CREST Center for Energy Efficient Technologies: Final Report

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Project Number: 121-A-00-08-00703-00,
CREST Center for Energy Efficient Technologies

U.S. Civilian Research & Development Foundation (CRDF Global)
USAID Ukraine

August 19, 2012

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Glossary of Acronyms

CEET	Center for Energy Efficient Technologies
CREST	Cooperation in Research and Education in Science and Technology
CSA	Coordination and Support Action Program under FP7
GC	Governing Council
GDA	Global Development Alliance
EECA	Eastern Europe and Central Asia
FP7	The European Union's Seventh Framework Programme for Research
HEI	Higher Education Institution
JSO	Joint Support Office
MESU	Ministry of Ukraine for Education and Science
NCP	National Contact Point
PNU	Vasyl Stefanyk Precarpathian National University
SASII	State Agency on Science, Innovation and Informatization of Ukraine
S&T	Science and Technology
STCU	Science and Technology Center in Ukraine
UAH	Ukrainian Hryvnia

Summary of Work Performed

Under Cooperative Agreement #121-A-00-08-00703-00, initiated on June 19, 2008, CRDF Global (CRDF) established the Center for Energy Efficient Technologies (CEET) at Vasyl Stefanyk Precarpathian National University (PNU) in Ivano-Frankivsk, Ukraine. CEET allows established researchers, as well as graduate and undergraduate students, to conduct research on energy efficient technologies to international standards using equipment and materials purchased with Global Development Alliance (GDA) funds.

During the course of the GDA, CRDF Global accomplished the following activities:

- Held an open competition to select the Center, a process that included external review and site visits to multiple Ukrainian universities and extensive coordination with Ministry of Ukraine for Education and Science (MESU).
- Organized a ribbon cutting ceremony for CEET. The ribbon cutting ceremony was attended by U.S. Ambassador to Ukraine William B. Taylor, MESU Deputy Minister Maxim Strykha, CRDF Global Senior Vice President Eric Novotny and Senior Technical Advisor Marilyn Pifer, and Director of CRDF Ukraine Natalia Artiukhovskaya.
- Trained CEET and PNU personnel in financial management.
- Authorized CEET to purchase new equipment to upgrade their laboratories and facilitated those purchases.
- Managed CEET's progress, which included approving personnel changes, payment requests and periodic reports.
- Completed two post-award site visits to CEET. Dr. Bruce Gnade of the University of Texas at Austin served as a scientific expert for both visits.
- Held a competition for young scientists at PNU to participate in research visits to the United States through a program funded by the National Science Foundation.
- Trained CEET participants in technology commercialization through a program funded by the United States Department of State.

During the course of the subaward, CEET accomplished the following activities:

- Received and put into service the following new equipment and supplies:
    - Derivatograph
    - Pore Size Analyzer
    - Radiation Source for the Mössbauer Spectrometer
    - Spectrophotometer
    - Drying Furnace
    - Electronic Balance
- Trained 52 students on the new equipment.
- Introduced 16 new courses.
- Published 13 new textbooks and educational materials.
- Initiated 36 new research projects.
- Published 89 articles in research journals, 43 of which included student authors and 23 of which included a young investigator as the primary author.
- Received four patents.
- Presented research results at 22 international conferences.
- Hosted two scientific conferences.
- Hosted three visiting lecturers.

By most of the quantitative indicators, CEET may be considered a success. One striking achievement is in the number of women participating in CEET. The percentage of female students participating in CEET remained nearly constant at 46% - 51% throughout the three year grant period, with numbers of both male and female students approximately doubling. More impressively, the number of female faculty members also doubled from 5 to 10 while the number of male faculty grew only slightly from 25 to 28. In a field (physics) traditionally dominated by men worldwide, this gain is a laudable achievement. Moreover, meetings with students during site visits revealed that the female students were more likely to be outspokenly ambitious, which bodes positively for continued female advancement in this Center.

Another area of notable success is the degree to which students and young researchers authored scientific publications. The number of students included as co-authors increased markedly during the course of the project, as did the number of young investigators publishing scientific articles as the primary author. Since an important goal of CEET was to empower early-career scientists to do independent research, this indicator is a direct measure of attainment of this goal. Both undergraduate and graduate students have expressed greater interest in research careers as a result of the experience of being able to do intellectually challenging research in an economically significant research field on state-of-the-art equipment.

The record of CEET in establishing and benefitting from collaborations is somewhat mixed. CEET reported a large number of new collaborations with Ukrainian collaborators, and reported a significant number of research publications co-authored with these collaborators. CEET also reported establishing collaborations with nine international research groups, but these interactions yielded a disappointingly small number of jointly-authored papers, suggesting that the level of joint work was not as robust as with other Ukrainian colleagues.

With a research focus on the important area of energy efficiency, it was of course hoped that the research would lead to commercialization of the technologies developed within the grant period. Though this has not yet happened, it should be noted that early-stage research may not rise to commercial viability for several years. CEET has not been able to interest local industry in developing CEET's technologies for the marketplace. In part, this reflects the generally low level of interaction between industry and academia in Ukraine and the lack of experience (or support) within universities for moving inventions to market. With hindsight, it would have been prudent to budget for technology commercialization training at CEET, which could have accelerated the technology commercialization process.

The biggest obstacle to success involved the promised cost-share from the Ministry of Education, Science, Youth and Sport of Ukraine (MESU). Funding from this source to CEET was chronically delayed and sometimes unpredictable restrictions were imposed on its use. The situation worsened following a change of leadership at MESU in early 2010 and the creation of the State Agency (originally the State Committee) on Science, Innovation and Informatization of Ukraine, which led to protracted confusion over which entity had responsibility for the CREST program.

The narrative that follows describes the selection procedure for the CEET host university, the research and educational achievements of CEET, and the monitoring and evaluation activities of CRDF Global. Numerical indicators are then presented with brief descriptions, and a discussion of lesson learned and suggestions for further work. Appendices present certain data such as a listing of scientific publications and conference abstracts prepared by CEET.

Selection of CEET host university

The goal of establishing a Center for Energy Efficient Technologies, as described in the original proposal, was to "develop innovative solutions and new technologies in order to improve energy conservation and efficiency in Ukraine." CRDF Global undertook this program within the framework of the existing U.S.-Ukrainian program "Cooperation in Research and Education in Science and Technology" (CREST). The CREST program aims to better prepare the next generation of young scientists and entrepreneurs and advance Ukraine toward a knowledge-based economy in which the research, education, and commercial communities work together to promote local and regional economic development.

The CREST program had previously established one Research and Education Center at National Mining University in Dnipropetrovsk. The CREST Governing Council, consisting of three representatives from the MESU and three members representing CRDF Global, agreed to jointly hold the competition for a Center for Energy Efficient Technologies as soon as funding was secured.

The Program Announcement for the CEET competition was drafted by CRDF Global, approved by the CREST Governing Council, and released on June 26, 2008. The announcement featured USAID's logo and clearly identified USAID as a funding partner for this program. The announcement solicited proposals from any higher education institution (HEI) in Ukraine of the 3rd and 4th accreditation level (graduate-degree-granting). The Program Announcement was posted on CRDF Global's U.S. and Ukrainian websites, as well as on the MESU website. The announcement was posted in the Ukrainian and English languages. In addition, MESU published the announcement in their newsletter *Svit*, which is sent to HEIs in Ukraine.

The deadline for proposal submission was September 15, 2008. CRDF Global and MESU received proposals from six Ukrainian HEIs. Proposals in English were received by CRDF Global via our electronic proposal submission website. Proposals in Ukrainian were received by mail at MESU in Kyiv. All proposals were screened for eligibility and completeness and all six passed this screening.

U.S. expert reviewers were solicited from the academic community using CRDF's extensive reviewer database. Each of the six proposals was reviewed by four different U.S. scientists (a total of 24 reviews were received). All completed reviews were received by October 13, 2008. MESU also coordinated expert review by Ukrainian scientists. In addition to providing comments on the proposals' strengths and weaknesses, the reviewers assigned a "fundability" score from 1 to 5 to each proposal.

On October 14, 2008, the CREST Governing Council (GC) met via teleconference in Arlington and Kyiv to discuss the results of the written external review and select finalist candidates. Five of the six GC members took part. The GC reviewed the U.S. and Ukrainian external scientific reviews and scores, and discussed the merits of each proposal.

Table 1. Proposals received through the CEET competition

Title	Name of University
Development and introduction of power effective technologies on the economic objects	Petro Mohyla Mikolayiv State University
Scientific-educational center of energy saving technologies	Odessa National Polytechnic University

Research and Educational Centre of Energy Efficient Technologies and Energy Management of NTUU 'KPI'	Kyiv Polytechnic University
Research and education center for energy efficiency technologies	Kharkiv Polytechnic Institute
Nanomaterials in the energy generation and accumulation devices	Vasyl Stefanyk Precarpathian National University
Sustainable Energy Saving Technologies of Fuel Utilization in Industry and Energy Systems	National Metallurgical Academy of Ukraine (Dnipropetrovsk)

Taking into account the scientific reviews and other features of the proposals (such as administrative structure and education plan), the GC selected four proposals to receive site visits. These proposals were from the following universities:

- Kyiv Polytechnic University
- Kharkiv Polytechnic University
- Vasyl Stefanyk Precarpathian University (Ivano Frankivsk)
- National Metallurgical Academy of Ukraine (Dnipropetrovsk)

The universities were notified of their finalist status. The non-finalist universities were also notified and thanked for their participation.

A CRDF-MESU team conducted joint site visits at all four finalist HEIs from October 23-29, 2008. The site visit delegation included a staff member from MESU, two program staff members from CRDF's Arlington office and one from the Kyiv office, and Dr. Fred Wilson, Professor Emeritus of Physics, Rochester Institute of Technology with expertise in evaluating methods of energy production and their efficiencies. Dr. Wilson traveled under contract to CRDF. A professional interpreter unaffiliated with any of the candidate universities also traveled with the team.

Each site visit consisted of a day-long meeting at the university, during which the applicant team was requested to schedule:

- A general presentation on the center as a whole, addressing proposed research, education activities, international linkages, and management aspects.
- Short presentations from researchers and faculty to be involved in the project.
- A presentation and discussion of the proposed program for support of young scientists.
- A discussion with students and young investigators.
- A tour of relevant laboratory facilities, including labs to be renovated and space for equipment to be purchased.
- A closing general discussion and question/answer session.

Following each visit, the team met privately to discuss impressions. Each team member also completed a written evaluation of each center.

The CREST GC met on November 3, 2008 in Arlington, Virginia to receive the site visit team's report. Based on the team's recommendation, the proposal of Vasyl Stefanyk Precarpathian State University in Ivano-Frankivsk was chosen by consensus. CRDF advised USAID/Kyiv of this choice and received approval to proceed on November 18, 2008.

The sub-award from CRDF was signed by PNU on February 26, 2009. The official opening (Ribbon Cutting ceremony) of CEET was held at PNU on May 13, 2009. U.S. Ambassador to Ukraine William B. Taylor,

MESU Deputy Minister Maksym Strykha, and CRDF Global Senior Vice President Eric Novotny delivered remarks at the Press Conference.

Equipment installed and other physical improvements at CEET

A derivatograph, purchased by CRDF Global for CEET, was delivered and installed in the University in December 2009. Several project participants were trained for handling and safe operation of the device. One project participant was dedicated to keeping the derivatograph in proper operational shape and ensuring security of the equipment. The derivatograph helps the Center's researchers analyze porous carbon and metal hydroxide/oxide materials during the development of new and innovative devices for energy generation and storage (electrochemical capacitors, Li-ion power sources).

A Pore Size Analyzer purchased by CEET with GDA funds was delivered to PNU in January 2011. The Pore Size Analyzer is used for nanostructural analysis of capacitors and other electronic nanomaterials generated from organic materials. A technician from Moscow installed the device and provided training to the personnel who will operate the equipment.

To maintain a Mössbauer spectroscope, used for analyzing the composition of nanomaterials, every two or three years CEET needs to replace the depleted radiation source for the device. PNU, after significant delay, received a license to purchase and import a radiation source from a company in Russia, using the university cost-share funds. In September 2011, the radiation source was installed, allowing CEET to investigate the magnetic field on atomic nuclei, valence state, morphology of nanoparticles, crystalline and magnetic microstructures and chemical bonds, and perform experiments for finding the isomeric shift and quadrupole moment of nuclei.

Additionally, in mid-September 2011, PNU purchased a spectrophotometer and in October 2011, the PNU purchased a drying furnace and an electronic balance for CEET, all as part of its cost share.

Improvements to training of young scientists at CEET

CEET identifies and attracts potential participants starting in the first year of their university studies. CEET professors and instructors conduct workshops and seminars to inform students about CEET. Undergraduate and graduate students are also involved in new student recruitment. CEET leadership then selects the most desirable candidates, based on their academic potential, interests and English language capabilities to join CEET.

CEET scientists, undergraduate students and graduate students are also reaching out to future scientists in local secondary schools through research collaboration with the Junior Academy of Sciences Institute of Postgraduate Education.

The educational sector of CEET is integrated with the scientific sector through the development of new training courses to prepare students for their degrees. CEET introduced a new curriculum series "Physics of Nanosystems" for students training in the fields of Physics and Applied Physics. This series is aimed at preparing students to study new high technologies for solid materials for energy devices. A permanent seminar for undergraduate and graduate students has been established through which scientists involved in the project give lectures on subjects of their research activities. CEET is also adopting new educational IT-technology in the physics department. (See Appendix 6 for a listing of new courses developed within the framework of CEET.)

As CEET participants, undergraduate students are able to perform more sophisticated research (using CEET's scientific equipment) than other university students. They can then use their undergraduate research to jump start their graduate careers.

Scientific progress at CEET

CEET's major scientific accomplishments are as follows:

- Development of new methods for obtaining and modifying materials for electrical energy sources and storage (including oxides of Ti, Mg, Si, Fe, spinel, and nanoporous carbon);
- Investigation of the structure, morphology, physical and chemical properties of these materials;
- Determining the characteristics of intercalation processes in material-based electrochemical systems and the influence of the method of production and modification on their electrochemical properties;
- Proving that laser and intercalation technology can be used for the modification of nanodispersed and nanoporous materials;
- Developing laboratory models of electrical energy sources on the base of nanodispersed and nanoporous materials with specific energy and capacitive characteristics comparable to known world analogues;
- Establishing scientific cooperation with other scientific and educational institutions, including the Institute of Semiconductors of National Academy of Sciences of Ukraine, Institute of Physics of NAS of Ukraine, Institute of Metals, and National University "Lviv Polytechnic".

The management of CEET report that the Center will continue to exist as a distinct unit of PNU after the grant funding from CRDF is concluded. CEET's impact on the university includes heightened interest from local authorities in the scientific achievements of the university, as well as a significant revival of university science activity through research grants for applied science.

Monitoring and evaluation

During the grant period, CRDF Global organized site visits to determine CEET's progress against USAID indicators and evaluate its achievements, equipment, and commitment to young researchers. A mid-term site visit took place on November 8, 2010 and an end-of-term site visit on March 22-23, 2012. Each site visit team included staff from CRDF Global's Arlington and Kyiv offices and Dr. Bruce Gnade, Vice

President for Research at the University of Texas at Dallas, an expert with outstanding knowledge of materials science and energy generation.

Each site visit included a walk-thorugh of the laboratories and equipment purchased under the project, a meeting with the university Rector and CEET management team, presentations by students of their research work, and a press conference to publicize and highlight the project's results. In each case, the site visit team also met separately with students and graduate students (without professors and senior staff) to discuss the impact of the CEET establishment on the students' educational and research experience and on their scientific ambitions.

Since an aim of the CREST program is to create sustainable Centers, CEET sustainability is an important criterion for program success. After the end of the grant period, CEET will continue to function through the following activities:

- Conducting research in applied materials science;
- Cooperating with other research groups and collaborating on experiments;
- Making efforts to commercialize their existing research, and cooperating with other groups (technologists, chemists) in order to provide market ready technological products;
- Teaching courses that were initiated by CEET and conducting specialized laboratory work on the subject of CEET for students;
- Managing the scientific groups to fulfill students' coursework with experimental studies to be conducted at CEET;
- Assisting undergraduate and graduate students and young researchers as they participate in research exchanges;
- Making it possible for students and young researchers to conduct research on the CEET equipment for their scientific work;
- Applying for future grants as a unit.

