTB Capital and I2BF Holdings have set up a Russian-Kazakhstan Nanotechnology Venture Fund. The Fund will operate for 10 years, attracting investments for breakthrough projects in nanotechnology and nanoprocess implementation in a variety of sectors in Kazakhstan and Russia<sup>62</sup>.

The next stage of the programme “Development of Nanoscience and Nanotechnology in the Republic of Kazakhstan 2010-2012” was established. The aim of the programme is socio-economic and technical-scientific modernization through nanotechnology understanding, training and drawing applied nanoscience closer to manufacturing and business. The objectives of the programme comprise development and application of nanotechnology in mountain metallurgical sector, development of nanomaterials and nanotechnologies for new generation of energy saving systems, solar and hydrogen power, development of nanostructured biomaterials in medicine and agriculture, nanoelectronics, sensors, catalysers and nanotechnologies in oil and chemical industries, synthesis and analysis of nanomaterials and nanostructured methods. National nanotechnology laboratories of open type are called upon to bring their contribution in accomplishing this task. Those include National Nanotechnology Laboratory established at the Al-Farabi University, and Physics and Technical Institute as well as National Nanotechnology Laboratory of Open Type - Nuclear Technologies and Renewable Energy Technologies at the East-Kazakhstan State University Amandzhalova<sup>63</sup>.

## Kyrgyzstan

The state policy of the Republic of Kyrgyzstan is aimed at obtaining practical results in priority economic directions and turning towards innovative technologies. With this regard a legislative project was developed “Science and Innovation Activities”<sup>64</sup>.

In 2007 the Prime Minister of the Kyrgyz Republic signed a Decree on Nanotechnology Development in Kirgizstan establishing the Nanotechnologies Development Board designed as a coordination platform of interested ministers, state committees and administrative bodies. The Board was entrusted with a task to develop a National Nanotechnology Initiative for 2008-2015. The aim of the Board was to define major direction of sustainable socio-economic development of

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<sup>62</sup> KCM “RUSNANO, Kazyna Capital Management (Kazakhstan), VTB Capital and I2BF Holdings set up a Russian-Kazakhstan Nanotechnology Venture Fund” (06.08.2010)  
<[http://www.kcmkazyna.kz/en/press\\_centra/news/rusnano\\_kazyna\\_capital\\_management\\_kazakhstan\\_vtb\\_capital\\_and\\_i2bfholdings\\_set\\_up\\_a\\_russian-kazakhstan\\_nanotechnology\\_venture\\_fund](http://www.kcmkazyna.kz/en/press_centra/news/rusnano_kazyna_capital_management_kazakhstan_vtb_capital_and_i2bfholdings_set_up_a_russian-kazakhstan_nanotechnology_venture_fund)>

<sup>63</sup> Akimbaeva A.M. et al. “Оценка научно-технического потенциала в области нанотехнологий” ISSN 1681-7494 (29.07.2011)  
<[http://www.rae.ru/use/?section=content&op=show\\_article&article\\_id=7785810](http://www.rae.ru/use/?section=content&op=show_article&article_id=7785810)>

<sup>64</sup> Nano News Net “О развитии нанотехнологий в Киргизии” (08.08.2007) <<http://www.nanonewsnet.ru/blog/nikst/o-razviti-nanotekhnologii-v-kirgizii>>

the Republic through integration of nanotechnologies, to define a financial framework, to coordinate activities in strategic direction of state policy in the field of nanotechnologies and their application, to coordinate work in creation of regional nanotechnology centres, to define strategic directions for national information resources, and to promote participation of the Republic in international programmes and projects<sup>65</sup>.

Following that Kyrgyzstan prepared a project for the “National Nanotechnology Programme 2008-2010”, an inventory of innovations of scientific research institutions, a project for establishment of National Fund of Sciences and Innovation with the aim to attract venture financing for innovation activity in order to support domestic science and to put forward an initiative to create a Kyrgyz technological park to stimulate consolidation of financial and technical resources and approbation of new innovative breakthroughs<sup>66</sup>. The Ministry of Education and Sciences established a Board of Young Scientists aiming at development of favourable conditions to attract attention of the new generations to science and innovation.

A Nanotechnology Laboratory was created at the Institute of Chemistry and Chemical Technology of the National Academy of Sciences of the Kyrgyz Republic. The institute developed machines with electric motors and machines which save fuel using the nanosupplements that enhance the efficiency of combustion of such fuel. The laboratory has patented seven inventions on the synthesis of nanomaterials. These include: method of obtaining titanium dioxide (a catalyser for the decomposition of water to hydrogen fuel), fullerenes (carbon nanostructures that can be used to obtain qualitatively new types of drugs, alternative energy, electronics and minimization of computer chips and parts). The laboratory is also developing construction materials<sup>67</sup>.

## Latvia

In July 1998, the Government of Latvia adopted a “National R&D Strategy” from 1998 to 2010 with four thematic priorities including nanotechnologies. The “State Programme in Materials Sciences” launched since 2005 is partly devoted to development, investigations and applications of functional nanomaterials and nanostructures. It includes nanodevices for electronics and photonics, nanoparticles synthesis and treatment, polymers and composite nanomaterials<sup>68</sup>.

Research in the field of nanotechnologies is conducted by several research universities. Institute of Solid State Physics (ISSP) at the University of Latvia <http://www.cfi.lu.lv/> is the largest and leading research organization in Latvia in materials science and nanotechnology and in the related cross-disciplinary fields. In 2005 the ISSP became the coordinator of the “National Programme in Materials Science”. ISSP is awarded the European Commission Centre of Excellence entitled “Excellence Centre of Advanced Material Research and Technology” (CAMART) and is involved in a few European FP7 projects including ERANET in materials MATERA, Network of Excellence MIND, as well as three materials science and nanomaterials projects CATHERINE, F-BRIDGE, NASA-OTM<sup>69</sup>.

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<sup>65</sup> Ibid.

