



Boosting EU-Ukraine cooperation in the field of Superhard Materials

NEWSLETTER No2

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START 2nd meeting

START 2nd meeting was organised by *Q-PLAN N.G.* in Thessaloniki (Greece) and lasted 2 days: 24-25 May 2012. The aim was to present all (both the ‘technical’ and ‘administrative’ aspects of the project and plan the work for the second period. To do so:

- The 1st day was devoted to the discussions among the partners in order to go through the Project tasks for the first semester and to report about each partner’s contribution according to their role and responsibilities; to discuss thoroughly the completeness of the Project tasks implementation and reach a common understanding of performed and future activity. The aim was to plan and initiate the activities for the second semester, namely
 - ✓ to discuss the progress in development of the ISM strategy;
 - ✓ to highlight the scientific topics and project titles which should be under the development during “on-job-FP7 training” in June 2012 in Poitiers, France and form the base for developing the Joint Research Action Plans between ISM/Institute P’ and ISM/UNIPRESS
 - ✓ to acquaint participants with the list of conferences in which ISM researchers were participated from the beginning of the Project “Start” and which are planned to be visited in 2012.
 - ✓ to discuss the activities during the first “Delegation Tour” to France (Paris, Caen, Poitiers) in May-June 2012
 - ✓ to acquaint the Project partners with the information concerning preparation of the training materials for the Intensive training in September 2012 in Ukraine
 - ✓ familiarization with the activity during Research Internships in France in May-June 2012 and Poland in October 2012.
 - ✓ which activity should be performed in order to make next steps toward considerable progress in dissemination and exploitation and promotion of the ISM research competencies.
 - ✓ to develop action plan for the second semester.
- The partners’ approach (methodology, decisions/suggestions, actions, etc) to carry out the work was presented to the Project Officer (PO) during the morning of the 2nd day. The PO presented the “EC point of view” on the project as well as his expectations concerning elaboration of the ISM Research strategy.

The following researchers attended the meeting:

- **Prof. Nikolay Novikov, Prof. Tatiana Prikhna**, V.N. Bakul Institute for Superhard Materials of the National Academy of Sciences of Ukraine (ISM);
- **Prof. Thierry Cabioc’h, Prof. Jacques Rabier** Centre National de la Recherche Scientifique (CNRS-PPRIME);



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- **Prof. Bogdan Palosz**, Institute of High Pressure Physics of the Polish Academy of Sciences (UNIPRESS).
- **Mr. Iakovos Delioglani** , International Environment and Quality Services North Greece Ltd (Q-PLAN N.G.)
- **Dr. Gediminas Ramanascas**, Project Officer of START.

Academician Prof. Dr-ing, Dr.h.c. Prof.h.c A.G. Mamalis - Project Scientific Director of the Project Center for Nanotechnology and Advanced Engineering (PC-NAE), Athens, Greece, has been invited and participated during two days for the meeting as an observer following the many years of collaboration with ISM. In the first day of the Meeting Prof. A. Mamalis outlined the strategy and research activity of PC-NAE.

All partners were represented during both days of the meeting, while the Project Officer joint us the 2nd day.

Delegation Tour in France

During the 1st delegation tour of the START project the team of ISM researchers has visited 3 scientific laboratories in France. The team of ISM researchers consisted of Prof. N. Novikov, Prof. T. Prikhna, Prof. V. Turkevich, Dr. A. Kozyrev, Dr. D. Turkevich, Dr. T. Basyuk, Ms. A. Starostina.

In May 29 Ukrainian delegation visited Laboratoire des Sciences des Procédés et des Matériaux (LSPM), University of Paris 13(Villetaneuse). During the visit director of LSPM Prof. K. Hassouni gave the lecture on LSPM's history, structure, staff, facilities and research work. ISM team visited eight different scientist subdivisions and acquainted with LSPM experimental facilities such as high pressure devices (toroid/multi-enclumes, up to 25GPa / 3000K), X-ray diffractometers, transmission electron microscopy, scanning electron microscopy, mass spectrometry, Brillouin spectroscopy, Raman spectroscopy, atomic force microscopy etc., methodology of synthesis of polycrystalline thin films, high purity monocrystalline diamond, doped diamond monocrystal, nanostructured thin films by PECVD, CVD and Sol-Gel processes, new phases under very high pressure, characterization the structural, electrical, mechanical, elastic, and magnetic properties of functional materials. Prof. V. Solozhenko and Prof. V. Turkevich agreed the theme of joint Ukraine-France bilateral research grant. In the framework of this research grant LSPM will use synchrotron radiation beam time in Hamburg and Grenoble for *in situ* study of phase transformation in the B-N-O system at high pressure and temperature. ISM will use his own big volume high pressure apparatus for synthesis and sintering of superhard cutting plates on the basis of the B-N-O system materials.



Ukrainian delegation



Lecture of Prof. K. Hassouni



Prof. V. Solozhenko and his PhD student



Atomic force microscope



Synthesis of doped diamond thin film



Laboratory of Brillouin spectroscopy

In May 31 ISM team was acquainted with laboratory CRISMAT/CNRS(Caen) and their experimental facilities (Spark Plasma Sintering (FCT-HD 25, 2400°C, 100 MPa, dynamic vacuum, argon/Ar, nitrogen/N₂, or forming /Ar:H₂ gaz), Hot-forging furnace, Box and tubular furnaces under controlled atmosphere, Spex milling and planetary milling machines, Two automatic Four Circle Diffractometer CAD, 4 Nonius, High-resolution transmission electron microscopy, Microanalysis X EDS, SQUID Magnetometers, Resistance Measurements facilities (PPMS), Laser Granulometer, Surface Analysis (SIMS, ESCA, AUGER), etc.). Special attention was devoted to Spark Plasma Sintering device. Research plan concerning the use of SPS furnace for sintering wide rank of superhard and functional materials was discussed. Prof. Prikhna gave the lecture “Superconductive and MAX materials sintered at high pressure in ISM: synthesis, properties and application”.