Although it is too early to judge whether CEET will survive as a distinct entity over the long run, it is encouraging that the CEET management is committed to continue the work of the Center.

Indicators and Results

Achievement of Intended Results:

1. Development of novel technologies and strategies that can be implemented in the near term to improve energy efficiency in Ukraine.
   - CEET has been working on strategies to use less expensive materials in energy efficient technologies, such as using iron oxide to replace ruthenium dyes in solar cells, and using local food waste to produce activated carbon for capacitors. These technologies are still in the early stages of development, but their widespread implementation has the potential to improve energy efficiency in Ukraine and elsewhere.

2. Engaging over 100 students and faculty directly in research and education programs that will develop students' skills, attract the best faculty, and enable the Center to produce effective results that will benefit the country.
   - To date, the REC has directly impacted 79 participants, including 52 students. This has increased from 51 original participants, including 21 students. The students who participate in CEET have access to additional educational opportunities through specialized coursework, and all CEET participants have access to advanced research equipment, which allows them to engage in high-quality research. As CEET continues its work, more students and faculty will participate in CEET and benefit.

3. Forging collaborative links between the university and local Ukrainian companies, who will gain access to state-of-the-art research equipment at the Center.
   - No local Ukrainian companies have partnered with CEET or used their research equipment. This is due in part to a lack of local Ukrainian companies working in this field. As CEET becomes more well known, through publishing articles in more prestigious journals and presenting their findings at international conferences, they will be in a better position to collaborate with Ukrainian companies.

4. Benefits to U.S. companies a) through direct collaboration with the Center and b) from the increasing quality of graduates from the CREST Center for staffing local operations in Ukraine.
   - No U.S. companies have collaborated with CEET as of yet, and no graduates are working for U.S. companies working in Ukraine. As CEET becomes more well known, through publishing articles in more prestigious journals and presenting their findings at international conferences, they will be in a better position to collaborate with U.S. companies.

5. In the longer-term, benefit to the Ukrainian economy through energy savings from adoption of technology developed at the Center.
   - It is too early for any CEET technologies to have had any impact on the overall economy of Ukraine.

6. Propagation of a beneficial model for integrating research into the education of young scientists.
   - CEET is the second research and education center implemented by CRDF Global in Ukraine. CRDF Global is currently working to secure funding for two more centers in Ukraine that would follow the same model.

CEET Success Indicators:
The major activity under this project was the establishment and operation of CEET, carried out through a subaward in effect from March 2009 through May 2012. The figures for FY09 therefore cover a period of seven months and the FY12 figures cover a period of eight months, while the FY10 and FY11 figures are for twelve months each.

- Increasing peer-reviewed publications from research using new equipment;

Publications by year	FY09	FY10	FY11	FY12	Total
Target	6	12	15	2	35
Actual	10	37	23	19	89

  - The target number of publications increased each year. Each year, CEET exceeded the target rate. A list of CEET's publications can be found in Appendix 2.

- Forming new collaborations on the basis of research made possible by new equipment;

Collaborations by year	FY09	FY10	FY11	FY12	Total
Actual	11	19	16	13	59

  - CEET has increased their number of collaborations over the course of the grant. A list of CEET's new collaborations can be found in Appendix 8.

- Introducing research techniques and modeling research management skills within the host university;
  - CEET employs modern, state of the art research techniques. CEET's research management skills are validated by PNU's support for its sustainability after the end of the project.

- Establishing partnerships or collaborations between the university and local Ukrainian companies that gain access to state-of-the-art research equipment at the Center;
  - No local Ukrainian companies have used the research equipment at CEET. However, a number of institutes of the National Academy of Sciences of Ukraine have used the equipment. Further information on equipment usage can be found in Appendix 1.

- Attracting young scientists from a partner university and from outside the Center's immediate geographic region;
  - Over the course of the grant, one undergraduate and two graduate students from outside the immediate geographic region have participated in CEET. Further information about student demographics can be found in Appendix 9.

- Engaging young researchers in peer-reviewed publications;

Publications featuring students and young investigators by year	FY09	FY10	FY11	FY12	Total
Students	2	15	18	8	43
Young Investigators (as primary author)	0	3	17	3	23

- Attracting additional outside funding as a result of improved research;

Sources of outside funding by year	FY09	FY10	FY11	FY12	Total

Target	0	4	4	4	12
Actual	5	12	12	1	30

- CEET has attracted 30 new sources of funding over the course of the grant, exceeding the targeted goals. A list of new sources of funding can be found in Appendix 11.

- Promoting international partnerships including co-authored papers, presentations at international conferences and participation in joint research projects.

Internationally co-authored publications by year	FY09	FY10	FY11	FY12	Total
Actual	0	2	2	1	5

Presentations at international conferences by year	FY09	FY10	FY11	FY12	Total
Actual	4	1	13	4	22

International joint research projects by year	FY09	FY10	FY11	FY12	Total
Actual	1	0	1	0	2

Statistics:

- Number of research projects initiated;

New research projects by year	FY09	FY10	FY11	FY12	Total
Actual	5	12	12	7	36

- Number of females/males trained to use new technology;

Students trained	Total
Females	23
Males	29
Total	52

- Number of scholarships/stipends granted by the Center;

Stipends paid by semester	Fall 2010	Spring 2010	Fall 2011	Spring 2011	Fall 2011	Spring 2012	Total
Actual	21	21	21	28	20	0	111

- Number of female/male students/faculty engaged in research;

Total participants by year	FY09	FY10	FY11	FY12
Female Students	10	10	19	20
Female Faculty	5	9	10	10
Female Total	**15**	**19**	**29**	**30**
Male Students	11	11	18	23
Male Faculty	25	27	28	28
Male Total	**36**	**38**	**46**	**51**

- Number of papers published by students in national and international journals;

Student publications in journals by year	FY09	FY10	FY11	FY12	Total
National	2	15	18	8	43
International	0	0	0	0	0

- Number of companies and NGOs introduced to new technologies; and

New research projects by year	FY09	FY10	FY11	FY12	Total
Actual	2	3	4	3	12

Success Stories:

CEET Students have participated in national and international student competitions, contests, and scholarship programs. In 2009 in the National Student Tournament of Physicists, a CEET participant won the individual championship. The CEET team "FLASH", consisting of four CEET students, received second place in the national tournament and the right to participate in the International Student Tournament of Physicists. In 2010 the team "FLASH" received the award for best report. The team won third place in 2011. Two CEET participants are members of the fellowship program "ZAVTRA.UA", sponsored by Ukrainian businessman and philanthropist Victor Pinchuk. In 2012 a CEET participant received third place in the National competition of student scientific works.

Additionally, two young investigators from CEET received grants through the peer-reviewed CREST Junior Scientist Research Collaboration competition. The purpose of the program is to promote and foster collaborative relationships between early-career scientists in U.S. universities and their counterparts in the Research and Education Centers established under the CREST program. Both young investigators received travel grants from the State Agency on Science, Innovation, and Informatization of Ukraine (SASII) to support research visits of up to three months at U.S. universities. This represents additional funding attracted to CEET.

The FP7 EU National Contact Point (NCP) "Nanosciences, nanotechnologies, materials & new production technologies" was created at PNU as result of CEET activity. No other NCPs were created in Ukrainian universities during this period. All of the NCP's personnel are also CEET researchers. CEET participated in JSO events and international study-tours (Germany, Austria, Hungary), organizing three joint events during 2010-2011 (A Workshop, 'Energy' Information Day and Technical Workshop and "brokerage event" to facilitate partnerships to apply for FP7 "Energy" funding). The NCP organized an information exchange between CEET, NCP "Nanomaterials", NCP for Energy Julich Research Centre (Germany), and Polish NCP for Research Programmes of the EU.

Below are quotations from CEET participants regarding the success of CEET:

"Researchers, especially young researchers, have got a firm belief that it is real in our country, particularly in Ivano-Frankivsk, to successfully develop modern science."

"No doubt the project was useful for us in all respects (scientific, educational activities, scientific contacts, suggestions and advices from CRDF [Global] staff), which will certainly help us to successfully develop our research and use them in practice, particularly in writing and implementing business plans."

Additionally, CEET has garnered some media attention. In total, nine articles, one radio news piece, one television interview, and four television mentions about CEET have been made.

Overall Impact Indicators:

- Enhancement of the knowledge base in the area of energy conservation and energy efficiency through the CREST Center's research-based education in Ukraine;
    - CEET's research work has led to new ideas and technologies in the fields of energy conservation and energy efficiency. These ideas have been shared through publications and conference presentations, which have in turn enhanced the general knowledge base.

- Internationalization of higher education in Ukraine through new collaborations and international knowledge transfer in the field of energy conservation and energy efficiency;
    - CEET has shared knowledge and formed collaborations with the following international bodies:
        - *Ryerton University,* Toronto, Canada (Participation in Toronto International Conference - Science and Technology for Humanity – TIC-STH 2009, September 2009);
        - *Institute of Problem Diagnostics & Research Centre of St. Boniface General Hospital,* Winnipeg, Canada (Report with multi-media presentation, September 2009);
        - *International Bureau of the Federal Ministry of Education and Research at the German Aerospace Center (DLR),* Bonn, Germany (One week FP7 Contact Point Training for EECA-Partner Countries for increasing the quality, quantity, profile and impact of bi-regional Science and Technology (S&T) cooperation, October 2009);
        - *Academy of Sciences of Turkmenistan,* Ashgabat, Turkmenistan (Participation in the International Conference on Energy Effective Technologies, February 2010);
        - *Dalian Foreign Science and Technology Exchange Centre,* China, Dalian City, (Participation in China International Patent Fair, August 2010.);
        - *Heilongjiang University, School of Chemistry and Material Science,* China*,* Harbin City (Organizing joint research, exchange of students and researchers, 2011);
        - *Gazy University,* Ankara*,* Turkey (organizing joint research, exchange of students and researchers, 2010-2011);
        - *University of Texas at Dallas,* Dallas, USA (CEET graduate student and post-graduate student participated in a research internship as winners of CREST Program "Scientific cooperation program for young scientists in geology, environmental and energy efficiency," November-December 2011);
        - *Institute of the Electronic Engineering and Industrial Technologies, Academy of Sciences of Moldova*, Kishinev, Moldova (Organizing joint research, 2011);
        - *Ottawa University*, Ottawa, Canada (Participation in the 2nd International Conference on Nanotechnology: Fundamentals and Applications, July 2011);
        - *FP7 EU National Contact Point in Kyiv, Ukraine and Joint Support Office (JSO)* for enhancing Ukraine's integration in EU research area (FP7 EU Project: EuropeAid/127891/C/SER/UA; Contract No 170-251, 2010-2011).

- Promotion of university-industry partnerships in the field of energy conservation and energy efficiency;

  - CEET understands how important university-industry partnerships are in driving quality innovation and is still striving to establish working partnerships with local and international industry.

- Potential for reduction of energy consumption and energy dependency in Ukraine.
  - CEET has produced devices that with further commercialization could be used as alternatives to current technologies and reduce energy consumption and dependency in Ukraine.

Potential Indicators of Failure:

- Equipment misused or disused;
  - CRDF Global has not detected any instances of misused or disused equipment.
- Participants not carrying out innovative research;
  - According to objective international scientific experts, the research being carried out by CEET is innovative.
- Evidence of poor management.
  - There has been no evidence of poor management.

Lessons Learned and Recommendations for Follow-on Activity

CEET can be considered a successful model for future programs for the following reasons:

1) PNU's undergraduate and graduate students have expressed greater interest in research work, because they have observed through their experience with CEET that (as remarked by one young scientist) “even in non-specialized scientific institutions in Ukraine it is possible to create world-class science and get a proper salary for it.”

2) CEET has provided the possibility for researchers and young researchers to work on new equipment, obtain world-class research results, and integrate into the international scientific community by making new contacts and applying for new grants. Research laboratory access for students can certainly be considered a best practice. Another important incentive is student research reports, which are presented at seminars carried out by CEET.

CEET's main weakness is the lack of research commercialization to date. Despite effort on the part of CEET, local industry has not been interested or able to develop CEET's technologies. This is a reflection of Ukraine's generally weak entrepreneurship climate and disinterest by Ukrainian industry in utilizing locally-developed innovations. There are very few opportunities for scientists to work with industry to create marketable products. To help overcome this difficulty, CEET participants attended a workshop held in April 2012 by CRDF Global’s Science and Technology Entrepreneurship program, which provided basic training on transferring ideas to marketable products. While CRDF Global has learned that more specific commercialization training should be offered to future centers, CEET has only been in operation three years, and is therefore in the early stages of technology development.

CRDF Global’s most important lesson learned concerns the cost share promised by MESU. These funds were consistently delayed and unpredictable restrictions were imposed on their use. CRDF Global has worked with MESU to jointly fund a number of programs in the past, but did not experience these problems before. CRDF has recently been collaborating with SASII for some joint programs. Under the current administration, SASII has proved to be a more reliable funding partner than MESU.

In consultation with CEET, CRDF Global recommends four follow-on activities:

1) Facilitating contacts with U.S. academic institutions interested in CEET’s development;
2) Facilitating reciprocal exchange programs for scientists, graduate students, and even undergraduate students between U.S academic institutions and PNU.
3) Contributing informational support for scientific publication plans.
4) Training CEET participants in technology development and commercialization.

APPENDIX 1: Final Project Financial Status Report Summary

AWARD NUMBER: UKX2-9200-IF-08

FINAL PROJECT FINANCIAL STATUS REPORT SUMMARY

Cooperation In Research and Education In Science and Technology (CREST)

USAID	Pre-Subaward	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 5	Quarter 6	Quarter 7	Quarter 8	Quarter 9	Quarter 10	Quarter 11	Quarter 12	Quarter 13	Previously Unreported	Total
Individual Financial Support (IFS)		$13,050 00	$13,050.00	$12,750.00	$13,050.00	$13,050 00	$13,050.00		$26,100.00	$13,050.00	$13,050 00	$13,050.00		$13,050.00		$156,300.00
Stipends/Young Investigator Support																$0.00
Equipment, Materials, and Supplies		$99,620 00		$2,789.00				$36,330 00								$138,739.00
Travel Expenses																$0.00
Institutional Support																$0.00
SUBTOTAL	$0.00	$112,670 00	$13,050.00	$15,539.00	$13,050.00	$13,050 00	$13,050.00	$36,330.00	$26,100.00	$13,050.00	$13,050 00	$13,050.00	$0.00	$13,050.00	$0 00	$295,039.00

MES	Pre-Subaward	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 5	Quarter 6	Quarter 7	Quarter 8	Quarter 9	Quarter 10	Quarter 11	Quarter 12	Quarter 13	Previously Unreported	Total
Individual Financial Support (IFS)				$44,000.00				$37,750 00					$17,192.98			$98,942.98
Stipends/Young Investigator Support				$31,000.00												$31,000.00
Equipment, Materials, and Supplies													$12,508.30			$12,508.30
Travel Expenses																$0.00
Institutional Support																$0.00
SUBTOTAL	$0.00	$0 00	$0.00	$75,000.00	$0.00	$0 00	$0.00	$37,750.00	$0.00	$0.00	$0 00	$0.00	$29,701.28	$0.00	$0 00	$142,451 28