<sup>66</sup> “Стратегия развития страны (2009-2011)” (2008) <[http://files.carnet.kg/sgp/kgd/country%20development%20strategy\\_2009-2011\\_rus.pdf](http://files.carnet.kg/sgp/kgd/country%20development%20strategy_2009-2011_rus.pdf)>

<sup>67</sup> IncrEAST “Kyrgyz scientists have patented seven inventions in the field of nanotechnology” (09.07.2010) <<http://www.increast.eu/en/967.php>>

<sup>68</sup> Nanoforum “European Nanotechnology Infrastructure and Networks” 6<sup>th</sup> Report (2005)

<<http://www.nanowerk.com/nanotechnology/reports/reportpdf/report54.pdf>>

<sup>69</sup> B2match “Institute of Solid State Physics” <<http://www.b2match.eu/update2011/participants/214>>

Riga Technical University Institute of Inorganic Chemistry is focusing on nanochemistry and materials - plasma and powders <http://www.nki.lv/Eng/index.htm>. Institute of Atomic Physics and Spectroscopy is the Centre of Excellence for Basic Research in Nanoscale Physics and Applications. It is a multi-disciplinary research division at Faculty of Physics and Mathematics (University of Latvia). Seven groups of the Institute are studying atomic/molecular physics and atmospheric/stellar spectroscopy and developing new optical methods/devices for industrial, environmental and medical applications <http://home.lanet.lv/~asi/en/index.htm><sup>70</sup>.

Companies involved in nanotechnology are Sidrabe (thin films vacuum coatings), Neomat Co (nanopowders by plasma method, cooperation with the institute of Inorganic Chemistry), Dardedze (holography, development of nanoscale lithography systems, cooperation with the Institute of Solid State Physics), Alpha (electronic devices, cooperation with the Institute of Solid State physics, Institute of Physics University of Latvia)<sup>71</sup>.

### Lithuania

Nanotechnology was appointed a prioritized research area by the government of Lithuania<sup>72</sup>. Agency for Science, Innovation and Technology (MITA)<sup>73</sup> <http://www.mita.lt> was established in 2010 with the aim to foster business and science cooperation and to create a friendly environment for business needs and innovation in line with the “National Innovation Strategy for the year 2010-2020” approved by Lithuanian government. “High Technology Development Programme for 2011-2013” lists nanotechnology<sup>74</sup>.

The Ministry of Education and Sciences, Ministry of Economy and municipal government (Vilnius, Kaunas) supported the creation of science and technology parks such as “Sunrise Valley” in Vilnius for IT, laser technology, semiconductor optical technology, nanotechnology and environmental technology<sup>75</sup>.

The Kaunas Research Centre for Microsystems and Nanotechnology (RSMN) <http://www.microsys.ktu.lt/> was established in 1999 at a University in Lithuania. The RSMN is funded partially by the University, the National Science Foundation and through international collaborations. Three main focuses of the research plan are underlying nanoscience of molecular structures, engineering and processing of nanoscale materials and dissemination of new knowledge for education<sup>76</sup>.

Other settings working in the field of nanotechnologies include the Institute of Chemistry

<sup>70</sup> Nanowerk “Nanotechnology Research – Universities” <[http://www.nanowerk.com/phpscripts/n\\_unis\\_c.php?country=Latvia](http://www.nanowerk.com/phpscripts/n_unis_c.php?country=Latvia)>

<sup>71</sup> Gradetsky. V. “Micro- and Nanoproduction Technologies in Eastern European Countries and NIS” Tech Gate Vienna (15-16.03.2007) <[http://www.itia.cnr.it/siti\\_progetti/IPMMAN/documents/2007-03-16%20workshop%20in%20vienna/Avstria2007.pdf](http://www.itia.cnr.it/siti_progetti/IPMMAN/documents/2007-03-16%20workshop%20in%20vienna/Avstria2007.pdf)>

<sup>72</sup> Andersson M-H. “Lithuania – rapid change management” <[http://www.nanonordic.com/extra/news/?module\\_instance=2&id=319](http://www.nanonordic.com/extra/news/?module_instance=2&id=319)>

<sup>73</sup> MITA is the main governmental institution, responsible for implementation of innovation policy in Lithuania. The main activity is the coordination of national (high-tech, industrial biotechnology) and international programmes (FP7, EUREKA, EUROSTARS, CIP) of research, technological development and innovation and other financial schemes (innovation vouchers, protection of industrial property rights).

<sup>74</sup> MITA “High technology development programme for 2011-2013”

<<http://www.mita.lt/en/general-information/national-programmes/high-tech-development-programme/about/>>

<sup>75</sup> Nanoforum “European Nanotechnology Infrastructure and Networks” 6<sup>th</sup> Report (2005)

<<http://www.nanowerk.com/nanotechnology/reports/reportpdf/report54.pdf>>

<sup>76</sup> Andersson M-H. “Lithuania – rapid change management” <[http://www.nanonordic.com/extra/news/?module\\_instance=2&id=319](http://www.nanonordic.com/extra/news/?module_instance=2&id=319)>

<http://www.chi.lt/Eng/About.htm>, Institute of Physical Electronics <http://www.fei.ktu.lt>, Institute of Physics <http://www.fi.lt/index.htm>, Lithuanian Energy Institute <http://www.lei.lt/eng/index.htm> and Semiconductor Physics Institute [http://uj.pfi.lt/index\\_e.html](http://uj.pfi.lt/index_e.html)<sup>77</sup>.

The Lithuanian Nanoscience and Nanotechnology Networks were established through the private initiative in 1999 as a result of collaborations between several institutions driven by the need to use scanning probe microscopy equipment. Among the different projects in the network are bilateral collaborations with the University in Kiel (Germany) and the Penn State University (USA)<sup>78</sup>.

## **Moldova**

On 15 July 2004 the Parliament of the Republic of Moldova adopted the “Code of the Republic of Moldova on Science and Innovations”. Encouragement of the scientific research and stimulation of a sustainable climate for innovation were acknowledged as main priorities for the social and economic development of the Republic of Moldova. Strategic directions included nanotechnologies together with industrial engineering, new products and materials<sup>79</sup>.

The programme “Nanotechnologies and Nanomaterials” is one of the seven state programmes established in priority areas. The Academy of Sciences implements this programme. A number of groups are working in the field of nanotechnology. For example the Institute of Electronic Engineering and Nanotechnology opened a Nanotechnology Laboratory. A scientific technological park was created in Moldova in 2007 and was intended to specialize in nanotechnology.