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Prototype of MAGLEV railway



Dr. J. Noudem



Differential thermal analyzer



Spark Plasma Sintering



General discussion



Lecture of Prof. Prikhna in laboratory
CRISMAT



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The end point of delegation tour was laboratory PHYMAT/CNRS, University of Poitiers (Poitiers). Director of Institute P' JP Bonnet gave the lecture on research work. ISM team was acquainted with laboratory PHYMAT experimental facilities (Hot Isostatic Press - GEC Alstom -(Graphite furnace 2000°C, 200MPa), Furnace under controlled atmosphere (Nabertherm, 2200°C), SPEX 8000 Mixer/milling and planetary ball milling machine (Fritsch Pulverisette 5), Dilatometer (Setaram, SETSYS 16/18) working under Ar flux or primary vacuum up to 1750°C, 4 circles X-ray diffractometers (D8-Bruker and XRD 3000-Seifert), Transmission electron microscopy (JEOL 200CX) and High-resolution transmission electron microscopy (JEOL 2200 FS), Paterson high temperature-high pressure testing system (500Mpa, 1200°C), Instrumented Micro-indentor (MHT CSM Instrument), Nano-indentor (NHT, CSM Instruments) etc.). Prof. T. Cabioch', Prof. J. Rabier and Prof. Prikhna discussed the possibility to apply for joint Ukraine-France bilateral research grant Vice-President of Poitiers University Prof. L. Thilly organized meeting and acquainted ISM team with international collaboration of University. The meeting has finished with discussion the proposal for next FP7 call.



Lecture of director of Institute P'
JP Bonne



Electron microscope

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Nanoindenter



Ukrainian-French team in the University of Poitiers



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On-the-job FP7 training

The 1st On-the-job FP7 training of the START project has been carried out from June 3 to June 5 in Poitiers on the basis of laboratory PHYMAT/CNRS, Institute P' and University of Poitiers. The following ISM researchers took part in training Prof. N. Novikov, Prof. T. Prikhna, Prof. V. Turkevich, Dr. A. Kozyrev, Dr. D. Turkevich, Dr. T. Basyuk, Ms. A. Starostina.

The following French researchers took part in training Prof. T. Cabioch' (University of Poitiers), Prof. J. Rabier (PHYMAT/CNRS), Dr P. Chartier (University of Poitiers), Prof. L. Thilly (University of Poitiers), Mr J.-M. Pincemin (University of Poitiers).

The careful analysis of "Orientation paper prepared in connection with the FP7 2013 Work Programme of THEME 4 – NMP" has been performed. As a result few directions such as "Nanotechnology for multifunctional lightweight construction materials and components" and "Innovative materials for advanced applications" were chosen. Four possible projects were under the discussion between French and Ukrainian partners and 4 young ISM researchers (less than 35 years old) from Ukrainian team prepared corresponding "White Paper" drafts of the Projects:

White Paper contains the object of scientific and technology collaboration, work program and time schedule. The aim and importance of collaboration and benefits emphasized. The great attention was paid to the discussions concerning amount and qualification of the European partners, availability of necessary research facilities for the Projects successful implementation and research team's interaction for attaining outstanding scientific results. The main role of the conducted "on-the-job FP7 training" and prepared projects is opening of the wide European perspectives for the research work and subsequent education of young ISM scientists and enhancing the movement of the Institute for Superhard Materials toward introduction into European Research Society.

Research internship in Poitiers

During Internship in the Institute P' May 28-June 11 2012 Dr. T. V. Basyuk and Ph.D student A.V. Starostina were integrated into the research team of French partner and jointly implement research work agreed amount the two parties. The idea of the training contained several aspects. First aspect consisted in the finding of the most interesting break through research topics for long-term cooperation between French and Ukrainian partners which in the nearest future can be transformed into international research projects. As a result there were selected two research topics: “High pressure-high temperature effect on structure and properties of solid solutions in MAX phases: $Ti_3(Al_xSn_{(1-x)})C_2$ and $Ti_2Al(C_xN_{(1-x)})_y$ compounds” for Dr. T.V. Basyuk and “High pressure-high temperature effect on structure and properties of MAX phases Ti_3AlC_2 synthesised at ambient pressure“ for PhD student A.V. Starostina.

Second aspect consists in founding mutual points of research with other (not from Institute P', University of Poitiers) potential project's partners. The third aspect was acquaintance with the modern methodologies which will be used for the proposed projects implementation. To fulfill the last task T.V. Basyuk and A.V. Starostina were leaned the HIP (high isostatic pressure) manufacturing process of MAX phases, gain the skills and performed investigations at scanning electron microscope and X-ray Bruker D8 advance diffractometer.



Ukrainian-French team in Institute P'(Poitiers)



HIP apparatus (1 GPa, 1400 °C)



Electron microscope



X-ray Bruker D8
advance diffractometer