PNU	Pre-Subaward	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 5	Quarter 6	Quarter 7	Quarter 8	Quarter 9	Quarter 10	Quarter 11	Quarter 12	Quarter 13	Previously Unreported	Total
Individual Financial Support (IFS)																$0.00
Stipends/Young Investigator Support																$0.00
Equipment, Materials, and Supplies			$11,364.43	$6,332.96	$1,638.87	$3,022 86	$13,489.00	$4,035.36	$1,027.67	$3,495.46	$14,888 85	$16,544.95	$2,906.71	$159.44	$38,948 61	$117,855.17
Travel Expenses			$2,320.34	$2,526.47	$868.49	$706 08	$743.50	$112.56	$1,114.21	$238.01	$208 68	$880.75				$9,719.09
Institutional Support			$9,791.46	$5,775.84	$6,415.96	$2,118.79	$1,447.28	$1,481.78	$3,109.88	$3,728.99	$1,682 67	$2,393.08	$4,074.82	$2,560.66		$44,581.21
SUBTOTAL	$0.00	$0 00	$23,476.23	$14,635.27	$8,923.32	$5,847.73	$15,679.78	$5,629.70	$5,251.76	$7,462.46	$16,780 20	$19,818.78	$6,981.53	$2,720.10	$38,948 61	$172,155.47

CRDF Global Expenses	Pre-Subaward	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 5	Quarter 6	Quarter 7	Quarter 8	Quarter 9	Quarter 10	Quarter 11	Quarter 12	Quarter 13	Previously Unreported	Total
USAID Funds	$9,090.38	$7,088 32	$47,345.94	$14,573.22	$3,355.04	$5,083 63	-$10,853.72	$28,255.85	$5,549.16	$3,812.73	$3,428 85	$3,915.17	$5,718.78	$14,595.60		$140,958.95
CRDF Global Leveraged Funds	$82,884.80	$24,738 57	$5,414.03	$7,039.00	$8,941.79	$3,606 60	$2,427.32	$17,663.82	$0.00	$0.00	$0 00	$0.00	$0.00	$0.00	$0 00	$152,715 93
SUBTOTAL	$91,975.18	$31,826 89	$52,759.97	$21,612.22	$12,296.83	$8,690 23	-$8,426.40	$45,919.67	$5,549.16	$3,812.73	$3,428 85	$3,915.17	$5,718.78	$14,595.60	$0 00	$293,674.88

Total Expenses	Pre-Subaward	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 5	Quarter 6	Quarter 7	Quarter 8	Quarter 9	Quarter 10	Quarter 11	Quarter 12	Quarter 13	Previously Unreported	Total
Total Expenses from All Sources	$91,975.18	$144,496 89	$89,286.20	$126,786.49	$34,270.15	$27,587 96	$20,303.38	$125,629.37	$36,900.92	$24,325.19	$33,259 05	$36,783.95	$42,401.59	$30,365.70	$38,948 61	$903,320.63

APPENDIX 2: Equipment

CEET Equipment List

	Description	Funding Source
1	Simultaneous Thermal analyzer (TG-DTA Apparatus) STA 449 F3 Jupiter with software	USAID
2	Automatic porous meter Quantachrome Autosorb (Nova 2200e)	USAID
3	Mossbauer Source (Analyzer)	PNU
4	Impedance spectrometer	PNU

Outside Organizations using CEET Equipment

Organization	Equipment / facilities used
National State University "Lviv Polytechnics"	Automatic porous meter Quantachrome Autosorb (Nova 2200e)
Ivano-Frankivsk University of Oil and Gas	Simultaneous Thermal analyzer (TG-DTA Apparatus)
Chernivici National State University	Simultaneous Thermal analyzer (TG-DTA Apparatus)
National State University "Lviv Polytechnics"	Mossbauer Source (Analyzer)
Institute of Metal Physics	Mossbauer Source (Analyzer)
Taras Shevchenko National State University	Mossbauer Source (Analyzer)
National State University Lviv Polytechnics	Impedance spectrometer
Ivan Franko Lviv National University	Impedance spectrometer
Taras Shevchenko National State University	Impedance spectrometer

Equipment description	% of total use by outside investigators
Simultaneous Thermal analyzer (TG-DTA Apparatus) STA 449 F3 Jupiter with software	2%
Automatic porous meter Quantachrome Autosorb (Nova 2200e)	2%
Mossbauer Source (Analyzer)	10%
Impedance spectrometer	5%

CEET use of Equipment belonging to Outside Organizations

Organization	Equipment / facilities used by CEET personnel
Institute of Physics of Semiconductors, NASU	Raman spectrometer
Institute of Chemistry of Surface, NASU	FTIR-spectrometer
Institute of Problems of Material Science, NASU	Transmission electron microscopy
Institute of Metal Physics, NASU	X-ray photoelectron spectrometer

APPENDIX 3: Publications

Publication Summary

	1st year	2nd year	3rd year
Total publications	**59**	**68**	**62**
Total research publications (not including conference abstracts)	10	37	23
Research publications including student authors	13	20	10
Research publications by young scientists (within 6 years of Kandidat/PhD)	0	13	10
Research publications with collaborators from other Ukrainian institutions	17	26	9
Research publications with foreign collaborators	0	4	1
Conference abstracts	**30**	**24**	**37**
Conference abstracts including student authors	9	8	14
Conference abstracts by young scientists (within 6 years of Kandidat/PhD)	22	18	29
Conference abstracts with collaborators from other Ukrainian institutions	11	8	7
Conference abstracts with foreign collaborators	0	2	5
Candidate or Doctoral dissertations based on work using CEET facilities	**0**	**3**	**2**

Research Publications:

Designations at the end of the citation indicate the following:

- includes **CEET student** authors **(S)**
- includes collaborators from **other Ukrainian institutions (U)**
- includes **international** collaborators **(I)**
- is a candidate or doctoral **dissertation** based on work at CEET facilities **(D)**
- the **senior author** for the work is a **young** investigator **or student (Y)**

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APPENDIX 4: Patents Received by CEET

1. Patent of Ukraine #45058, MPK H 01 M 4/00. Cathode materials for lithium power sources / I.M. Gasyuk. A.M. Gamarnyk. M. Ya. Sichka, T.B. Grushevsky: Vasyle Stefanyk Precarpathian National University. No. u 2009 04834;, 18.05.09; published . 26.10.09, Vol. No. 20.

2. Patent of Ukraine # 54833. Method of optimizing of the thermo-electrical properties of Lead Telluride nanostructures. D.M. Freik, L.I. Nukuruy, I.I. Chavyak, A.I. Tkachuk. Registration number: u 2010 06326. Data registration: 25.05.2010. Date of publishing: 25.11.2010, Bull. N 22.
   Proposing technology modes of forming lead telluride nanostructures by “hot wall” method at the regulation of type and temperature of substrate.

3. Patent of Ukraine # 58507. Method of laser modification of the properties of electrode material for lithium electrochemical power sources. Ostafiychuk B.K., Budzulyak I.M., Ilnytsyy R.V., Segin M.Ya. Registration number: 2249/3У/10. Date of publishing: 11.04.2011., Bull. № 7.
   It was shown that laser irradiation of titanium dioxide (anatase) ($E = 0.03$ J, $\tau = 15$ ns, $f = 28$ Hz) increases the energy density of lithium plating appropriate elements to 32-37%.

4. Patent of Ukraine # 58508. Method of optimizing the properties of the electrode material. Ostafiychuk B.K., Budzulyak I.M., Ilnytsyy R.V., Segin M.Ya. Registration number: 2263/3У/10. Date of publishing: 11.04.2011., Bull. № 7.
   Parameters of pulsed laser irradiation of the electrode material based on titanium dioxide were optimized.

APPENDIX 5: Dissertations Defended by CEET Participants

1. B.I. Rachiy. Morphology and electrochemical properties of thermal modified nanoporous carbon. Dissertation for the Candidate Degree in Physics and Mathematics. Speciality 01.04.18 – Physics and Chemistry of Surface. Vasyl Stefanyk Precarpathian National University, Ivano-Frankivsk, 2010.

2. S.A. Galiguzova. Physical and chemical processes of electrochemical intercalation of Li^+ in Zn - deputized lithium – ferrous spinel. Dissertation for the Candidate Degree in Physics and Mathematics. Specialty 01.04.24 -Physics of the Colloid Systems. Vasyl Stefanyk Precarpathian National University, Ivano-Frankivsk, 2010.

3. M.Ya. Sehin. Cathode matters of lithium power sources on the basis of laser modified titania. Dissertation for the Candidate Degree in Physics and Mathematics, Speciality 01.04.18 - Physics and Chemistry of Surface. - Vasyl Stefanyk Precarpathian National University, Ivano-Frankivsk, 2011.

4. B.Y. Deputat. Synthesis, crystal structure and electric properties of ceramics Li_2O-Fe_2O_3-Al_2O_3 on transition to metastable condition. Dissertation for the Candidate Degree in Physics and Mathematics. Speciality 01.04.24 – Physics and Chemistry of Colloid Systems. Vasyl Stefanyk Precarpathian National University, Ivano-Frankivsk, 2011

APPENDIX 6: Conference Abstracts

PHYSICS AND TECHNOLOGY OF THIN FILMS AND NANOSYSTEMS
XII International Conference, 18-23 May, 2009
Ivano-Frankivsk, Ukraine

1.	**Modification of physical and chemical properties of nanoporous carbon** (*) Ostafiychuk B.K., Budzulyak I.M. The possibility of modification of nanoporous carbon for the electrodes of supercapacitors with the help of laser irradiation and alloying by metals with high electronic density are presented
2.	**Features Transport Phenomena in Lead Chalkogenide Thin Semiconductor Films (*)** Freyik D.M. The review of works is done on the questions of nanomaterials science, in which the accented attention is on the physical features of quantum-size structures, methods of their receipt and terms of forming. The prospects of creation of new elements of nanoelectronics are separately considered in addition, their descriptions are resulted.
3.	**X-Ray Diffraction on Helium Irradiated $Y_3Fe_5O_{12}$ Film Near-Surface Layers (*, S)** Fedoriv V. D., Kurovets V. V. Crystalline structure changes in near-surface layers of helium implanted $Y_3Fe_5O_{12}$ films are investigated by x-ray double-crystal diffraction method. Strain-depth profiles are calculated on the basis of statistical dynamic theory.
4.	**Topology features forming from a steam phase nanostructure of PbTe (*, U)** Lytvyn P.M., Lischynskij I.M., Freyik D.M., Sipatov O.Yu. Yuzefovich O.I. Investigational mechanisms of origin and growth of nanocrystals structures connections of $A^{IV}B^{VI}$ on single-crystal (split (111) off BaF_2 and (0001) mica muscovite) and amorphous dielectric surfaces (film oxide is on the single-crystals silicon of SiO_2-Si), and also two-layers structures on their basis.
5.	**The properties of the electrochemical systems formed on laser irradiated fumed TiO_2 base (*, S,U)** Ostafiychuk B.K., Ilnytskiy R.V., Budzulyak I. I., Sehin M.Ya., Havenchuk Yu.V. The effect of the combined action of heating in furnace and laser irradiation of rutile and anatase TiO_2 form mixture on electrochemical system properties formed on their basis. It is set that maximal intercalation degree depends substantially on the ratio of rutile and anatase form content and particle size obtained at laser irradiation.
6.	**Laser modification of $Li_xTiS_2F_y$ intercalation compounds (*, U)** Budzulyak I.M., Grygorchak I.I., Yablon L.S., Morushko O.V. The co-intercalation processes of disulfide titanium by lithium and fluorine are investigated. The regularities of laser irradiation effect on properties of intercalation compounds are set.
7.	**The effect of laser irradiation on kinetics of lithium electrochemical intercalation processes into SiO_2-C nanocomposite (*)** Mandzyuk V.I., Myronyuk I.F. The effect of laser irradiation on kinetics of electrochemical processes of lithium ions introduction into nanocomposite SiO_2-C is investigated. It is set that this process realized due to absorption mechanism independently from laser irradiation regimes, accordingly to which lithium ions accumulates on cathode material surface.
8.	**The electrolyte type dependency of electrochemical capacitors specific capacity (*, U)** Merena R.I., Lisovskiy R.P., Rachiy B.I.

	High temperature treatment influence of nanoporous carbon materials (NCM) on the electrolyte/NCM system electric double layer parameters was studied.
9.	**The $FeCl_3$-intercalation modification influence on structure and properties of nanoporous carbon-electrolyte interface double electric layer (*, U)** **Pokladok N.T. , Grygorchak I.I. , Mokliak V.V.** For graphite inclusions intercalation we propose to use the ferum trichloride. It improves porous structure for Fe therma injection in activated carbon structure for free charge carrier concentrator increase.
10.	**Synthesis and mossbauer studies of nanocrystalline ferrite powders (*, U)** Yushchuk S.I., Yuryev S.O., Mokliak V.V., Tsyupko F.I., Nikolaichuk V.J. Method of nanocrystalline ferrite powders synthesis is proposed and their mossbauer studies are realized. The phase composition of obtained material is set.
11.	**Grown and modified by ionic implantation Si+ the changes of structure FGF (*, S)** Garpul O.Z., Solovko Y.T. We considered the conformity of formation structure layers of $Y_3Fe_5O_{12}$-films as a result of growing by the method of rarely phase of epitaxy and it was set the features of variation division of elements as a result of ionic implantation of Si+.
12.	**Features of Transport Phenomena in Electronic Lead Chalkogenide Crystals (*,S)** Nykyruy L.I., Dzumedzey R.O. The carrier mobility at account of any scattering mechanisms is calculated in approximation on variation position to the Boltsman equation and Cane's band structure. The thermo-electrical properties are analysed. Dimensionless thermo-electrical quality factor for PbX and PbX:In on wide temperature and carrier concentration ranges was calculated and investigated (X = S, Se, Te).
13.	**Electrochemical properties of a cathode material based on Ti –ions dopped lithium-ferrous spinel (*, U)** Gasyuk I.M., Ugorchuk V.V., Mokliak V.V. This study focuses on electrochemical properties of cathode materials and efficiency of their application in creating lithium sources of current.
14.	**The annealing Influence on Crystalline Structure Ferrite-Garnet Films Implanted by Heavy Ions (*)** Ostafiychuk B.K., Kravets V.I., Klyuka S.Y., Yaremiy I.P. The influence As^+-ions implantation and post-implantation annealing on the crystalline structure of YIG films is investigated. As shown, the crystalline structure transformation of ion-implanted layers occurs by various mechanisms at different irradiation doses.
15	**Superparamagnetic γ-Fe_2O_3: Synthesis and Properties (*)** Kotsyubynsky V.O., MokliakV.V., Chelyadyn V.L. Simple method of monophase nanosized γ-Fe_2O_3 synthesis is proposed and the complex investigations of obtained materials crystal and magnetic microstuctures were realized.
16	**Carrier Scattering and Thermo-Electrical Properties of PbTe:In (*, S)** Nykyruy L.I., Dzumedzey R.O., Lysak A.V., Iljkiv O.I. The influence of doping of the Indium on electrical-physical properties of the PbTe crystals are investigated. There are definitions of concentration and temperature ranges of the dominance of scattering mechanism of the ionizing Indium donor. The analyses will be provided on the base of

	variation position to the Boltsman equation and Cane's band structure. The thermo-electrical properties are analysed. Dimensionless thermo-electrical quality factor for PbTe and PbTe:In on wide temperature and carrier concentration ranges was calculated and investigated.
17	**The Deformation of Near-Surface Layer of FGF of Implantation by Si^+** Ostafiychuk B.K., Garpul O.Z., Yaremiy I. P., Kravets V.I. **(*, S)** The single crystal ferrite-garnet films $Y_3Fe_5O_{12}$ implanted by Si^+ ions of $D=5\cdot10^{13}cm^{-2}$ dose at different implantation energies (100–150 keV) are investigated. It is shown that value of maximal relative deformation decrease as a result of the energy implantation increasing.
18	**Structural Changes IN Single Crystals OF Gallium-Gadolinium Garnets After Irradiation BY He^+ Ions (*, S,U)** Ostafiychuk B.K., Yaremiy I.P., Yaremiy S.I., Fodchuk I.M., Zaplitnyy R.A. Changes in crystalline structure of gallium-gadolinium garnets $Gd_3Ga_5O_{12}$ (111) under the influence of irradiation with He^+ ions were studied. The energy of implanted ions – E=100 keV, the dose $D=2\cdot10^{15}$. A model of possible structural changes in $Gd_3Ga_5O_{12}$ near-surfaces layers after He^+ ion implantation was proposed.
19	**The Kinetics of Low-Temperature Relaxation of GGG Single Crystals Implanted by He^+ Ions (*, S)** Fedoriv V.D., Yaremiy S.I. The single crystals GGG plates implanted by He^+ ions are investigated. It is established mechanism low-temperature relaxation in implanted layer for 4 years at a room temperature.
20	**Splited Graphite as an Active Material for Multifunctional Ionistors (*, U)** Kalitsinskyj V.Z., Grygorchak I.I. In this study an ability of usage of graphite in electrochemical double-layer systems was analyzed. To improve the operating characteristics of graphite there was proposed thermo-intercalation method of its modification. The results of experimental investigations of derived material are presented.
21	**Obtaining and Electrochemical Properties of Porous Carbon for Electrodes of Supercapacitors from Pistachio Shell (*, S,U)** Ostafiychuk B.K., Budzulyak I.M., Magometa O.D., Rachiy B.I., Gamarnyk A.M. Electrochemical properties of porous carbon material from pistachio shell are explored. It is shown, that it can be used successfully as electrode material for supercapacitors.
22	**Semiconductor Nanomaterials, Nanotechnology and Nanoelectronics** Freik D.M., Chobanyuk V.M., Galuschak M.O., Lopyanko M.A. **(*, U)** The review of works is done on the questions of nanomaterials science, in which the accented attention on the physical features of quantum-size structures, methods of their receipt and terms of forming. The prospects of creation of new elements of nanoelectronics are separately considered in addition, their descriptions are resulted.
23	**Dye-Sensitized Solar Cells (*, S)** Nagirna N.I. The DSSC is made on $TiO_2/CH_3COOH/C_{34}H_{62}O_{11}$ basis. The photocurrent and open circuit voltage volumes are measured. The photoelectron number are calculated in range of 550-610 nm. It makes $2{,}74\cdot10^{18}$ $(м^2\cdot с)^{-1}$. The efficiency of DSSC is 0,6 %.