Researches in Moldova have already obtained positive results in this field and some of their achievements may be ready for commercialization<sup>80</sup>.

## **Poland**

Development of nanostructures and nanocomposites in Poland has been supported since the 5th Framework Programme. In November 2000 the Polish State Committee for Scientific Research launched a Targeted Research Project “Metallic, Ceramic and Organic Nanomaterials: Processing – Structure – Properties – Applications”. In 2001 other projects were launched by the Polish State Committee for Scientific Research/Polish Ministry of Science and Information Society Technologies.

A first attempt for a national nanoscience and nanotechnology strategic plan has been expressed in the report “Strategy for the Reinforcement of Polish Research and Development Area in the Field of Nanosciences and Nanotechnologies”, written by the members of the Interdisciplinary Committee for Nanoscience and Nanotechnology, created by Ministry of Science and Higher Education in 2006.

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<sup>77</sup> Nanoforum “European Nanotechnology Infrastructure and Networks” 6<sup>th</sup> Report (2005)  
<<http://www.nanowerk.com/nanotechnology/reports/reportpdf/report54.pdf>>

<sup>78</sup> Andersson M-H. “Lithuania – rapid change management” <[http://www.nanonordic.com/extra/news/?module\\_instance=2&id=319](http://www.nanonordic.com/extra/news/?module_instance=2&id=319)>

<sup>79</sup> Permanent Mission of the Republic of Moldova to the United Nations “Science” Ministry of Foreign Affairs and European Integration of the Republic of Moldova (2010) <<http://www.onu.mfa.md/science-en/>>

<sup>80</sup> Vlas. O. “Молдавские нанотехнологии могут продать за рубеж” (04.02.2011) <[http://ru.publika.md/link\\_108161.html](http://ru.publika.md/link_108161.html)>

Polish Nanotechnology Platform was created in 2008 and proposed a strategic programme for Polish nanotechnology, based on the report and the results of the project “Foresight of Advanced Materials”. According to the strategic programme proposed by the Platform, the future development of Polish nanotechnology is connected mainly with following areas: polymer nanocomposites, nanoparticles and nanoceramics, nanometals, intelligent nanostructures, nanobiotechnologies and nanolayers<sup>81</sup>.

Special attention has been given in Poland to the centres of excellence and centres of advanced technology. Centres of advanced technology were created at the end of 2004, by groups of leading Polish research centres and industrial companies with the aim to develop poles of high technology in various areas. Centres of excellence are smaller structures, formed within existing organisations, with similar aims as centres of advanced technology<sup>82</sup>. The Institutes of Polish Academy of Sciences set up their centres in the field of nanotechnologies and nanosciences, knowledge based multifunctional materials and new production processes and devices, as have universities and other research entities throughout Poland. They serve as a technological platform for the national and international research community<sup>83</sup>.

The long-term programmes operated in Poland, supporting nanotechnology, resulted in establishment of over 40 centres for nanotechnology research across the country<sup>84</sup>. Links to many research centres, centres of excellence and networks can be found at: <http://www.nanoforum.de/dateien/temp/Poland.pdf>, <http://www.imt.ro/mnt/V7N1/Page%208.pdf>.

There are about 70 companies using the nanotechnology achievements within their activity<sup>85</sup>. Examples of Polish nanoproducts can be found at: <http://nanonet.pl/ppn/NANOTECHNOLOGIESFORPEOPLE2011-03-14.pdf>

## Romania

Topics in national programmes in Romania included microtechnologies since 1993 and nanotechnologies since 2000<sup>86</sup>. Coordinated activities in nanotechnologies started with the Special R&D Programme “New Materials, Micro and Nanotechnologies 2001-2006” (MATNANTECH).

The networking was initiated in 2000 by the National Institute for Research and Development in Microtechnologies IMT- Bucharest, recognised as a national “nano” network by EU <http://www.imt.ro/MicroNanoTech>. Coordinated by the Ministry of Education, it is a hub of national networks, a technological platform and an innovation pole<sup>87</sup>. Nanotechnology networks

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<sup>81</sup> Narkiewicz. U. “Nanotechnologies for people: Examples of Polish Nano-Companies” (14.03.2011)

<<http://www.nanonet.pl/index.php/organizacje/ppnano/2113-nanotechnologies-for-people-examples-of-polish-nano-companies>>

<sup>82</sup> Nanoforum “European Nanotechnology Infrastructure and Networks” 6<sup>th</sup> Report (2005)

<<http://www.nanowerk.com/nanotechnology/reports/reportpdf/report54.pdf>>

<sup>83</sup> Ibid.

<sup>84</sup> Nanopoland “Poland goes nano!” <<http://www.nanopoland.com/a/1/Poland%20goes%20nano!.html>>

<sup>85</sup> Ibid.

<sup>86</sup> Dascalu D. “Romanian Consortium for Nanoscience and Nanotechnology (RCNN) and Its Role in Dissemination, Training and Networking” 1st NanoForum Workshop: Nanomaterials and Application, Sinaia, Romania (5-7.10. 2003)

<<http://www.nanoforum.org/events/workshop/Dascalu.pdf>>

<sup>87</sup> Ibid.

(coordinated by IMT-Bucharest) are: BIONANONET - Bionanotechnology Network; MINAMAT-NET - Characterization of Materials and Structures for Micro and Nanonengineering; NANOTECHNET - Network of Research Laboratories in Nanotechnologies, 3N - Consulting Centre in Nanomaterials, Nanostructures and Nanotechnology; CENOBITE - Centre for Researches in Nanobiotechnologies; NANOMATFAB – Virtual Centre of Research in Nanomaterials and New Production Processes <http://www.romnet.net/nano>.

IMT is coordinator or partner in a number of research projects related to the “nano” field financed from the national programme MATNANTECH. It also acts as a “bridgehead” to integrate Romanian nanotechnology research into the European Research Area (ERA). During 2003-2010, IMT was involved in approximately 25 European projects (FP6, FP7, and related). In a few cases, IMT is co-operating with renowned international companies, for example in two ENIAC-JU projects (public-private partnership in nanoelectronics)<sup>88</sup>.

Its Centre of Nanotechnologies is an interdisciplinary group of laboratories that uses state-of-the-art equipment for structuring and characterisation at the nanoscale. Meanwhile, IMT MIMOMEMS group of laboratories (specialising in microwave devices and photonics) is a centre of excellence in RF and Opto MEMS (financed by the EC, REGPOT programme 2008-2011)<sup>89</sup>.

Apart from scientific research and technological development, IMT is active in technology transfer and innovation, as well as in education and training. Since 2005, IMT includes an autonomous Centre for Technology Transfer in Microengineering (CTT-Baneasa), and since June 2006, a Science and Technology Park for Micro- and Nanotechnologies (MINATECH-RO). Dissemination of information is provided by web pages of the networks (hosted by [www.imt.ro](http://www.imt.ro)) and by the “Micro and Nanotechnologies Bulletin” edited by IMT.

The RO-NANOMED project is devoted to the creation and development of an integrated research network in the field of nanobiotechnology for health. This network is targeting integration into the European Technology Platform (ETP) “NanoMedicine”<sup>90</sup>.

The “Romanian Consortium for Nanoscience and Nanotechnology” (RCNN) emerged as a “coalition” of the most motivated members from the institutes and research centres, involved in networks and research projects in nanotechnology<sup>91</sup>.

There are a number of laboratories involved in nanotechnology R&D. Laboratory of Nanotechnology is affiliated as Centre of Nanotechnology to the Romanian Academy since 2001. The Laboratory of Nanotechnology was recognized at the national level. Information about other laboratories can be found at:

<http://www.nanoforum.org/dateien/temp/Nanotechnology%20in%20the%20Candidate%20Countries.pdf?12082003150227>.

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<sup>88</sup> InnovationEurope “IMT-Bucharest National Institute for R&D in Microtechnologies” (05. 07.2010)

<<http://www.innovationeu.org/news/innovation-eu-vol2-1/0271-imt-bucharest.html>>

<sup>89</sup> MIT-Bucharest “Research Centers in Romania” MNT Bulletin Vol.8/No.2 (2007)

<<http://www.imt.ro/mnt/V8N2/5.pdf>>

<sup>90</sup> Nanowerk “Nanotechnology Research – Laboratories”

<[http://www.nanowerk.com/nanotechnology-labs.php?url2=Romanian\\_Nanomedicine\\_Network\\_Ro-Nanomed.php](http://www.nanowerk.com/nanotechnology-labs.php?url2=Romanian_Nanomedicine_Network_Ro-Nanomed.php)>

<sup>91</sup> Dascalu D. “Romanian Consortium for Nanoscience and Nanotechnology (RCNN) and Its Role in Dissemination, Training and Networking” 1st NanoForum Workshop: Nanomaterials and Application, Sinaia, Romania (5-7.10. 2003)

<<http://www.nanoforum.org/events/workshop/Dascalu.pdf>>

## Russian Federation

Russian Federation has been carrying out research at the nanoscale since the 90th. State Initiative “Strategy for Nanoindustry Development” was announced in Putin’s address to Parliament in 2007. RUSNANO <http://www.rusnano.com/> was created in March 2011 as an open joint-stock company through reorganization of the Russian state-run Corporation of Nanotechnologies established in 2007. RUSNANO's mission is to implement the state policy in the field of nanotechnologies. The company focuses on commercialization of nanotechnologies, lowering market barriers for nano-enabled products, attracting private investment to nanoindustry and promoting Russian nanoproducts on the world market<sup>92</sup>.

In order to accomplish its task RUSNANO co-invests in nanotechnology projects with substantial economic potential or social benefit in areas such as manufacturing of nano-enhanced products and materials, creates an infrastructure for nanotechnology projects, develops scientific forecasting and roadmaps, addresses such issues as standardisation, certification and safety and focuses on education and popularisation. As of March 2011 RUSNANO approved 104 projects in Russian regions out of which 27 projects with foreign participation (12 EU)<sup>93</sup>.

RUSNANO selects promising spheres for investment based on longer-term sight created by the leading Russian and world experts. In order to assist the Russian nanotechnology industry advance to the global market and strengthening of its international links RUSNANO develops partnerships with the leading nanotechnology centres in the world and organizes the annual Nanotechnology International Forum in Russia<sup>94</sup>. Together with its partners RUSNANO establishes joint ventures in the Russian Federation and provides infrastructural, managerial and administrative support.

Industries covered by RUSNANO range from construction to medicine and pharmaceuticals, and from industrial products and equipment manufacturing to consumer goods. As of 2011 cluster of investment projects includes solar energy and energy conservation, nanostructured materials, medicine and biotechnology, optoelectronics and nanoelectronics<sup>95</sup>.

In 2010 Eurasian Development Bank<sup>96</sup> and RUSNANO signed a memorandum of cooperation planning to offer joint financing of nanotechnology projects. The parties agreed to coordinate their efforts in accomplishing mid-sized and long-term investment projects to strengthen integration of economic processes among countries of the Eurasian Economic Community as well as to increase their production of innovative nanotechnology-enabled goods and to create new workplaces in industry, medicine, transportation, and other areas of commerce in EurAsEC countries.

As part of its focus on developing its science and innovation capabilities, Russian Federation has established the National Nanotechnology Network (NNN) <http://www.rusnanonet.ru/>. The Network is intended to coordinate the work of the largest participants in the innovative process. It is aimed at boosting the volume of nano-production and creating an entry point for Russian

<sup>92</sup> RUSNANO “Fostering Nanotechnology Innovation in Russia” (26.05.2010) <<http://www.rusnano.com/Document.aspx/Download/26463>>

<sup>93</sup> RUSNANO “Russian Corporation of Nanotechnologies” <[http://www.consult-strategy.de/homepage/CSP\\_RUSNANO\\_Corporate\\_eng.pdf](http://www.consult-strategy.de/homepage/CSP_RUSNANO_Corporate_eng.pdf)>

<sup>94</sup> Rusnanotech <<http://www.rusnanoforum.ru/Section.aspx/Show/28040>>

<sup>95</sup> Mostinskiy S. “RUSNANO priorities and principals in working with foreign partners” (11.03.2011) <[www.iceur-vienna.at/points/Rusnano.pptx](http://www.iceur-vienna.at/points/Rusnano.pptx)>

<sup>96</sup> International organization founded through the intergovernmental agreement between the Russian Federation and the Republic of Kazakhstan, Republic of Armenia and the Republic of Tajikistan.

companies on the global market. It provides updated information about various aspects of nanoindustry development in Russia. The network's web portal is a universal information sources for NNN participants including enterprises and organisations specialized in nanotechnology, manufacturers, investors, lawyers, students, consumers, etc.