ACTUAL SCIENTIFIC ACHIEVEMENT– 2009
Fundamental Problems of the Novel Materials and Technologies Development
V International Scientific-Practice Conference, 27 June - 05 July, 2009
Prague, Czech Republic

1	**Magnetic Microstructures of Nanocomposite Materials γ-Fe_2O_3 / α-Fe_2O_3: Mossbauer Studies** Kotsyubynsky V.O., MokliakV.V., Chelyadyn V.L., Ostafiychuk K.B. Material γ-Fe_2O_3 / α-Fe_2O_3 was obtained by sol-gel method: slow drying (60°C on the air) of colloidal solute $Fe(NO_3)_3 \cdot 9H_2O$ and $C_6H_8O_7 \cdot H_2O$ with different molar ratio between precursors; obtained gel have annealed at 473 K, 573 K and 673 K during 1 hour. Sample systems were investigated by X-ray diffractometry (XRD), Mossbauer spectroscopy (MS), infra-red optical spectroscopy (FTIR). Obtained material is the composite, contained relatively perfect clusters of α-Fe_2O_3, surrounded by nanoparticles γ-Fe_2O_3 in the MO- and SPM-states with presence of γ-FeOOH phase. The influence of magnetic dipole interparticle interaction on parameters of mossbauer spectras was observed.

MOSSBAUER SPECTROSCOPY : APPLICATION
XI International Conference , 1-5 June, 2009
Ekaterinburg, Russia

1	**Synthesis and Properties of Nanocomposite Material γ-Fe_2O_3 / α-Fe_2O_3: Mossbauer Studies** Kotsyubynsky V.O., MokliakV.V., Chelyadyn V.L. Material γ-Fe_2O_3 / α-Fe_2O_3 was synthesized by drying of colloidal solute $Fe(NO_3)_3 \cdot 9H_2O$ and $C_6H_8O_7 \cdot H_2O$ Accordingly to XRD analysis data, obtained systems – mixture of γ-Fe_2O_3 and α-Fe_2O_3; average sizes of X-ray scattering coherent blocks, which are close to particle size, for γ-Fe_2O_3 and α-Fe_2O_3 after annealing at 200°C are 60±15 nm and 230±15 nm respectively. Mass ratio of γ-Fe_2O_3 / α-Fe_2O_3 phases and their particle sizes depend on ratio between precursors at synthesis and annealing temperatures.
2	**Application of Mössbauer Spectroscopy for Research Of Structural Features and Physical Properties of Nanoporous Carbon** R.I. Merena, V.V. Mokliak, R.P. Lisovskiy, B.I. Rachiy For the increase of electronic state density in nanoporous carbon (NC) the method of alloying of initial materials by the metal ions was used. The introduction of metals substantially promotes the capacity characteristics of supercapacitors on NC basis. With the purpose of research of the state and behaviour of metals in NC (in particular iron), which substantially influence on properties of double electric layer, the method of mössbauer spectroscopy was used. The mössbauer spectrum consisted of two doublet component (DC), the parameters of which answer the possible phases of $FeO_n \cdot H_2O$ and β-FeOOH, or iron must be in the unstable ionized Fe^{3+} state. The presence of $FeO_n \cdot H_2O$ compound and Fe^{3+} ions in the free state in this material is improbable as on the final stage of introduction annealing of explored material was made. The absence in the spectrum of Zeeman sextets testifies that the iron ions do not form the iron carbides, i.e., not inculcated in the structure of material.
3	**Structure and Mössbauer Studies of Lithium Iron Spinel Alloyed with Aluminum** Gasyuk I.M., Mokliak V.V., Deputat B.Y., Yaremiy I.P. By ceramic method at temperature of synthesis at 1000 ^{o}C there was obtained series of samples with an expected composition $Li_{0,5}Fe_{2,5-y}Al_yO_4$ (spinel), with the purpose of their employment in the capacity of active substance of positive electrodes of lithium sources of current.

	For obtaining different structural forms the thermal treatment was carried out by two methods: series #1 – speed of cooling t ≈ 0,03 °C/sec; series #2-t t ≈ 4 °C/sec. At determination of phase composition and research of structural forms of samples systems there was applied methods of roentgenophase analysis (RPhA) and Mössbauer spectroscope (MS).

INTERMOLECULAR AND MAGNETIC INTERACTIONS IN MATTER – 2009
JOINT CONFERENCES ON ADVANCED MATERIALS.
6TH WORKSHOP ON FUNCTIONAL AND NANOSTRUCTURED MATERIALS.
10TH CONFERENCE
September, 27 – 30, 2009
Gdansk, Poland

1	**Influence of Ni-intercalative Modification of Nanoporous Carbon on Structure and Properties of Electric Double-layer at Boundary with Electrolyte** **Venhryn B. Ya., Grygorchak I. I., Mudry S. I., Kulyk Yu.O (U)** A detail analysis of the principal diffusive maximum profile revealed its asymmetric shape and allowed us to conclude about the formation of carbon nanoclusters with a graphite-like short range order. The existence of nanopores was also established. The sizes of nanopores and their distribution were determined by means of the X-ray small angle scattering method. Impedance measurements were carried out within frequency interval (10^{-3}–10^{6} Hz) at constant bias from interval [−1,+1] V and used to obtain volt-farad dependencies. The De Levie equivalent electric circuit was modified by a structural chain, representing the volume charge capacity in activated carbon in order to model the obtained Nyquist diagrams. These data as well as the measured cyclic voltamperograms of electrochemical cells allowed us to determine the Fermi level change due to the modification and find the hierarchy in influences on the material's specific capacity and changes of the porous structure.

1-st UKRAINIAN-FRENCH SCHOOL
CARBON NANOMATERIALS: STRUCTURE AND PROPERTIES
September, 14 – 18, 2009
Beregove, Ukraine

1	**Activated carbon material for supercapacitor electrodes on the anthracite basis** **B.I. Rachiy, V.I. Mandzyuk, L.V. Golovko, V.A. Povazhnyy (U)** The correlation between porous structure of ANC from anthracite and its physicochemical properties is investigated in the work, its behavior in electrochemical systems of capacitor type and possibility of using as electrode material for EC are studied. The analysis of structure-adsorptive characteristics of ANC have shown that there are expansion and coalescence of micropores at increase of degree of steam and gas activation of anthracite. Thanks to the optimization of steam and gas activation parameters it is possible to obtain samples of practically homogeneous monoporous activated anthracite with pore size in range of 3,5-6 nm at insignificant content of micropores. According to impedance and potentiodynamic researches it is set that high-porous material with the largest nanoporous volume and insignificant content of micropores is the most effective material for making electrodes of EC.

FUNCTIONAL AND COMPOSITION MATERIALS
20-21 October, 2009

Donetsk, Ukraine

1	**Obtaining And Magnetic Microstructures of Nanocomposite Material γ-Fe_2O_3 / α-Fe_2O_3** **Kotsyubynsky V.O., MoklyakV.V., Chelyadyn V.L.,Ostafiychuk K.B., Grubiak A.B.(S, U)** Material γ-Fe_2O_3 / α-Fe_2O_3 was obtained by sol-gel method: slow drying (60°C) on the air colloidal solute $Fe(NO_3)_3 \cdot 9H_2O$ and $C_6H_8O_7 \cdot H_2O$ for different molar ratio between precursors; obtained gel was annealed at 200, 300 and 400°C during 1 hour. Systems of samples were investigated by X-ray diffractometry (XRD), Mossbauer spectroscopy (MS), infra-red optical spectroscopy (FTIR). Accordingly to XRD analysis data, obtained systems – mixture of γ-Fe_2O_3 and α-Fe_2O_3; average sizes of X-ray scattering coherent blocks, which are close to particle size, for γ-Fe_2O_3 and α-Fe_2O_3 after annealing at 200°C are 60±15 nm and 230±15 nm respectively. Mass ratio of γ-Fe_2O_3 / α-Fe_2O_3 phases and their particle sizes depend on ratio between precursors at synthesis and annealing temperatures. Correspondingly to FTIR data all systems contain adsorbed water and CO_2; presents of amorphous γ- FeOOH phase is established. Accordingly to MS data, for all materials after annealing at 200°C γ-Fe_2O_3 phase is dominant; nanoparticles of γ-Fe_2O_3 are both in magnetic ordered (MO) and superparamagnetic (SPM) states. SPM-part of samples was fixed by MS as two doublet components (DC) with close values of isomeric shift (reference to metallic α-Fe) δ=0,34–0,36 mm/s, and different values of quadrupole splitting Δ, which are determined by neighbour encirclement of Fe^{57} nuclei. DC of MS spectras with Δ=0,88 mm/c is respond to resonance absorption in nanoparticles γ-$Fe_2O_3$with non-zero values of electric field gradient on Fe^{57} nuclei and is explained by deformation effects in crystal lattice of maghemite. Zero values of Δ for second DC are determined by cubic symmetry of particle structure, which are in non-stressed state. The decreasing of MS experiment temperatures (T) from 290 до 88 K caused the linear decreasing and disappearance DC with Δ = 0 mm/s and relative contents about 23% at 290 K; at the same time non-linear decreasing of DC with Δ = 0,88 mm/s was observed . We took the value 4,5 nm (XRD-data) as minimal γ-Fe_2O_3 particle size, supposed that at T=88 K for them the stopping of magnetic moments oscillations take place and calculated the magnetic anisotropy constant of nano-γ-Fe_2O_3– K = $(1,3 \div 1,9) \cdot 10^5$ J/m^3. In presupposition of proportionate exiting between relative contents of DC for MS-spectras and SPM-particles of γ-Fe_2O_3, the calculation of particles size distribution was done. Relative contents 4,5-5,4 nm particles is about 43 %; 5,4 - 6,0 nm – 24 %; 6,0 - 7 nm – 33 %. Correspondingly to linear approximation of *H(T)* the average size of γ-Fe_2O_3 particles is about 5,4-7,2 nm (spherical approaching). So, it's proved that obtained material is the composite, contained relatively perfect clusters of α-Fe_2O_3, surrounded by nanoparticles γ-Fe_2O_3 in the MO- and SPM-states, with presence of γ-FeOOH phase.

8-th INTERNATIONAL CONFERENCE
ELECTRONIC PROCESSES IN ORGANIC AND INORGANIC MATERIALS
(ICEPOM-8)
Ukraine, Residence Synyogora, Ivano-Frankivsk Region, May 17 – 22, 2010,

1	**Kinetics of lithium intercalation processes into amorphous hydrated titania** **I.F. Muronyuk, V.O. Kotsyubynsky, V.L. Chelyadyn.** It was determined that on the first stage (0 < *x* <1,0) different process took part simultaneously. Accordingly to the thermal gravimetric and infrared spectroscopy data structural group OH^- and adsorbed in pores of material H_2O molecules consist up to 20% mass samples. Ion-changing lithium adsorption is the key factor that determines the energetic cathode material capacity. At the same time during the ion-changing processes H_2O molecules are formed which will react with electrolyte components. The second stage (1,1 < *x* <2,1) includes complex processes which took place during the

	formation and structural changes in the mosaic passivation layer with the ionic type of conductivity which totally cover the cathode material.
2	**Structure of nanotitania doped by transition metals ions** **I.F. Muronyuk, V.O. Kotsyubynsky, V.L. Chelyadyn, V.V. Mokliak, P.I.Kolkovsky (S)** Nanomaterials on the titania basis find a wide using as active parts of photocatalysis systems, electrode materials of lithium ion power sources, gas sensors, protonic membranes of fuel cells. The development of the active methods of influence on the phase contents and surface morphology of nanotitania is the important scientific problem. One of the possible ways is the selection of additional precursors and inhibitors of titania phase transitions. Systems TiO_2 / *x* V_2O_5 (*x*=0,5; 1; 2; 3 mass %); TiO_2 / *x* Cr_2O_3 (*x* = 1; 2; 3 mass %), TiO_2/ *x* MnO_2 (*x*=3 mass %) were obtained by the liquid phase hydrolysis method from $TiCl_4$ / HCl solution at 273 K with the using of additional precursors $V_2(SO_4)_5 \cdot 3H_2O$, $Cr(NO_3)_3 \cdot 9H_2O$, $Mn(SO_4)_2 \cdot H_2O$. Structure, morphology and disperse characteristics of material are depended of condensation processes kinetic characteristics, pH degree and temperature. The obtained materials were investigated by X-ray diffraction, low-temperature nitrogen adsorption and infra-red optical spectroscopy methods directly after the drying at 320 K.
3	**B.I. Rachiy, V.I. Mandzyuk, R.P. Lisovskiy, R.I. Merena. (Y)** **The dependence of carbon material resistance on thermal treatment regimes** The determination of specific resistance of carbon materials (CMs) is realized at different pressures of compressing for different temperatures of carbonization process. The specific resistance decreases monotonously for all materials, being the constant at pressure of 1,4 MPa. It caused by increasing of contact area between carbon particles. The increasing of carbonization temperature results in decreasing of specific resistance. The sharp falling takes place at T ≥ 1073 K. Most probably, the content of sp^2-bonded carbon grows at those temperatures, as a result the conductivity of carbon increases: sp^2-electrons are free current carrier at π-bonds breakage [3]. CMs carbonized at temperature of 1173 K are the most suitable material for its follow chemical and thermal treatment. Further increasing of temperature results in partial graphitization of CM, that, in turn, causes the decreasing of its specific capacity.
4	**Freik D.M., Nykyruy L.I., Chobanyuk V.M., Dzumydzey R.O.** **Transport properties of Thallium doped lead telluride due impurity content** Defined boundaries of dominance change of doping scattering with change dopant content. Opportunities to improve of semiconductor materials electrophysical properties by doping it analysis.

INTERNATIONAL SEMINAR
“ORGANIC AND NONORGANIC MATERIALS
FOR MOLECULAR ELECTRONICS AND NANOPHOTONICS ”
Ukraine, Cherkasy, April 23-35, 2010

1	**Ivastchyshyn F. O., Grygorchak I. I., Stariha P. I., Cherpak V. V. (U)** **Behavior of intercalated hybrids with configuration nonorganic semiconductor-conducting polymer in outer electric and magnetic fields**

V INTERNATIONAL SCIENTIFIC CONFERENCE
“RELAXED, NONLINEAR AND ACOUSTIC OPTICAL PROCESSES AND MATERIALS” – RNAOPM’2010”.
Ukraine, Lutsk , June 01-05, 2010.