Nanotechnological Society of Russia (NtSR) was founded in 2008 in Moscow as a non-profitable organization <http://www.nts.info/eng/>. The NtSR joins representatives from research, education, business, administration, and other areas related to nanotechnologies. The main NtSR aims include promotion of creativeness, cooperation, and progress in the Russian nanosociety; assistance in commercialization of the research results; education in area of nanotechnologies; information support; international collaboration; public contacts and propagation of innovation progress<sup>97</sup>. The NtSR has active contacts and formal agreements with the state corporation "RUSNANO", NT-MTD Co, Nuclear Society of Russia, and other organizations.

Nanoeducation has been an important part of the state nanotechnology programme that is governed by the Ministry of Education and Sciences of Russia. Russia established a Special Governmental Programme "Nanoeducation" financed from the federal budget. The core point of the programme is installation of equipment in educational establishments of different kind and organization of special training nanotechnology laboratories<sup>98</sup>.

In 2008, 35 higher schools in Russia were equipped with special nanoeducational complexes. The universities, the first tried on the experiment, were chosen according to their specialization and rating and were situated all over the country. Nanoeducational complexes are also being installed in Russian secondary schools. Russian Government collaborated with NT-MDT Co- global company producing nanotech devices. The company provides special training tools "NANOEDUCATOR" for Russian educational establishments. It is a scientific educational complex with a set of learning aids, accessories for introducing students to nanotechnology and giving them a basic understanding of how work with objects at nanoscale level<sup>99</sup>.

Russian Federation organises Annual International Forum "High Technology of XXI"<sup>100</sup> with exhibitions dedicated to nanotechnologies<sup>101</sup>.

## Serbia

On 25 February 2010, the Government of the Republic of Serbia adopted the "Strategy of Scientific and Technological Development of the Republic of Serbia for the period 2010-2015". The national strategy identified seven focus areas including new materials and nanoscience. The themes within the Research Cycle Programme 2011-2014 for this priority field include synthesis and examination of properties of nanostructural functional materials and their application;

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<sup>97</sup> The NtSR comprises around 1100 members, including 30 members of Russian Academy of Sciences (RAS), 43 associated members of RAS, 337 doctors of sciences, and 342 PD. They cover physics, math, chemistry, biology, medicine, pharmaceuticals, and many other areas. NtSR is presented in 70 regions of Russia. There are members from other countries.

<sup>98</sup> Nanowerk "Nanoeducation in Russia gains momentum" (24. 03.2010) <<http://www.nanowerk.com/news/newsid=15493.php>>

<sup>99</sup> Azonano "Russian Federation Continues Investing in Nanoeducation Despite Economic Recession" (25.03.2010) <<http://www.azonano.com/news.aspx?newsID=16646>>

<sup>100</sup> 12th International Forum "High Technology of XXI" <<http://www.engl.vt21.ru/>>

<sup>101</sup> 12th International Exhibition "High Technology of XXI" <<http://www.engl.vt21.ru/vt.php>>

technologies based on nanostructural materials, and technologies for production and control of nanostructures; new technologies for sustainable and efficient production of materials with additional function based on raw materials and domestic industrial facilities; designing and modelling properties of nanomaterials and nanotechnology; toxicity and risk in application of nanomaterials and nanotechnology; and contemporary intercalative materials for lithium batteries<sup>102</sup>.

The project to build the Centre for Promotion of Science is to be completed by 2013<sup>103</sup>, as a part of the Campus of Science and Art in Novi Beograd. The plan also includes the construction of the building area of 6,000 m<sup>2</sup> whose primary function is to host the National Share Facility for Materials and Nanoscience, and Blue Danube Supercomputing Facility and a main building hosting National Laboratory for Physics, Materials and Nanoscience<sup>104</sup>.

The Institute of Microelectronic Technologies and Single Crystals (Belgrade University) carries out activities in the field of nanotechnologies and photonic crystal research<sup>105</sup>.

## Slovakia

The Slovak Academy of Sciences (SAS) [www.sav.sk](http://www.sav.sk) has established the NanoSMART Centre of Excellence in Nanostructured Materials. The Centre has been created from selected departments of six institutes of SAS with the aim to create a comprehensive frame for research and development of advanced metallic and ceramic materials with defined nanoscale structure and extraordinary properties for scientific and industrial applications<sup>106</sup>. A number of researchers from SAS institutes on Materials Research, Inorganic Chemistry, Experimental Physics, Geotechnics, Materials and Machine Mechanics, Physics, and Electrical Engineering and laboratories from universities collaborate in it. Research topics are mainly dedicated to ceramic nanocomposites and metallic materials, and their mechanical, magnetic, superconducting, semiconducting, electric properties and use in water treatment<sup>107</sup>.

The principal objective of the research within the Centre of Excellence of APVV: SOLIPHA (Research and education centre of excellence for solid phase research focused on nanomaterials, environmental mineralogy and material science) is the investigation of solid phases at the micro- and nano-levels. The research is focused on questions of environmental pollution related to mining activities, sustainable exploitation of raw materials, study of nanomaterials, material science and associated technologies<sup>108</sup>.

Main areas of nanotechnology related research in Slovakia are related to bulk nanostructured materials (metallic, ceramic, composites, etc.), nanopowder, nanotubes, nanowires, polymers and

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<sup>102</sup> Ministry of Science and Technological Development

<[http://www.nauka.gov.rs/eng/images/stories/vesti/00000-11/110203/CH25\\_Science\\_and\\_research\\_.pdf](http://www.nauka.gov.rs/eng/images/stories/vesti/00000-11/110203/CH25_Science_and_research_.pdf)>

<sup>103</sup> PIU Research and Development Ltd <<http://www.piu.rs/projects.php?lan=eng>>

<sup>104</sup> PIU Research and Development Ltd <<http://www.piu.rs/projects.php?lan=eng&id=10>>

<sup>105</sup> Nanowerk <[http://www.nanowerk.com/nanotechnology-labs.php?url2=Belgrade\\_University\\_Institute\\_of\\_Microelectronic\\_Technologies\\_and\\_Single\\_Crystals.php](http://www.nanowerk.com/nanotechnology-labs.php?url2=Belgrade_University_Institute_of_Microelectronic_Technologies_and_Single_Crystals.php)>

<sup>106</sup> Klingová S. "NMP Excellence in Slovakia" <<http://www2.ffg.at/buk/va/Downloads/6B16CE48.pdf>>

<sup>107</sup> Nanoforum "Nanotechnology in the EU – Bioanalytical and Biodiagnostic Techniques" (2004)

<<ftp://ftp.cordis.europa.eu/pub/nanotechnology/docs/nanoforumnanobioreport.pdf>>

<sup>108</sup> Institute of Inorganic Chemistry, SAS "Centres of Excellence/National centres" (2009) <<http://www.uach.sav.sk/?q=node/29>>

biomaterials, thin films and coatings, education, standardization and application<sup>109</sup>.

## Slovenia

The Slovenian science policy is integrated into the European Research Area. The “National Research and Development Programme 2006-2010” listed nanotechnology as one of the national R&D priorities<sup>110</sup>.

In 2003, the Government decided to support the establishment of centres of excellence by the Ministry of Higher Education, Science and Technology (MHEST) and to co-finance the centres of excellence with the resources available from the European Regional Development Fund (ERDF). Among the selected proposals was the plan for the establishment of a centre of excellence in the field of nanoscience and nanotechnology<sup>111</sup>.

The formation of the Centre of Excellence in Nanoscience and Nanotechnology (CE Na&Nt) provided an opportunity to join together key researchers and their institutions in the area of nanoscience and nanotechnology as well as members of the industrial community. There are several research institutes and research units within universities cooperating in the Centre. The research activities carried out in the CE Na&Nt are interdisciplinary (physics, chemistry and electronics).

The most important centre is the Jožef Stefan Institute (IJS) in Ljubljana (leading Slovenian scientific research institute) which includes departments with a focus on nanotechnology research. In addition, national centres of excellence are being established as networks of research institutes at the IJS <http://www.ijs.si/>.

SINANO is the Slovenian Network on Nanotechnology. The Network comprises tasks related to nanomaterials, sensors based on biological molecules, and chemical processing technologies, equipment and also long term research parts<sup>112</sup>.

The Slovenia Current Research System SICRIS database comprises a number of national research programmes and projects related to nanotechnology <http://sicris.izum.si>. The list of research institutes, universities and laboratories involved in nanotechnology R&D may be found at <http://www.nanoforum.de/dateien/temp/Slovenia.pdf>.

## Tajikistan

The first structure aimed at development of nanotechnologies was established in Tajikistan in 2007. A department of nanotechnology was established at the S.U.Umarov, Physical Technical

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<sup>109</sup> Dusza J. “Research in Nanotechnology and Nanomaterials in Kosice” IMR SAS (09.02. 2007)

<[http://kutik.bzlogi.hu/fileadmin/uploads/prezentaciok/prez\\_20070209\\_jd\\_01.pdf](http://kutik.bzlogi.hu/fileadmin/uploads/prezentaciok/prez_20070209_jd_01.pdf)>

<sup>110</sup> Ministry of Higher Education, Science and Technology “National Research and Development Programme for the of 2006-2010 Period” (16.12.2005) <[http://www.mvzt.gov.si/fileadmin/mvzt.gov.si/pageuploads/pdf/znanost/ang\\_verzija/NRDP.pdf](http://www.mvzt.gov.si/fileadmin/mvzt.gov.si/pageuploads/pdf/znanost/ang_verzija/NRDP.pdf)>

<sup>111</sup> IJS “Center of Excellence: Nanoscience and Nanotechnology”

<[http://nin.ijs.si/nano\\_files/SL\\_Centre%20of%20Excellence%20in%20Nanotech1.pdf](http://nin.ijs.si/nano_files/SL_Centre%20of%20Excellence%20in%20Nanotech1.pdf)>

<sup>112</sup> NanoForum “Slovenia” <<http://www.nanoforum.de/dateien/temp/Slovenia.pdf>>

Institute. According to the Academy of Sciences, Tajikistan has already started cooperation in this field with Russia, in particular with the Shubnikov Institute of Crystallography and the United Institute for Nuclear Research<sup>113</sup>.

## Turkmenistan

The activities of the Academy of Sciences of Turkmenistan were restored in 2007. Following that, a number of new institutes were open and a new structure for science, new technologies and innovations was established within the governmental framework<sup>114</sup>. The basic target landmarks in creation of socially oriented market economy include, among others, realization of technological breakthrough due to priority development of science and education with forming of national innovation system, creation of nanotechnologies, increase of authority and motivation of intellectual labour<sup>115</sup>.

Turkmenistan intends to foster international cooperation, research and education in the field of innovation technologies, including nanotechnologies.

To this end, International Exhibition and Scientific Conference “Science, Technique and Innovation Technologies in the Great Revival Epoch” was held in June 2011 in Ashgabat. The exhibition included nanotechnology achievements and over 40 countries participated in the Forum. The conference discussed scientific and technological achievements for the development of the economy of Turkmenistan, in particular in the areas of energy, agriculture, construction, seismology, medicine and communication<sup>116</sup>.

Turkmen-Russian Science and Innovation Forum “Innovations, New Technologies and Energy Efficiency Issues” took place in Ashgabat in June 2011. Several priority fields for further Turkmen-Russian cooperation were identified. These included advanced materials, nanotechnologies, power engineering and energy efficiency, telecommunications, biotechnology and pharmaceuticals<sup>117</sup>.

According to the institute of Strategic Planning and Economic Development a technological park will be established in Turkmenistan. The park will create opportunities for research in the field of alternative energy and nanotechnologies<sup>118</sup>.