1	**Grygorchak I. I., Voytivych S. A., Ivastchyshyn F. O., Kalynyckyy V.Z. (U)** **Template synthesis of nanoparticles and sypramolecular structures for increasing of Faradic and capacitance accumulation efficiency**

XVI-th INTERNATIONAL SEMINAR ON PHYSICS AND CHEMISTRY OF SOLIDS.
Ukraine, Lviv, 6-9 June, 2010

1	**B.Ya. Venhryn, I.I. Grygorchak , S.I. Mudry, Yu.O. Kulyk (U)** **Change of fractal structure in of actively carbonized charcoal after intercalative modification with 3d-elements** Fractal structures in solids cardinally differ from typical structures in crystalline or amorphous materials that is the reason of significant changes of their physical properties. Elements of such structure are atoms, molecules, clusters and small nanoparticles, which are arranged according to untypical ordering low. Therefore, due to such structure those materials are more sensitive to change of thermodynamic parameters and outside factors that allows considering them as promising for application in various areas. Particularly, materials, possessing the fractal structure, are candidate materials for new memory systems. One group of such materials are carbon-based ones in which a nanosize porous are commonly distributed. Fractal structure of carbon materials, as is shown in numerous experimental studies, significantly depends on method of their producing and treatment that influences physical-chemical properties. The changes of fractal structure can be investigated by means of small-angle X-ray scattering, which allows determining both the kind of fractal aggregates and such parameter as fractal dimension. Here we represent the result on SAXS studies of fractal structure changes in charcoal after intercalation with 3d-elements. It was found that scattered intensities depend on wave vector.. It should be noted also that at values of wave vector less than some definite value so the slope of ln I(s) linear dependence change up to 4, indicating the Porod low for scattering by scattering by homogeneous particles with smooth surface. These obtained results allowed us to conclude that volume fractal units are formed as a result of carbon nanoparticles aggregation. It was established also that intercalation of charcoal with 3d-elements promotes the reduction of initial carbon clusters size and increase of specific porous surface.

IV INTERNATIONAL SCIENTIFIC CONFERENCE
“MATERIALS OF ELECTRONIC TECHNIQUE AND MODERN INFORMATION TECHNOLOGY. – METIT-IV”.
Ukraine, Kremenchuk, 19-21 May, 2010

1	**D.M. Freik, L.I. Nukuruy, R.O. Dzumedzey.** **Kinetic Phenomena in Doping Lead Chalkogenides Crystals (S)** The carrier mobility calculation for lead telluride crystals, doped by Indium, was provide in variation approach and analysis due temperature change and impurity content ((0.002 ÷ 0.2) at. % In). There are shown, at the temperature increase (from 4.2 K) the scattering on vacancy and acoustic phonons are increase too, but from (15-30) K dominant optical component of phonon scattering. Since these positions are well explained by the presence of peak mobility temperature dependence, which depending on the content of impurity in nitrogen-like range of temperatures.

XIII OPEN SCIENCE-TECHNICAL CONFERENCE OF INSTITUTE OF TELECOMMUNICATION, RADIOELECTRONICS AND ELECTRONIC TECHNIQUE OF THE NATIONAL UNIVERSITY «LVIV POLITECHNICA»,
Ukraine, Lviv, 13-15 April, 2010

1	**D.M. Freik, L.I. Nukuruy, R.O. Dzumedzey, V.M. Chobanyuk.(U)** **Doping scattering in p-PbTe:Tl crystals**

	In paper analyzed influence of hard holes energy band on IV-VI-type semiconductor transport phenomena that increase by doping of p-type impurity, in particular, Thallium.

OPEN SEMINAR
"ACTUALL PROBLEMS OF THE THEORETICAL AND EXPERIMENTAL PHYSICS",
Ukraine, Ternopil , 27-28 February, 2010

1	**Nykyruy L.I.** **Transport properties in solid solution on the base of IV-VI compounds** In conference materials considered conditions of solid solutions based on lead chalcogenides forming, which allows for wide range to control the most important properties of semiconductors, including gap and charge carrier mobility. Determined the dominant scattering mechanisms of charge carriers in solid solutions PbS_xSe_{1-x} .

Ukrainian-German Symposium on the Physics and Chemistry
of Nanostructures and on Nanobiotechnology
Beregove, Crimea, Ukraine, 6-10 September, 2010

1	**R.I. Merena, R.P. Lisovskiy, B.I. Rachiy, V.I. Mandzyuk** **Synthesis and modification of nanoporous carbon for supercapacitor electrodes (Y)** The aim of our research is to enhance specific power-consuming characteristics of SC by applying for their formation cheap carbon materials obtained by hydrothermal treatment method of pits (plum, cherry, apricot). The aim was solved by use of nanoporous carbon as an active material of SC electrodes obtained by hydrothermal treatment of pits in a closed autoclave, placed in a muffle furnace, where heating of the vegetable raw was conducted in the presence of water vapour to a temperature of 250-300°C. This way of NC obtaining enables to form SC with specific capacity of 198 F/g (plum), 176 F/g (cherry), and 185 F/g (apricot).
2	**I. M. Budzyulyak, N. Y. Ivanichok, R. P. Lisovskiy, V. I. Mandzyuk, R. I. Merena, B. I. Rachiy** **The Application Of Porous Carbon Material In Hybrid Capacitor Systems (S)** The hybrid electrochemical capacitor system, in which a porous carbon material (PCM) pressed in a nickel net was used as the polarized electrode and a faraday electrode was formed on the base of lithium spinel $Li_xMn_2O_4$ was studied. 1M water solution of Li_2SO_4 was used as an electrolyte. The optimum choice of electrode pair was carried out on the base of the results of research of the got electrode material properties. PCM got from raw phytogenous material was used as cathode material. The synthesis of anode material on the basis of lithium-manganese spinel of $Li_xMn_2O_4$ composition was carried out for traditional ceramic technology from manganese dioxide and lithium hydroxide. A cell of HC shows a reversibility with the sloping profile of voltage at mean value ~ 1,5 V and provides a maximal specific capacity of 24 mA·h/g, coming from total weight of activated electrode material (including positive and negative electrodes).
3	**V.I. Mandzyuk, I.F. Myroniuk, V.A. Tertykh, I.S. Berezovska, V.V. Yanishpolskii** **Mesoporous SiO_2 as electrode material for lithium power sources (Y,U,I)** The possibility of the use of homogeneously mesoporous SBA-16 silica as electrode material is explored in the work. A value of specific surface determined by BET method is 810 m^2/g. According to data of transmission electronic microscopy the synthesized material has well-ordered and regularly located pores with a middle diameter 5 nm. The discharge capacity of mesoporous silica is 180 mA·h/g at the first cycle. However, after charging of element it is 9 mA·h/g only, and the value of irreversible capacity exceeded 95 %. The main reason of such behaviour of the electrochemical

	system is irreversible absorption of lithium ions on the surface of cathode material with the simultaneous forming of superficial solid state layer with the ionic type of conductivity. It should be noted that coulomb efficiency is near to 1 at growth of number of charge / discharge cycles (~ 200). Thus a charge / discharge capacity does not exceed 1 mA·h/g.

II International Science Conference
"Nanostructural materials – 2010: Belarus – Russia – Ukraine"
Kyiv, Ukraine. – 19-22 October, 2010

1	**B.K. Ostafiychuk, I.M. Budzulyak, N.Y. Ivanichok, R.P. Lisovskiy, O.V. Morushko, B.I. Rachiy.** **Hybrid supercapacitor of nanoporous carbon / metal-oxide spinel system (S)** The hybrid electrochemical capacitor system on the nanoporous carbon / lithium manganese spinel base is explored. 1 M Li_2SO_4 is used as an electrolyte. As initial material porous carbon material prepared from vegetable raw materials was used as cathode material. The synthesis of anode material was carried out according traditional ceramic technology from manganese dioxide and lithium hydroxide. The sizes of pores were determined by BJH method. Specific surface of cathode materials is provided by pores with an average diameter of 1,5 – 2,5 nm. Specific surface of porous carbon material is 799 m^2/g, micropore surface – 722 cm^2/g, total pore volume – 0,418 cm^3/g, and micropore volume – 0,297 cm^3/g. The capacitor formed is reversible relatively its charge / discharge and provide maximal specific capacity 24 mA·h/g.
2	**V.O.Kotsyubynsky, V.L. Chelyadyn, V.I. Mandzyuk, I.F. Myroniuk, V.V. Dmytruk, M.M. Dudydra (S)** **Intercalation of lithium ions in utradispersed rutile: structural and electrochemical research** The regularities of electrochemical intercalation of lithium ions into nanodispersed rutile form of titania are explored by the methods of impedance spectroscopy, X-ray diffractometry, electronic microscopy. The kinetics of lithium ions insertion is analyzed and diffusion coefficients of lithium ions into rutile structure are calculated. The dominant role of influence of surface effects is shown. The formation of solid electrolyte interface on the cathode material surface with ionic type of conductivity is considered.

XI International Conference
"Fundamental Problems of Energy Transformation in the Lithium Electrochemical Systems"
Russia, Novocherkassk, 13-17 September 2010

1	**I.F. Myronyuk, V.O, Kotsyubynsky, V.L. Chelyadyn, V.I. Mandzyuk,** **V.V. Moklyak, Ostafiychuk B.K. (U)** **Lithium Ions Intercalation in Nanodispersed Rutile:** **Structure and Electrochemical Properties** Nanodispersed rutile was obtained by sol-gel method based on the hydrolysis of $TiCl_4$ by solution of HCl 36% until the 1.5 M solution of $TiOCl_2$ formation. Coagulation of the sol was stimulated by ethyl alcohol adding into the reaction medium at 40°C until the pH = 1.5 value of reaction medium will be achieved. The original material was used as a base of the cathode composition for the model lithium power sources. Frequency dispersion of complex impedance has been studied in the range of 10^{-2}-10^5Hz (device Autolab/FRA-2). Based on the impedance-spectroscopic data three stages were found out, which correspond to ranges of the degree of insertion $0 < \boldsymbol{x} \leq 0{,}12$; $0{,}12 \leq \boldsymbol{x} \leq 0{,}63$ and $0{,}67 \leq \boldsymbol{x} \leq 0{,}88$. The first stage is characterized by a sharp decrease of the OCV and it is connected with the localization of Li^+ ions on the surface with the following intercalation into rutile structure. The localization of Li^+ ions is the most probable in the octahedral oxygen vacancies, as well as in the structural channels [001], and the emergence of the pair interaction between intercalated lithium ions in the plain (110) can lead to the blockage of the channel and serve as a barrier to subsequent

	introduction. High specific surface of the nanodispersed rutile increases the number of channels opened for Li+ intercalation and neutralized the influence of their blocking. Next advantage is and the possibility of localization of Li^+ ions in the form of the sorption layer on the surface of cathode materials. The regularities of electrochemical intercalation of lithium ions in nanodispersed rutile were studied. The kinetics of the process was analyzed; diffusion coefficients of the Li^+ ions were calculated. The dominant role of the influence of surface effects was shown.
2	**Gasyuk I.M., Kaykan L.S., Ugorchuk V.V.** **Frequency and Content Influence on the conductivity and dielectric properties non- stoichiometric spinels $Li_{0,5}Fe_{2,5-y}Mg_yO_4$** The influence of atomic content on the electric properties of spinels $Li_{0\ 5}Fe_{2.5}Mg_yO_4$ (y = 0-1.0) was investigated by impedance spectroscopy method. System relaxation times were calculated. The dominant role of Fe^{2+} ions in the dielectric polarizing mechanism was proved.
3	**Sulym P.O., Kaykan L.S., Nykolyuk M.K. (Y,S)** **Electric properties of rare-earth element doped lithium-iron spinels** Frequency – temperature dependencies of the conductivity for the system $Li_{0,5}Fe_{2,475}Ln_{0,025}O_4$ (Ln=Pr, Eu, Ho, Er) were investigated. Activation Energies and charge transfer kinetic characteristics were calculated.
4	**Gasyuk I.M., Ugorchuk V.V., Grabko T.V., Deputat B.Ya. (S,D)** **Li-ion diffusion coefficient determination in Fe_3O_4 by Impedance Spectroscopy Method** Nanodispersed magnetite Fe_3O_4 was synthesized by chemical precipitation method. Experimental galvanic cell with the cathode on the base of obtained material were constructed. Impedance spectra during galvanostatic discharge were registered. Lithium ion diffusion coefficient in the Nanodispersed magnetite was calculated ($D \approx 10^{-13}$ см^2/с).
5	**Gasyuk I.M., Galiguzova S.A., Yavorskyy Yu.B. (D,S)** **Lithium-iron spinel as a promising cathode material of lithium-ion power sources** Lithium-iron spinel was synthesized by ceramic method. The possibility of using slowly cooled as well as tempered spinel for the original power source high-capacitance cathodes (C ≈ 400 A h / kg) was shown.

10th Biennial Conference on High Resolution X-ray Diffraction and Imaging
University of Warwick, United Kingdom, 2010.

1	**Pylypiv V.M., Vladimirova T.P., Fodchuk I.M., Ostafiychuk B.K., Kyslovskyy Ye.M., Molodkin V.B., Olikhonskii S.I., Reshetnyk O.V., Skakunova O.S., Lizunov V.V., Harpul' O.Z. (U)** **X-Ray Dynamical Diffractometry of the Defect Structure of Garnet Crystals** The theoretical foundation of the modern crystallography of real single crystals with complex basis has been created. The developed approach is based on the generalized statistical dynamical theory of X-ray diffraction by imperfect single crystals and takes into account the presence of various structural defects as well as provides the self-consistent description of coherent and diffuse components of diffraction patterns from such crystals.
2	**Pashniak N., Fodchuk I., Davydok A., Biermanns A., Pietsch U., Balovsyak S., Zaplitniy R., Bonchyk O., Savitskiy G., Vivorotka I., Yaremiy I. (U,I,S)** **High-Dose Implantation of $Y_{2,95}La_{0,05}Fe_5O_{12}$ Epitaxal Films by Nitrogen Ions** High-resolution X-ray reciprocal space mapping was used to study structural changes within the surface layers of $Y_{2,95}La_{0,05}Fe_5O_{12}$ epitaxial films grown on (111) $Gd_3Ga_5O_{12}$ substrate after high-dose implantation of nitrogen ions. The process of interaction between nitrogen ions and crystal lattice after implantation was studied.

II International Conference «Actual problems of physics of condense state». –
6-10 October 2010, Kyiv, Ukraine

1	**S.L. Revo, T.G. Avramenko, K.O. Ivanenko, B.I. Rachiy (U)** **Structure and mechanical properties nanocomposite material tetrafluorethylrene –carbon** Properties of carbon materials based on the thermal dispersed graphite as component nanocopmosite in the tetrafluorethylrene matrix were investigated. Needle-like nanofragmented structures were obtained

VII International School-Conference «Actual problems of semiconductor physics»
28 September – 1 October 2010, Drogobych, Ukraine

1	**V.M. Chobanyuk, L.I. Nukuruy, R.O. Dzumedzey, O.M. Voznyak.** **Charge carriers transport and scattering in doping Lead Telluride Crystals** Describe carrier scattering mechanisms in doping IV-VI semiconductors. Calculate carrier mobility for PbTe:In(Ga, Tl) crystals. Investigate electrical properties from impurity content. Scattering features analyses in the point of view of the impurity-dependence effective mass of carriers.

2nd International Conference on Nanotechnology: Fundamentals and Applications
Ottawa, Canada, 27-29 July, 2011

1	**V. Kotsyubynsky, I. Myronyuk, V. Chelyadyn, V. Moklyak** **Lithium Ions Intercalation in Nanodispersed Rutile : Structure and Electrochemical Properties** Nanodispersed rutile with rod-like particles was synthesized by hydrolysis of $TiCl_4$ in hydrochloric acid - ethanol alcohol aqueous solution at 40°C. It was found that the specific surface, crystallite size, degree of agglomeration are determined by molar ratios ethanol. The obtained material was used as the base of cathode composition for lithium power sources. The maximum values of specific capacity (250 mAh / g) at discharge in galvanostatic conditions are fixed in the case of using material with the maximum agglomeration degree and minimal particle size. Phasic character of Li^+ ions intercalation is set and the diffusion coefficient at different stages of the process is calculated.

New Electrical and Electronic Technologies and their Industrial Implementation
7th International Conference, Zakopane, Poland, 2011

1	**V.O. Kotsyubynsky, V.L. Chelyadyn, I.F. Myronyuk, V.V. Moklyak** **Hydrated nanodispersed anatase as cathode material for lithium power sources** Nanoparticles of titanium dioxide with various hydration degrees were obtained by controlled hydrolysis of $TiCl_4$ by hydrochloric acid. It was found out that the synthesis conditions (pH and temperature of reaction medium, content of additional precursors) effect on the nucleation rate and determine the phase state and morphology of TiO_2 nanoparticles. The obtained materials were tested as a base component of cathode composition of model LPS.

VI International Symposium
"Fullerenes and Nanostructures in Condensed Matter"
14-17 June 2011

1	**V.O. Kotsyubynsky, V.L. Chelyadyn, I.F. Myronyuk, V.V. Moklyak, P.I.Kolkovskiy** SYNTHESIS AND PROPERTIES OF NANOCOMPOSITE MATERIALS BASED ON TITANIUM DIOXIDE AND OXIDES OF TRANSITION METALS

	Developing of new and improving existing methods of synthesis of nanosized oxide systems provides ways to modify the crystal and electronic structures of functional materials, their morphology and phase composition to achieve a predetermined, optimized for a specific application area properties. The aim is to develop methods for the synthesis of nanocomposite materials based on titanium dioxide and oxides of transition metals to control their structural characteristics

Materials of the second international conference "Education for nanotechnology: contemporary approaches and prospects"
Russia, Moscow, May 25-27, 2011

1	**A.V. Kopayev, B.K Ostafiychuk, I.P. Yaremiy, Y.M. Tafiychuk (S)** Integrated research and education program on research nanosized oxide powders obtained by sol-gel method involving self-combustion The technology of preparation of various complex oxides - soft magnetic ferrites, the lanthanide transition metal structure, with magnetoresistive properties were done. The influence of chemical composition and size of nanoparticles obtained powders on the electrical, magnetic and magnetoelectric properties with a characteristic particle size 10 - 70 nanometers was investigated.

Materials of XIII International Conference “Physics and Technology of Thin Films and Nanosystems”
Ukraine, Ivano-Frankivsk, 16-21 May, 2011 (*)

1	**N.Y. Ivanichok, I.M. Budzulyak, R.P. Lisovskiy, I.P. Yaremiy (S)** **The effect of electrode material phase composition energy characteristics of hybrid capacitors** It was shown that selecting the composition of $Li_{1+x}Mn_{2-x}O_4$ spinel used as an electrode material, one can form hybrid capacitors, which exceeds in 3 times the energy density of symmetric capacitor produced on the porous carbon material basis.
2	**I.M. Budzulyak, L.M. Gumenyuk, Y.T. Solovko, R.V. Ilnytskyy (S)** **Influence of TiO_2 structure modifications on its sorption properties** It was found that adsorption water is present on rutile structure and completely lost at heating to 200°C. Thus decreasing of H_2O mass is more than 0,4 % for rutile and is about 0,1 % for anatase. Heating rutile over than 450°C results in the growth of structure defects due to the loss of oxygen, that negatively effects on electrochemical properties of cells formed on their base.
3	**O.V. Morushko, I.M. Budzulyak, B.I. Rachiy, L.S. Yablon** **Electron-microscopy investigations of nanoporous carbon** Analysis of electron-microscopy investigations of nanoporous carbon developed surface and its element wise composition in the single points adds and proves the data about the structure of pore systems, obtained by the methods of porometry and X-ray low-angle scattering.
4	**I.P. Yaremiy, U.O. Tomyn, S.I. Yaremiy, V.I. Kravets (S)** **Crystal structure of epitaxial *Bi*-substituted ferrite-garnet films modified by double boron implantion** The features of influence of the double implantation in comparison with monochromatic implantation, and the influence of the implantation succession on the strain profiles X-ray diffractometry investigation of Bi-substituted ferrite-garnet films implanted with B^+ ions were studied. Investigation of the influence of double boron implantation on the crystal structure of superficial layers of epitaxial ferrite-garnet films showed that the results of their modifications depend on the sequence of implantation, and the strain profiles in the case of cumulative dose of $\leq 2\cdot10^{14}$ sm^{-2} are monotonically decreasing.

5	**I.M. Fodchuk, T.A. Kazemirskiy, R.A. Zaplitnyy, I.I. Gutsuliak, U. Pietsch, A.V. Davydok, N.V. Pashniak, O.Y. Bonchyk, G.V. Savitskiy, I.I. Syvorotka, I.P. Yaremiy (I, U)** **Structural changes in iron-yttrium garnet implanted by nitrogen ions** The changes of the crystalline structure of surface layers of Yttrium Iron Garnet implanted by nitrogen ions were researched. Methods of generalized dynamical theory of X-ray scattering strange profiles and the main types of radiation defects in ion-implanted layer were determined.
6	**V.D. Fedoriv, I.P. Yaremiy, N.V. Stashko** **Synthesis of Polycrystalline Yttrium Iron Garnet the Sol-Gel Method with the Subsequent Annealing** Yttrium Iron Garnet ($Y_3Fe_5O_{12}$) was synthesized by the sol-gel method of autocombustion. The advantage of this method is that due to significant outgassing finely dispersed weak-agglomerated powder, in which metal oxides are mixed almost on molecular level, produce. It was found out that the garnet phase content is proportional to the size and temperature and it forms on the basis of accompanying phase α -Fe_2O_3 and $YFeO_3$. Intensive formation of garnet structure begins at 900 ºC.
7	**Y.M. Tafiychuk, I.P. Yaremiy, I.Ja. Vylka, V.S. Bushkova (S)** **Synthesis and characterization of nanocrystalline LaFeO3 by sol-gel auto-combustion method** The aim of our research was to obtain powders $LaFeO_3$ of sol-gel autocombustion method, which is one of the most promising ways of receiving nanodisperse materials. Determined that crystalline structure of received material $LaFeO_3$ is orthorhombic (space group Pbnm). The average particle size of nanocrystalline $LaFeO_3$ was ~ 20 nm.
8	**V.V. Kurovets, S.I.Yaremiy (S)** **Microhardness of helium implanted monocrystalline materials with a garnet structure** To evaluate the influence of ion implantation He^+ on the near-surface layers of single crystals of GGG microhardness was measured. It was found that depending on the value of microhardness of ion-implanted near-surface layer-tional GGG monocrystal of a minimum dose of irradiation at a dose of $2 \bullet 10^{15}$ sm^{-2}.
9	**I.P. Yaremiy, S.I. Yaremiy, U.O. Tomyn (S)** **Atomic emission spectroscopy of nanoporous carbon materials** The purpose of the research was to analyze powdered carbon materials based on plant materials used in manufacturing supercapacitors on the presence of technology impurities and microelements. It was determined that the original unmodified powder contained such elements as K, Ca, Na, Mg, Fe, due to their absorption from the soil during growth, and technological impurities Cu and Fe, which were included in the powder during its modification.
10	**V.O. Kotsyubynsky, V.L. Chelyadyn, R.V. Ilnytskyy, I.F. Myronyuk, V.V. Mokliak** **Electrochemical intercalation of Li^+ in the dehydrated anatase synthesized by the method of $TiCl_4$ hydrolysis** It was found that lithium ions during intercalation processes occupy the host positions in the near-surface area of titania particles with the forming of two zones – subsurface lithium enriched and internal one. At the intercalation degree of lithium ion per formula units of titania about x = 0.6 the electrode covered by LiF film with the ionic type of conductivity. Intercalation of Li^+ in the cathode continues to $x \leq 0.8$. The final blocking on the TiO_2 particles surface is happening at x 1.0 with the charge transferring through two interface. In the range of intercalation degree $0 < x \leq 0.8$ a sharp decline of the lithium ions diffusion coefficient (D_{Li}) in the anatase structure is observed with the D_{Li} values changing within the range 10^{-9}–10^{-11} $cm^2 \cdot s^{-1}$ (impedance

	spectroscopy data).
11	**L.I. Myronyuk, V.O. Kotsyubynsky, V.L. Chelyadyn** **Atomic Structure and Morphology of SnO_2 Nanoparticles Prepared by Pyrogenic and Liquid-Phase Methods** The material obtained by the interaction of $SnCl_4$ or $SnCl_4 \cdot 5H_2O$ with NaOH solution is a hydrated product with the average size of coherent scattering areas about (1 ÷ 4) nm. Tin dioxide nano-particles obtained by pyrogenic method based on process of $SnCl_4$ sintering in hydrogen-air flame does not contain adsorpted forms of water.
12	**V.L. Chelyadyn, V.O. Kotsyubynsky** **The influence of nanodispersed titanium dioxide hydration degree on specific capacity of lithium power sources with cathodes on its base** Nanoparticles of titanium dioxide with various hydration degrees were obtained by controlled hydrolysis of $TiCl_4$ by hydrochloric acid. It was found out that the synthesis conditions (pH level and temperature of reaction medium, type and content of additional precursors) effect on the nucleation rate and determine the phase state and morphology of TiO_2 nanoparticles.
13	**Nykyruy L.I., Mazur M.P. (U)** **Theoretical basis of calculation of thermoelectric parameters doped crystals of lead chalcogenides** On the base of variation procedure calculated influence of type and content of impurities in lead chalkogenide crystals. Benefits of variation procedure in compare calculation in time relaxation approximation were shown.
14	**Ahiska R., Freik A., Gorichok I., Nykyruy L. (I)** **Growth and Characterization of Thermoelectric Lead Telluride** Technology modes to receive Lead Telluride crystals with optimized Thermoelectric properties were developed. Defined technological regimes of regulation by the dominant scattering mechanisms of charge carriers.
15	**Voznyak O.M., Zukowski P., Nykyruy L.I., Lysak A.V. (I)** **Relaxation time approximation and variational method in the calculation of kinetic parameters of semiconductors** Theoretical equations to calculate the charge carrier mobility of doped lead telluride crystals is defined. Established calculation efficient for time relaxation approximation and variational method.
16	**V.O. Kotsyubynsky, V.V. Mokliak, P.I.Kolkovskyy, A. Grubyak (S)** **Photovoltaic Cells Based on Nanodispersed Titania Sensitized by Anthocyanine Dyes** The complex of works aimed at constructing and testing models of photoelectrochemical energy sources based on nanodispersed titania sensitized by anthocyanine dyes is carried out. The phenomena of electronic and ionic transport in photovoltaic cells (PVC) is researched. Several series of PVC are constructed using synthesized and commercial ultrafine titania.
17	**Myronyuk I.F., Gergel T.V., Danylenko M.I., Chelyadyn V.L. (U)** **Atomic structure of fumed silica nanoparticle** The research allowed of finding out that structural patterns of X-ray amorphous silica are short open-branched chain clusters with the length of 0.6-2.4 nm. In one repetitive fragment of the linear part of the chained cluster, there are two SiO_4, the vertexes of which go up and down in turn and which are connected with each other through the common oxygen atom. The photos globules SiO_2, obtained at the maximum distinction microscope revealed micropores with an average size of 0.3 nm, which are proportionate with SiO_4 tetrahedrons and are structural defects

	of amorphous X-ray material. Note that this reveals a linear increase in the total volume of pores with increasing specific surface of pyrogenic silica nanoparticles.
18	**Mandzyuk V.I., Nagirna N.I., Povazhnyi V.A., Golovko L.V., Rachiy B.I. (U)** **Anthracite as electrode material for lithium power sources** Six standards of nanoporous carbon obtained from natural Donets anthracite (Ukraine) by steam and gas activation method in boiling bed at temperature of 1100–1200 K. Electrochemical introduction of lithium ions was carried out in two-electrode glass cells with separated cathode and anode space in galvanostatic regime (current density was 40 μA · cm^{-2}, voltage interval was 3.4 ÷ 0.05 V) using TIONiT P2.00-xx charge / discharge stand. As follows from received results (table), the value of specific capacity of the explored materials correlates with the size of specific surface and total pores volume. The effect of micropores volume is less significant.

I International Scientific Conference "Semiconductor materials, Information Technologies, and Photovoltaic" (SMITP-2011)
5-7, May, 2011, Kremenchuk, Ukraine

1	**Freik D.M., Nykyruy L.I., Malashkevich G.E., Harbacheva A.N., Bachuk V.V. (I)** **Topology and optical properties of nanostructures based on lead telluride** It was established that the optical properties (absorption spectra, absorption and reflection) of thin films and nanostructures based on lead telluride are defined as natural gas condensate, and come substrates and growing technological factors, which form a predefined topology of the condensate.

XIV Open Scientific-Technical Conference of the Institute of Telecommunication, Radioelectronic and Electronic Technique of National University "Lviv polytechnics",
5–7, April, 2011, Lviv, Ukraine

1	**Nykyruy L.I., Dzumedzey R.O., Gevak T.P., Kotyk M.V. (S)** **Scattering Mechanisms in PbTe:Bi Doped Crystals** Impurities of V group (Sb, Bi) differently affect to energy spectrum of electrons in PbTe, which is associated with their amphoteric properties. The bismuth impurity makes it possible to control the concentration of electrons in crystals and in thin-film structures PbTe.

XI All-Ukrainian School of Youth Scientists on the Statistic Physics and Condensed Matter,
1-3, June, 2011, Lviv, Ukraine

1	**Dzumedzey R.O., Nykyruy L.I. (S)** **Scattering Mechanisms in Lead Telluride Doped Crystals** Calculation of charge carrier mobility of crystalline PbTe: Tl, PbTe: In and PbTe: Bi depending on the content of impurities: (0.01 - 0.4) at. % Tl, (0,002 - 0.02) at. % In and (0.25, 0.5 and 1) at. % Bi was done. Dependence the temperature and concentration ranges of dominance of individual scattering mechanisms of charge carriers: on acoustic and optical phonons, short-range potential vacancies and potential impurities was determined.