The Turkmen State Power Engineering Institute is expected to launch a special subject, "Fundamentals of Nanotechnology". The new discipline is introduced into the training of specialists such as mechanical, electrical, automation and chemical engineers. The main objective

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<sup>113</sup> Nano News Net “В Таджикистане будут заниматься разработкой нанотехнологий” (30.01.2008)

<<http://www.nanonewsnet.ru/blog/nikst/v-tadzhikistane-budut-zanimatsya-razrabotkoi-nanotekhnologii>>

<sup>114</sup> NTSR “В Туркмении создается технопарк” <[http://www.ntsrf.info/nanoworld/news.php?ELEMENT\\_ID=3966](http://www.ntsrf.info/nanoworld/news.php?ELEMENT_ID=3966)>

<sup>115</sup> Atayev M. “The Strategy of Social and Economic Development of Turkmenistan in the Era of New Revival” Institute of Strategic Planning and Economic Development of Turkmenistan

<<http://www.iipresentations.com/A1087/Ministries/4-InstituteofStrategyDevelopmentSpeecheng.pdf>>

<sup>116</sup> Turkmenexpo.ru “Инновационное развитие – залог дальнейшего процветания независимого Туркменистана” (13.06.2011)

<<http://www.turkmenexpo.ru/news/2313/>>

<sup>117</sup> TDH “Turkmen-Russian Forum: speeding up scientific and technological advance in the interests of the two friendly nations” TGON (15.06.2011) <[http://www.turkmenistan.gov.tm/\\_en/?idr=5&id=110615a](http://www.turkmenistan.gov.tm/_en/?idr=5&id=110615a)>

<sup>118</sup> NTSR “В Туркмении создается технопарк” <[http://www.ntsrf.info/nanoworld/news.php?ELEMENT\\_ID=3966](http://www.ntsrf.info/nanoworld/news.php?ELEMENT_ID=3966)>

is to study ways to create nanoparticles and nanomaterials, their structure and properties, methods to manipulate nano-objects and application of these nano-objects in different systems. In addition, students will become familiarized with methods of extraction of compact materials with extremely fine-grained structure as well as learn about diffusion and chemical properties of nanomaterials. The special course also assumes familiarity with the microstructure of compact nanomaterials: microscopic, spectroscopic and indirect methods, direct observation of the nanoparticle and the details of the nanostructure by electron microscopy and other new methods of nanolithography<sup>119</sup>.

## Ukraine

Ukraine sees development of science, introduction of new technologies and relying upon innovations as a necessary factor to raise national economy. The State Target Scientific and Technical Programme “Nanotechnology and Nanomaterials” for 2010-2014 was approved by Decree of Cabinet of Ministers in 2009. The main goal of the programme is to develop national nanoindustry.

The target of the national nanotechnology initiative is to create new industry in Ukraine which would be environment friendly, automated, secure, capable to substitute in part the conventional production and old “dirty” industry, to increase GRP through enlargement of “high tech” sector of economy and creation of high quality jobs, improvement of state security and development and commercialization of nanotechnologies in biomedicine, agriculture, security and environmental protection. The main feature of the strategic plan for nanotechnologies is to respond to the global priorities in this area. Nine research and development directions were identified: physics of nanostructures, technologies of semiconducting nanostructures, diagnostics of nanosystems, nanomaterials, nanobiotechnologies, nanochemistry, nanoelectronics and nanophotonics, safety of nanotechnologies and development of national nanoindustry<sup>120</sup>.

The National Academy of Sciences of Ukraine (NAS) provides major advances in this field. It has been conducting fundamental research and is implementing targeted projects in the area of nanostructure systems, nanomaterials and nanotechnologies.

National Academy of Sciences of Ukraine, Ministry of Education and Science of Ukraine, State Agency of Ukraine for Investments and Innovations and the company “LMT Corporation” organize the Annual International Forum “Innovation and High Technology” as well as International Specialized Exhibition in Nanotechnologies that provide a platform for solving complex problems and achieve goals that coincide with the objectives of the state programme. The mission of the Forum is to create conditions for an innovative development of the Ukrainian economy and the country’s occupation of advanced positions in Europe and the world. The strategy of the Forum is to unite science, industry, investments, crediting, and the quality management system in order to strengthen the scientific and technical potential, to develop international and national cooperation in the sphere of science and engineering, to ensure the

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<sup>119</sup> East Time “Turkmen students to study nanotechnology” (20.04.2011)

<<http://easttime.info/news/turkmenistan/turkmen-students-study-nanotechnology>>

<sup>120</sup> Ragulya A.V. “Ukrainian Research of Nanomaterials for Energy and Environment Protection Application” Madrid, Spain (21-23.04.2010)

<<http://www.ciemat.es/sweb/Spain-ISTC-STCU/22Abril/RecentAchievements.pdf>>

modernization and re-equipment of all industries of the Ukrainian economy and to provide a prompt introduction of innovative achievements and financing thereof<sup>121</sup>.

A Ukrainian website for nanotechnologies provides public access to fundamental information on nanotechnologies, advances, their application and commercialization <http://nano.com.ua/>.

Within the framework of the programme “Ensuring Nanoindustry Development” TT2ID created an internet-office of technology transfer that would join and coordinate activity of specialists from technology transfer departments of different institutions of NAS of Ukraine. It will present information on research and promote developments conducted within the framework of the state programme<sup>122</sup>.

Russia and other CIS countries play an important role in the international scientific cooperation of Ukraine. Special attention is paid to formation and implementation of the joint Ukrainian-Russian scientific and technological projects in the field of new technologies, in particular, in the common priority direction of "Nanophysics and Nanotechnologies". Ukraine also cooperates with border states like Belarus<sup>123</sup>, Poland as well as EU in establishing joint projects in high-tech industries such as nanotechnologies.

## Uzbekistan

Modernization and application of new technologies falls within the framework of the major economic reforms undertaken by the government of Uzbekistan. In July 2008, the Head of the State approved a Resolution on Action Plan to develop innovative products and technologies for the future. The Resolution enabled respective government agencies and manufacturing enterprises to create special funds at the expense of depreciation and net profits assigned for modernization and implementation of new technologies. They also set up offices and engineering bureaus to deal with innovative development of the industry. Educational and research institutions and design organizations are provided with tax incentives for a period through 2013.