Materials of the Mediterranean-East-Europe Meeting "Multifunctional Nanomaterials (NanoEuroMed 2011)", Ukraine, Uzhgorod, 12–14 May 2011, 2011

1	**V.O. Kotsyubynsky, V.V. Moklyak, P.I. Kolkovsky, A.O. Kotsyubynsky, I.M. Fodchuk, V.L. Chelyadyn, A.B. Grubyak (S, U)** **Low temperature mossbauer studies of supermagnetic nanocomposite g-Fe_2O_3 /a-Fe_2O_3** A new method of nanocomposite material g-Fe_2O_3 / a-Fe_2O_3 obtaining with the control of the phase composition and magnetic properties are developed. Study of the influence of synthesis and treatment conditions on the supermagnetic properties of g-Fe_2O_3 particles is carried out.
2	**V.L. Chelyadyn , V.O. Kotsyubynsky, R.V. Ilnytskyy , V.I. Mandzyuk , M.I. Danylenko , V.V. Dmytruk** **Current Generation Processes of Lithium Power Sources with Cathode on The Base of Hydrated Form of X-Ray Amorphous Titanium Dioxide** The focus was to explore the current generation processes of lithium power sources based on hydrated form of X-ray titanium dioxide ($TiO_2 \cdot nH_2O$). The electrode materials were studied with testing LPS (electrochemical cell - galvanic pair Li | 1M solution of $LiBF_4$ in γ-butyrolactone | cathode), in which nanoparticles were the base of cathode composition (88 %). To record current generation chemical reactions flow in detail, the cell discharge was carried out in galvanostatic mode at current density C/250
3	**V.L. Chelyadyn , L.I. Myronyuk, V.O. Kotsyubynsky, V.V. Dmytruk (S)** **Obtaining of titanium dioxide by $TiCl_4$ hydrochlorid-acid hydrolysis** The research allowed to find out what $TiCl_4$ hydrolysis products are titanium-containing hydrocomplexes, chemical composition which can be written as a formula $[Ti(OH)_n(OH_2)_{6-n}]^{(4-n)+}$. Hydroxylation level of titanium anions (n) and complex ions charge depends on pH. Ti-O bond length in complex precursors related to the degree it hydroxylation and anions ion potential (pH ~ 0.5 ÷ 4.0) and cations ion potential (pH> 4.0) of the reaction medium. Invented method of $TiCl_4$ hydrochlorid-acid hydrolysis enables to obtaining nanoparticles of crystalline titania which to have preassigned physical and chemical properties.
4	**N.I. Nagirna, V.I. Mandzyuk, B.I. Rachiy (S)** **The effect of thermal treatment on energy characteristics of lithium power sources on nanoporous carbon base** The effect of thermal treatment on energy characteristics of lithium power sources on nanoporous carbon based is investigated. The research objects were nanoporous carbon materials obtained from apricot pits through their high-temperature carbonization (t = 600 ÷ 1100ºC) in autoclave at high pressure (~ 10 atm) of water steam atmosphere. It is shown, that the value of specific capacity of the electrochemical element non-monitonically depends on the temperature of obtaining of porous carbon with its maximum (1355 mA·h/g) at 750°C. The principal reason of such the behaviour is the conformity of specific surface value of active electrode material to the temperature of its obtaining.
5	**B.K Ostafiychuk, I.M. Budzulyak, L.M Gumenyuk, I R.V. lnytskyy, Ya.T. Solovko** **Electrochemical intercalation of composites based on rutile modification of TiO_2** This thesis deals with researches influence of doping by MnO_2, MgF_2, ZnF_2 admixtures of TiO_2 rutile structure to increase the specific energy parameters of LPS based on TiO_2 rutile forms of Dupont R-706. Receiving lithium power sources (LPS) with high electrochemical characteristics by simple and cheap methods is the main aims of this work. Complex researches of samples were carried out using simultaneous thermoanalyser STA 449 F3 Jupiter, X-ray diffractometer DRON-3.0 and impedance spectroscopy. Found out that doping of rutile structure of titanium dioxide by admixtures of MnO_2, MgF_2, ZnF_2 is an effective way to improve the electrochemical characteristics of LPS.

V Ukrainian Science Conference on Semiconductor Physics (USCSP-5),
Uzhgorod, Ukraine, 9-15 October, 2011. (U)

1	**Nukuruy L.I., Dzumedzey R.O., Gevak T.P.** **Charge carriers scattering mechanisms in doped crystals PbTe:Ga (In, Te)** In paper the calculation of charge carrier mobility of crystalline PbTe:In content for different impurity indium (0.002-0.02) at. % In and crystalline p-PbTe:Tl impurity content depending on the waist (0.01-0.4) at. % Tl. The temperature and concentration ranges dominance of individual scattering mechanisms of charge carriers: the acoustic and optical phonons in short-range potential vacancies and impurity potential.

10th International Conference on Sustainable Energy Technologies,
İstanbul, Türkiye, 4-7 September, 2011. (U, I)

1	**Freik D., Ahiska R., Yurchyshyn I., Nykyruy L., Lysyuk Yu.** **Nanostructured Materials Based on Compounds IV-VI for Thermoelectric Energy Converters** The thickness dependencies of the thermoelectric parameters were observed at room temperature for nanostructures p-PbTe on polyamide and p-SnTe on mica, grown from the vapor phase. Detected oscillations were explained by quantum size effects due to the current carriers' confinement in quantum wells.

Modern Methods in Theoretical and Experimental Electrochemistry
Pless, Ivanovsk region, Russia (3-7 October 2011)

1	**LITHIUM POWER SOURCES BASED ON MODIFICATION OF TITANIUM DIOXIDE** **Gumenyuk L.M., Budzulyak I.M., Ilnytskyy R.V. (Y,S)** This work presents research of the influence of binary compounds MnO_2, MgF_2, ZnF_2, which have the matrix structure of rutile on specific energy characteristics of lithium power sources based on anatase crystalline structure of titanium dioxide. Complex researches of samples were carried out using simultaneous thermoanalyser STA 449 F3 Jupiter, X-ray diffractometer DRON-3.0, electrochemistry analysis. So, the results have shown that 1% of impurity change energy performance of original anatase. This gives reason to expect even better results when changing the concentration of MnO_2 or MgF_2, or if other not investigated admixtures of rutile crystalline structure.
2	**Gasyuk I.M., Boychuk A.M, Ugorchuk V.V.** **The dependence of the diffusion coefficient on the composition of iron-containing lithium-manganese spinel** We investigated the influence of iron substitution on the coefficient of electro-stimulated diffusion of lithium in single-phase lithium-manganese spinel with composition $LiMn_{2-y}Fe_yO_4$, де y=0.1, 0.5, 1.0. Electrochemical cell were built based on the synthesized materials that were discharged in galvanostatic mode. Diffusion coefficient in spinel of different compositions is within 10^{-12}- 10^{-11} cm^2 / s, that allows to use these materials as a cathode material for lithium power sources. It was found that with increasing amounts of iron in systems of diffusion coefficient is growing at potentials below 3 V. This corresponds to an additional horizontal section of the discharge curve.

Materials of Conference "Issues of Chemistry and Chemical Technology
Dnepropetrovsk, Ukraine, 2011.

1	**I.M. Gasyuk, V.V. Ugorchuk, L.S. Kaykan** **Lithium-iron spinel oxides - promising cathode materials for lithium sources**

	Lithium-iron spinel was synthesized and iso-and heterovalent-substitution were held. The behavior of the synthesized compounds as cathodes for lithium power sources was studied and their high energy efficiency was shown. In the case of magnesium-substituted spinel the number of embedded magnesium should be chosen for high values of conductivity and high electrochemical performance of the studied material, which would provide sufficiently high concentration of vacancies in octa-sublattice, while staying outside of single-phase system.
2	**I.M. Gasyuk, M.Ya. Sichka, P.P. Jakubowski** **Electrochemical intercalation-deintercalation of lithium in the structure of nanodispersed MgF_2** Experimental models of current source with a cathode based on synthesized by chemical vapor deposition of MgF_2 were made, which are characterized by maximum values of accumulated specific charge 240-250 A h / kg. We investigated diffusivity of lithium ions using three methods: galvanostatic intermittent titration (GiTT); cyclic voltammetry (CVA); spectroscopy of electrochemical impedance (SEI). The value of diffusion coefficient for the process of intercalation within 10-11-10-12 cm^2 / s, and for the process of deintercalation - 10-11-10-12 cm^2 / s. Thus, synthesized nanodispersed magnesium fluoride MgF_2 can be successfully used as a cathode active material for LPS, with sufficiently high reproducibility of the specific electrochemical capacity of a large number of charge-discharge cycles at 240 A • h / kg.

«New electrical and electronic technologies and their industrial implementation»
Zakopane, Poland 2011.

1	**I.M. Budzulyak, B.I. Rachiy, R.I. Merena.** **The principles of thermal optimization of carbon materials for electrochemical capacitors** Energetics and kinetics of electrochemical processes at the interface of nanoporous carbon / electrolyte were investigated, the influence of morphology and status of a developed surface on the formation of electrical double layer and its properties was determined. It is shown that heat treatment of porous carbon-based plant material increases the specific surface on 20-40%, the volume of micropores - to 0.3 cm^2/g and, consequently, increases the specific capacitance of electrochemical capacitors on 20-30%.

APPENDIX 7: New Courses

1. Physics of lasers and laser technologies (lecture courses and practical training, professor I.M.Budzulyak);

The principles and basic physical processes underlying the operation of lasers (gas, semiconductor, dye) are explained. Examples of application of laser technology to create new materials and the effect of laser radiation on the physical properties of solid-state facilities are studied.

2. Superconductivity and superconductive materials (lecture courses and practical training, assistant V.V. Mokliak);

The basic theory of superconductivity is studied, compounds promising for formation of high-temperature superconductors are considered, methods of obtaining and their application in industry are explained.

3. Electronic and ionic processes (lecture courses and practical training, assistant V.Ugorchuk);

The basic representation of the crystals electron theory is shown, the concept of energy bands and features of semiconductors energy bands are studied. Experimental determination of such important parameters as mobility, band gap, kinetic coefficients and their interpretation from the standpoint of classical and quantum theories of crystals are given.

4. Basics of Crystallography and crystalphysics (lecture courses and practical training, assistant professor. I.P. Yaremiy).

The main types of crystallographics are shown, methods to determine specific compounds to a particular symmetry and correlation of crystal structure and physical properties of solids are discussed.

5. Resonance research methods (lecture courses and practical training, assistant V.V. Mokliak);

The fundamental resonance methods are reviewed. Basic principles of physics of the processes underlying these methods are explained. Examples of application of resonance methods to study the structure and properties of solid-state systems and methods of decoding the experimental spectra are given.

6. Nanomaterials in the generated and storage devices (lecture courses and practical training, assistant V.V. Mokliak);

The ways of obtaining nanometer range materials, the ways of their size control, establishment of physical and chemical properties of nanomaterials are studied. Particular attention is given to the use of nanomaterials as electrodes for batteries of primary and secondary types, and capacitors with giant electric capacity.

7. Physics and Chemistry of Surface (lecture courses and seminars, assistant professor V.O. Kotsyubynsky);

The formation of the surface as a special state of matter and peculiarities of its manifestation at the physical contact and chemical interactions of objects of finite size is considered in terms of energy. An analysis of the effect of the specific surface material increasing on its physicochemical properties is realized.

8. Methods of nanomaterials synthesis (lecture courses and seminars, assistant professor V.O. Kotsyubynsky);

The basic methods of synthesis, leading to formation of nanometric-size particles (hydrothermal synthesis, autocombustion method, method of mechanochemical grinding, etc.) are studied. It is a comparative analysis of methods and perspectives of their use for synthesis of active electrode substance for devices of generation and energy storage.

9. The Methods of Radio-Electronic Materials Crystal Structure Investigation (lecture courses and practical training, assistant professor V.D. Fedoriv);

The basic theory of research methods of the crystal structure of radioelectronic materials and their practical realization are studied. The phase composition, parameter of unit cell, the degree of microdeformation, and block sizes of coherent scattering are all considered.

10. Diffraction Methods of Investigation (lecture courses and practical training, assistant professor V.D.Fedoriv);

Introduction for students to the general theory of diffraction for three-dimensional crystal lattice and the basic X-ray methods of investigation of solids. The acquired knowledge for the investigation of mono-and polycrystalline systems is realized practically.

11. Laser physics and laser technologies (lecture courses and seminars, prof. M.M. Yatsura);

The basic physical principles of laser-based three- and four-level systems are studied. The basic properties of laser radiation (high coherence, monochromaticity, polarization) and the ways of their realization are considered. Considerable attention is given to the use of lasers in the study of nanomaterials and devices on their base.

12. Physics of colloid systems (lecture courses and practical training, assistant V.V. Mokliak);

The question of what colloids are, their classification and basic properties, methods for the study of colloidal systems and methods for their study are considered.

13. Physical and Chemical Bases of Intercalation Technologies (lecture courses and seminars, assistant R.V. Ilnytskiy);

The basic methods for intercalation into the cathode structure of lithium power sources are studied. The basic theory of the intercalation process, their advantages and disadvantages are considered.

14. Intercalation Technologies (lecture courses and seminars, assistant R.V. Ilnytskiy).

An overview of the main intercalation technology is conducted. The influence of several factors (mobility of ions, pore size, the properties of "guest" - "host" systems) on a depth of penetration intercalated ion is analyzed. The possibility of intercalated systems use in devices for generation and storing energy are considered.

15. Physics of Superconductors (lecture courses and practical training, assistant V.V. Mokliak);

The basic theories that explain the phenomenon of superconductivity (the theories of Landau, Bardeen-Cooper-Schrieffer) are studied and the effects that occur in the material in the superconducting state (the Meisner effect, isotonic effect, etc.) are examined. The creation possibilities of new types of supercapacitors with high critical temperatures are analyzed.

16. Peculiarities of radioelectronic materials obtaining (lecture courses and practical training, assistant V.V. Mokliak).

The methods of obtaining material used in electronic engineering are considered. Their properties, depending on crystal structure and methods of their production, are analyzed. The analysis of investigation methods of such materials and prospects of their use in modern technology is conducted.

APPENDIX 8: New Educational Materials

1. B.K. Ostafiychuk, M.M. Yatsura, A.M.Gamarnyk. Physics: Textbook. – Ivano-Frankivsk, LIT, 2009. – 553 p.
2. D.M. Freik, L.I.Nykyrui. Solid State Physics. Structure and surface properties. Laboratory Practicum. – Ivano-Frankivsk, Hostynets, 2009. –120 p.
3. I.P. Yaremiy. Technical Mechanic. – Ivano-Frankivsk, Hostynets, 2009.–197 p.
4. Freik D.M., Nykyruy L.I., Chobanyuk V.M. Physics of Solid State. Crystal structure. Physics practical work. University's Student handbook. – Ivano-Frankivsk. Published in the Vasyl Stefanyk PreCarpathian National University. – 2009. – 120 p.
5. V.D Fedoriv, I.P. Yaremiy, V.V. Moklyak. Diffraction methods of crystal structure of solid state material. - Ivano-Frankivsk, Gostinets, 2009 – 28 p.
6. Grygorchak I. I, Ponedilok G. V. Physics and technology. Laboratory Course for student speciality 0702 «Applied Physics». – Lviv: National University «Lviv Polytekhnica», 2009. – 50 p.
7. Gotra Z., Grygorchak I., Lukianets B., Bolshakova I., Stahira P., Politanskyi L. Nanoelectronics // Lviv: Liga Pres, 2009. – 344 p.
8. Nykyruy L.I. Mathematical treatment of physical experiment results. – Students handbook. Ivano-Frankivsk: "Gostynetsj", 2010.- 58 p.
9. Nykyruy L.I., Boryk V.V. Intellectual property in international research projects. Handbook. Ivano-Frankivsk: "Gostynetsj", 2010.- 75 p.
10. Ostafiychuk B.K., Ruvinskiy M.A., Yacura M.M., Budzulyak I.M. Handbook of general physics. Optics: waves, rays, quanta. - Ivano-Frankivsk: Publishing house of Precarpathian National University, 2011. - 664 p.
11. Myronyk I.F., Kotsyubynsky V.O., Ostafiychuk B.K. Synthesis, Structure and Electrochemistry of Oxide Nanomaterials**. –** Ivano-Frankivsk: Publishing and design department of Information Technologies Center, 2011.- 455 p.
12. I. Gasyuk, L. Kaykan. Statistical methods for processing the results of physical experiment: a course of lectures: [textbook] – Ivano-Frankivsk: Publishing House of V.Stefanyk PreCarpathian National University, 2011. - 159 p.
13. B.Ostafiychuk, I. Gasyuk, L. Kaykan. Waves. Lecture courses. – Ivano-Frankivsk: Physics and Technology Department of PreCarpathian National University, 2011. - 199 p.