In 2008, the first annual “Republican Fair of Innovative Ideas, Technologies and Projects” was organized by the Ministry of Economy and the Committee for the Coordination of Development of Science and Technology under the Cabinet of Ministers. The innovations fair was attended by representatives of ministries and agencies, enterprises of all sectors of national economy, farms, institutions of the Academy of Sciences, universities, research centres, design companies as well as international organizations. Following that, further steps were made to strengthen the alliance of scientists and manufacturers. These efforts resulted in a Presidential Resolution “On Additional Measures to Stimulate Innovative Projects and Technologies in Production” of 2008. The document provided for the establishment of a Committee for the Coordination of Development of Science and Technology to catalyze innovation processes. This was seen as a step forward in state’s policy for development of nanotechnologies.

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<sup>121</sup> International Innovative Forum of CIS countries 2011 <<http://www.hi-techexpo.com/en/exhibitions/index.php>>

<sup>122</sup> Institute of Physics, NAS “Technology Transfer, Innovations and Intellectual Property Department” <[http://www.iop.kiev.ua/site/dep/dep\\_tt\\_en.php](http://www.iop.kiev.ua/site/dep/dep_tt_en.php)>

<sup>123</sup> Национальная академия наук Украины “II Международная научная конференция Наноструктурные материалы-2010: Беларусь-Россия-Украина” <<http://www.nas.gov.ua/conferences/nano2010/Pages/default.aspx>>

Formation and implementation of the technological and innovative policy by joint-stock companies within the Uzbekneftegaz NHC is carried out in compliance with government decisions and guiding documents in the sector. In accordance with the Resolution “On Additional Measures to Stimulate Innovative Projects and Technologies in Production” the Innovative Activity Centre of the Uzbekneftegaz NHC was established under the sectoral institute O’zlitineftgaz JSC. The Academy of Sciences of the Republic of Uzbekistan and Uzbekneftegaz NHC jointly established the scientific engineering centre UzNANOneftegaz for the closer collaboration between scientists and producers within the implementation of innovative projects<sup>124</sup>.

The first experiments on the nanometre level were undertaken in the 90th at the Thermophysics Department of the Uzbekistan Academy of Sciences. A laboratory of perspective research was put in place to provide further research in this area. In 2007 the laboratory received 10 international scholarships and grants. Researchers are also carrying out activities in the field of nanophysics<sup>125</sup>.

The Institute of Chemistry and Physics of Polymers<sup>126</sup> carries out research on the basis of pluridisciplinary approach. The institute developed new substances and nanomaterials applicable in agriculture, construction and medicine. The Department of Immunopharmacology at the Tashkent University created a Centre for Molecular Medicine and Nanotechnology.

## CONCLUSIONS

It is difficult to embrace the overall picture of ongoing activities in field of nanotechnologies. Despite the political will and a number of R&D activities undertaken in Central and Eastern Europe, Caucasus and Central Asia many countries are facing a number of challenges.

At the EU level, Member States are at different stages of nanotechnology development. A significant barrier for a common European approach in this area is linked to fragmentation of activities in terms of funding opportunities and safety discussions<sup>127</sup>. There is a need for a coordinated framework for technology and innovation that would facilitate knowledge transfer and further collaboration between research and industry across all Member States<sup>128</sup>. At the same time there is an urgent need for a harmonised European approach to nanotechnology risk assessment and management<sup>129</sup>. Discussions are going on with regard to adaptation of existing regulatory tool such as REACH Regulation<sup>130</sup>.

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<sup>124</sup> A. Ivanova “Интервью директора Института химии и физики полимеров АН Узбекистана” УзА (28.07.2008)  
<[http://www.ut.uz/eng/opinion/innovation\\_simple\\_solutions\\_to\\_complex\\_tasks.mgr](http://www.ut.uz/eng/opinion/innovation_simple_solutions_to_complex_tasks.mgr)>

<sup>125</sup> The Governmental Portal of the Republic of Uzbekistan “Нанотехнологии – фактор инноваций” (19.01.2010)  
<<http://www.gov.uz/ru/press/society/4074>>

<sup>126</sup> The Governmental Portal of the Republic of Uzbekistan <<http://www.uza.uz/ru/society/3479>>

<sup>127</sup> High Level Group on Key Enabling Technologies Nanotechnology Report “Nanotechnology: a sustainable basis for competitiveness and growth in Europe” (12.2010) <[http://ec.europa.eu/enterprise/sectors/ict/files/kets/3\\_nanotechnology\\_final\\_report\\_en.pdf](http://ec.europa.eu/enterprise/sectors/ict/files/kets/3_nanotechnology_final_report_en.pdf)>

<sup>128</sup> Ibid.

<sup>129</sup> J.F. Clerc, KET “Open Day on Nanotechnologies” (27.10.2010)

<sup>130</sup> Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC  
<<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:396:0001:0849:EN:PDF>>

With regard to EECCA countries, despite high scientific and research capacity, the governmental funding in many countries has not yet reached its peak. Neither did the private sector investment. There is a need to develop solid infrastructures for nanotechnology research and development, to promote coordination of innovation projects, to strengthen the capacity, to equip laboratories, to create incentives for transformation of nanotechnology inventions into commercialized products, and to further develop a dialog between stakeholders including manufacturers, private sector, competent authorities, researchers and civil society. There is also an urging need to develop sustainable regulatory approaches for risks assessment and management.

Competitiveness of economy of every country depends largely on the level of the high technology production. No doubt that nanoscience and nanotechnologies have become one of the perspective areas of science, industry, and business for both EU and EECCA countries. However, many question remain unanswered. To what extent political decisions are concerned in reality with socio-economic implications? What number of announced inventions can indeed become commercialized products desirable for the society?

While facing various implications of nanotechnologies, adopted solution need to trace a delicate balance between, on the one hand, efficient protection of health and the environment based on the precautionary principle and, on the other hand, conditions for innovation necessary for socio-economic development. In this regard regional cooperation may be crucial.