APPENDIX 9: New Collaborative Contacts

Name and nature/extent of contact	Type of contact						
	Ukrainian research organization	Ukrainian Universities	Ukrainian industrial enterprise	Ukrainian local authorities	Foreign research organization	Foreign Universities	Foreign industrial enterprise
Correspondence initiated with:							
National Mining University MES of Ukraine (Dnipropetrovsk) Organization of relation between two CREST Centers		+					
Soil and Fertilizer Institute Heilongjiang Academy of Agricultural Sciences Heilongjian Yuenong Seed Co., LTD (China, Harbin City) Agreement of Intent: Joint investigation established in the field of new silica-based materials for agricultural purposes development						+	
Ten Chnenj LTD (China, Heilongjiang Province) Agreement of Intent: Established partnership in the field of industrial fumed silica- materials development							+
Western Ukrainian Scientific Centre (Lviv) Report on the Special Meeting of Western Ukrainian Scientific Centre Main Bureau , Lviv, Ukraine (June, 14, 2009)	+						
Institute of Problem Diagnostics & Research Centre of St. Boniface General Hospital (23-25.09.2009, Winnipeg, Canada) Report with multi-media presentation about science activity of Science-Educational Centre "Nanomaterials in Accumulation and Generation of Energy Devices" in Vasyl Stefanyk PreCarpathian National University					+		
Exchange visits carried out with:							
Heilongjiang University (December, 01-08, 2011, Harbin City, China) CEET Vice-Director of Science and Leader Group 3 was to visit Heilongjiang University (Group of Solid State Electrochemistry) in Harbin City, China in framework of joint Ukraine-China science project for exchange of experience and organizing future collaboration between CEET and Heilongjiang University in research and education						+	

Heilongjiang University (December, 14-18, 2011, Harbin City, China) Visit to CEET of and Leader Group of Electrochemistry Department of the Heilongjiang University (Harbin, China) Prof., Dr. Zhao Hui with colleagues for development exist collaboration, organizing and provide joint experiment and publish of joint paper in refereed scientific journal						+	
Heilongjiang University Group Leader of Electrochemistry Department of the Heilongjiang University (Harbin, China) Prof., Dr. Zhao Hui has lectured for CEET students "New oxide materials for electrochemistry".						+	
University of Texas at Dallas (28.11-25.12.2011, Dallas, USA) CREST CEET young scientists (graduate student and post-graduate student) participated in a research internship as winners of CREST Program "Scientific cooperation program for young scientists in geology, environmental and energy efficiency"						+	
Research collaboration initiated with:							
G.V. Kurdyumov Institute of Physics of Metal NAS of Ukraine (Kyiv) Joint scientific research in magnetic films physics laboratory of National Academy of Science (Institute of the Physics of Metals, Kiev) and Vasyl Stephanyk Precarpathian National University	+						
Kyiv National University of Technology and Design Organizing joint research collaboration in the direction of manufacturing of electrochemical sources Organizing of student exchange between CEET and Department Electrochemical Power Engineering and Chemistry, invitation of lecturer		+					
Heilongjiang University, School of Chemistry and Material Science (China, Harbin City) Joint research in Nanomaterial Science with Heilongjiang University (School of Chemistry and Material Science): a) joint project for the framework state science-technical programs; b) students and researchers exchange and degree programs; c) joint research on the nanomaterials reception, and creation of supercondensers, accumulators and gas sensors.						+	
Gazy University (Ankara, Turkey) Bi-lateral joint project "New Semiconductor Materials on the Base of Lead Telluride for Thermo-Electric Energy Transformers".						+	
Institute of the Electronic Engineering and Industrial Technologies Academy of Sciences of Moldova (Kishinev, Moldova) Development and optimization of technology for creation the low-dimensional (thin films, nanowires) semiconductor material on the basis of lead telluride for new thermo-electric energy convectors					+		
Funding received for collaboration with:							

State Fund of Fundamental Research (Kyiv) Funding the project "Research of the processes of the formation of intercalates with abnormally high 'guest' loading "				+			
Science and Technology Centre of Ukraine (STCU) Took part in Canadian conferences: Toronto International Conference - Science and Technology for Humanity (TIC-STH 2009, 26-27.09.2009, Ryerton University, Toronto, Canada) 2nd International Conference on Nanotechnology: Fundamentals and Applications, Ottawa, Canada, 27-29 July, 2011				+			
Academy of Sciences of Turkmenistan (February, 2010, Ashgabat, Turkmen) Took part in international conference supported by Turkmen President on Energy Effective Technologies. CEET reported about hydrogen storage problems.					+		
Dalian Foreign Science and Technology Exchange Centre (China, Dalian City) Participation in China International Patent Fair. August, 6-8th, 2010. China, Dalian City					+		
Kyiv Institute of Scientific-Technical and Economy Information MES of Ukraine (Kyiv) Participation in the preparation of materials and an exhibition for the "20th China International Fair For Trade and Cooperation" (June, 15-18, 2009).	+						
International Bureau of the Federal Ministry of Education and Research at the Project Management Agency c/o German Aerospace Center (DLR) (26.10.2009 - 30.10.2009, Bonn, Germany) Took part in FP7 Contact Point Training for EECA-Partner Countries, a one week internal training visit for EECA partner countries Ukraine, Belarus and Moldova. The event aimed at increasing the quality, quantity, profile and impact of bi-regional Science and Technology (S&T) cooperation.					+		
Joint Support Office (JSO) for enhancing Ukraine's integration in EU research area (FP7 EU Project: EuropeAid/127891/C/SER/UA; Contract No 170-251) Took part in JSO-ERA study-tour in Austria-Hungary: EU NCP system.					+		
Polish National Contact Point for Research Programmes of the EU (NCP Poland, IPPT PAN) in cooperation with Warsaw University of Technology and financed from the European CSA Project FP7 NMP 2010 - M-Future Took part in Conference: FUMAT 2011: European Industrial Technologies Conference on Materials (22-23 September 2011, Warsaw, Poland), presenting an oral report and exhibition materials.						+	

National Contact Point for the Research Programmes and the European Commission in close collaboration with the Ministry of Science and Higher Education and the Ministry of Economy of Poland Took part in Conference: Strategic Energy Technology Plan Conference 2011 under the Polish Presidency of the EU Council (28 – 29 November 2011, Warsaw, Poland), presenting an oral report and exhibition materials.					+		

APPENDIX 10: CEET Demographics

CEET Participants:

	1st year	2nd year	3rd year
A. Total students (graduate and undergraduate)	32	31	20
B. Students receiving scholarship support	32	31	–
C. Total research and teaching staff	35	37	30
D. Staff receiving IFS	17	18	19
E. Young faculty (including postdocs)	18	23	17
F. Young faculty (including postdocs) receiving IFS	8	10	11
G. Ratio of total students to total staff (A/C)	0,91	0,84	0,67
H. Ratio of young faculty to total staff (E/C)	0,51	0,62	0,57
I. Female/Male distribution	25/42	26/42	16/25

Geographic origin of CEET students:

Percentage of CEET students who are:	Undergraduate students	Graduate students
From the region in which the CEET is located	25	21
From elsewhere in Ukraine	1	2
From outside Ukraine	0	0
Total	26	23

APPENDIX 11: Research Projects

Title of Research Project	Principal investigator or faculty sponsor	Problem studied	Number of undergraduate students on project	Number of graduate students on project
Porous Carbon Materials	Budzulyak Ivan M.	- The obtaining and physical-chemical investigation of nanoporous carbon (NC) as supercapacitors electrode materials; - the optimization of obtaining technology of NC based on the base of plant raw material; - the development of new technologies of NC modification with the aim of supercapacitors specific energy characteristics increasing; -complex investigations of structure and electrochemistry compounds materials on the base of NC.	7	5
Electrode Materials for Lithium Power Sources in Oxides, Hydroxides, Salts Structures Based on Metals and Metalloids	Myronyuk Ivan F.	- The optimization of obtaining technology of nanosized TiO_2, H_2TiO_3, $Mg(OH)_2$ materials; - the increasing of characteristics of lithium power sources; -the obtaining of cathode powder materials on the base of metal and metalloids sulfides and fluorides and development of lithium power sources with specific energy characteristics.	6	3
Magnetic Nanomatherials and Dye Sensitezed Solar Cell	Kotsyubynsky Volodymyr O.	- The development of new methods of nanomaterials synthesis on the base of Fe oxides- hydroxides and Fe,Cr,Mn,V-doped TiO_2; - the testing of obtained compounds as electrode materials for secondary lithium power sources; -the elaboration of electrode materials for low-cost and effective photoelectrochemical devices, such	8	8

		as dye sensitized solar cells; - electrochemical devices based on the photointercalation Li^+.		
Cathode Materials for Lithium Power Sources on the Base of Spinel and Rutile Structures	Gasyuk Ivan M.	- The development of cathode materials on the basis of Mg-modified spinel and rutile structures; - the cathode materials of lithium power sources on the basis of nano- and microdispersed forms of Fe_3O_4; - the investigation of intercalation/ deintercalation properties of Li-Fe spinels as function of synthesis conditions, doping, morphology.	5	7

APPENDIX 12: Additional Research Funding

Program Name	Grant to		Source of Funds					
	Institution	Individual Investigator	Budgetary sources	Non-budgetary sources (industry)	Local government sources	CRDF Global grants	Foreign grants other than CRDF Global	Foreign contracts
Ministry of Education And Science of Ukraine. "Research of physicochemical properties of electrode nanomaterials on the basis of Ti, Si, Mg, Zn oxides and carbon, doped by polyvalent elements (V, Cr, Mn, Fe)"	☒	☐	☒	☐	☐	☐	☐	☐
National Academy of Sciences of Ukraine «Obtaining and study of physicochemical properties of nanopowdered oxide materials for gas sensors»	☒	☐	☒	☐	☐	☐	☐	☐
Ministry of Education And Science of Ukraine. The Foundation of Fundamental Research F25.4/208 „Research of the processes of the formation of intercalates with abnormally high "guest" loading	☒	☐	☒	☐	☐	☐	☐	☐
Ministry of Education And Science of Ukraine. "Nanomaterials in the devices of power generation and accumulation"	☒	☐	☒	☐	☐	☐	☐	☐
Ministry of Education And Science of Ukraine. "The Development of Electric Energy Molecular Accumulators Obtaining and Modification Methods "	☒	☐	☒	☐	☐	☐	☐	☐
Grant of President of Ukraine "Nanocomposite materials TiO_2<Fe> as active cathode material at the generation device: Mossbauer study "	☒	☐	☒	☐	☐	☐	☐	☐
Ministry of Education And Science of Ukraine. "Third Generation of Solar Cell:	☐	☐	☒	☐	☐	☐	☐	☐

synthesis and investigation of materials“								
National Academy of Sciences «The development of obtaining methods and physical-chemical properties investigation of electrode nanomaterials for hybrid supercapacitors»	☐		☒	☐	☐	☐	☐	☐
National Academy of Science «Nanosized semiconductor structures on the base of IV-VI compounds for thermoelectricity applications»	☒	☐	☒	☐	☐	☐	☐	☐
National Academy of Sciences «The nanodispersed oxide of iron, zinc and titanium for electrochemical and gas sensor system: technologies development and properties investigation»	☒	☐	☒	☐	☐	☐	☐	☐
State Agency for Science, Innovation and Informatization of Ukraine «Nanodispersed rutile: synthesis, structure, electrochemistry»	☒	☐	☒	☐	☐	☐	☐	☐
State Agency for Science, Innovation and Informatization of Ukraine «The study of specific energy characteristics of lithium power sources based on titanium dioxide»	☒	☐	☒	☐	☐	☐	☐	☐
State Agency for Science, Innovation and Informatization of Ukraine «Synthesis and investigation of structural, magnetic and photocatalytic properties of iron oxides nanodispersed»	☒	☒	☒	☐	☐	☐	☐	☐

APPENDIX 13: Conferences and Visitors hosted by CEET

Conferences hosted by CEET

Full Title of Conference Total registered : 153	Dates of Conference	Approximate number of attendees		
		from the CEET	other Ukrainian	foreign
XIII International Conference on Physics and Technology of Thin Films and Nanosystems (ICPTTFN-XIII)	16-21 May, 2011	22	250	50
XII International Conference on Physics and Technology of Thin Films and Nanosystems (ICPTTFN-XII)	May, 18-23, 2009	20	170	35

Visitors to the CEET:

Name of lecturer	Home institution	Length of visit	Year of visit
Dr. Zhao Hui	Heilongjiang University Department of Solid State Electrochemistry, Harbin, Republic of China	3 days	2011
Dr. Rasit Ahiska	Gazi University Faculty of Technology Dept. Electronic & Computer Technology, Ankara, Turkey	4 days	2011
Dr. Peter Swiantek	Julih Research Center Expert (NCP Energy) Julih, Germany	2 days	2010

APPENDIX 14: Press Coverage of CEET

Ukrainian Scientists Use Fruit Stones to Make SuperCapacitors

It is already the third year for the Research and Education Center (REC), focused on "Nanomaterials in Energy Generation and Accumulation Devices" at the Pre-Carpathian National University (Ivano-Frankivsk, Ukraine). The REC was created in 2009 through the close cooperation of CRDF Global, USAID and the Ministry of Education and Science (MES) of Ukraine within the framework of the Cooperation in the Scientific and Technical Research and Education (CREST) program in the field of energy efficient technologies.

During this time, REC scientists have learned how to use the stones of fruits (apricots, cherries and plums) as environmentally friendly raw material for scientific experiments in the creation of ultracapacitors with miniature sizes and huge energy power. Thanks to a signed agreement of cooperation with one of the Ukrainian canneries, the REC has received a regular supply of these fruit stones for its research operations with nanoporous carbon, which has huge energy-intensive properties. For example, a battery the size of a mobile phone has enough power for a vehicle engine, or be used to instantly trigger Catapult military aircraft. And in the national economy, such a capacitor can be used in leveling the voltage of tidal power.

According to Ivan Mironyak, the vice-rector of the Vasyl Stefanyk Precarpathian National University, nanoporous carbon may be used in medicine. "After detailed studying of this substance, scientists can even neutralize cancer cells. That is why our research projects involve chemists and physicists, as well as experienced professors, young researchers and students interested in joint research and working together, " added Mr. Mironyak.

Since the Ivano-Frankivsk REC has allowed scientists to move from individual research to the creation of laboratory samples for ultracapacitors and lithium current sources, the REC researchers have already received their first letters of interest from Chinese and Korean scientific teams who also wish to use nanoporous carbon in their production.

Link

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Ivano-Frankivsk Center Has Another New Doctor of Sciences

Dr. Volodymyr Kotsyubynskyi of the Pre-Carpathian National University (PNU) in Ivano-Frankivsk has recently received his Doctor of Sciences degree for work on the development of new affordable and safe electrode materials for power supply devices. His work was jointly funded by CRDF Global, the U.S. Agency for International Development (USAID), and the Ministry of Education and Science (MES) of Ukraine under a program to enhance and expand energy efficiency research and improve the training of young scientists in Ukraine.

Dr. Kotsyubynskyi, who serves as the Deputy Director of the Research and Education Center (REC) “Nanomaterials in Energy Generation and Accumulation Devices,” is the third REC researcher to defend a doctoral dissertation since the REC was established three years ago at PNU. This energy efficiency-

themed REC is part of a broader program implemented by CRDF Global to accelerate Ukraine's transition to a knowledge economy by improving science education at the university and post-graduate levels.

Dr. Kotsyubynskyi says that one of the REC's major achievements is to heighten students' interest in research "because they realized [through] taking an active part in the REC that even in Ukraine in non-specialized scientific institutions you can create world-class science." The ability – provided under this USAID-supported program – to conduct research using new modern equipment and materials helps integrate researchers in Ivano-Frankivsk into the international scientific community.

Link

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Information on press-conference-2012 in Ivano-Frankivsk REC

CRDF Global staff Marilyn Pifer, Elisabeth Shoop and Tetyana Narchynska, along with Bruce Gnade, an expert in nanomaterials from the University of Texas at Dallas, paid a site visit to the Research and Education Center "New Nanomaterials for Energy Generation and Storage Devices" at Vasyl Stephanyk Pre-Carpathian National University in Ivano-Frankivsk, Ukraine on March 22-23, 2012. The three-year grant to the Center, supported by USAID and cost-shared by the Ministry of Ukraine for Education and Science, has allowed the Center to develop new dyes and materials for batteries, capacitors, electrodes and solar and thermoelectric cells, largely using treatment of inexpensive and readily available materials such as cherry stones and apricot pits. Five students, including two who had spent three weeks in Dr. Gnade's lab in Texas, presented their research results in English. A well-attended press conference gave the Center management an opportunity for local publicity. CRDF Global's grant to this Center will close in May 2012.
More on site visit – on Pre-Carpathian National University Web and on CRDF Global Ukraine Facebook page

Video by the Ukrainian TV about CRDF Global site visit to the REC "Nanomaterials in Energy Generation and Accumulation Devices" and March 22, 2012 press conference held in Ivano-Frankivsk to announce the results of the REC's research activities since 2009:
Link with video

Additional video after the press-conference:
Link with video