

## XVI INTERNATIONAL FORUM ON THERMOELECTRICITY

The Forum took place from May 19 to 22, 2015 in Paris in the conference hall “Forum de Grenelle”, in the immediate vicinity of the Eiffel Tower and other attractions of Paris.

The Forum was dedicated to Jean-Charles Peltier, a French researcher and pioneer in thermoelectric cooling.

The International Thermoelectric Academy (ITA), a French Company Marvel Thermoelectrics, the Institute of Thermoelectricity of NAS and MOS of Ukraine and the Ham Town Council acted as organizers of the Forum.



The following persons formed the International Organizing Committee: L. Anatyshuk (Ukraine), Chair, A. Casian (Moldova), H.J. Goldsmid (Australia), J. Sharp (USA), J. Snyder (USA), J. Stockholm (France), L. Chen (China), M. Fedorov (Russia), R. Funahashi (Japan), S. Asmontas (Lithuania), T. Kajikawa (Japan), Y. Grin (Germany) – members. The Local Organizing Committee was headed by J. Stockholm (France).

The objective of the Forum was the analysis of the state-of-art in thermoelectricity based on the information of the achievements in the field within the last two years, broad debate on identification of the most prospective trends in thermoelectricity, formulation of recommendations aimed at acceleration of progress in thermoelectricity

17 thermoelectric organizations and companies acted as sponsors of the Forum, namely: ALTEC-M (Ukraine), Crystal TE (Russia), FerroTec (Japan), Genterm (USA), ISP NASU (Ukraine), KELC (Japan), Marlow Industries (USA), Modul (Ukraine), RIF Corporation (Russia), RMT Ltd (Russia), SELEN (Azerbaijan), Smart Thermoelectrics (Russia), SODERN (France), Thermion Company (Ukraine), Thermoprylad (Ukraine), Z-Max (Japan).

Leading specialists from 25 countries took part in the work of the Forum.

124 presentations were made at the Forum, 12 of which were invited, made by world leading scientists on the achievements in thermoelectricity, 42 oral presentations and 70 poster sessions.



*President of the ITA, Dr. L. Anatyshuk (Ukraine)*

President of the International Thermoelectric Academy, academician of the National Academy of Sciences of Ukraine, L. Anatyshuk opened the Forum.

The participants of the Forum observed a minute of silence to honour the memory of the ITA members K.I. Uemura, R. Buist, V. Mykhailovsky and V. Schennikov who passed away in 2013-2015.

President of the ITA, Dr. L. Anatyshuk (Ukraine) presented a film "On life and scientific activity of Jean-Charles Peltier".

The invited paper on recent activity on thermoelectric power generation technology in Japan was presented by an ITA academician, Dr. T. Kajikawa (Shonan Institute of Technology, Japan) and Dr. R. Funahashi (National Institute of Advanced Industrial Science and Technology Ikeda, Osaka, Japan).



*L. Chen (China)*

An ITA academician Dr. L. Chen (Shanghai Institute of Ceramics, China) reported on recent progresses on thermoelectric materials and applications in China within the last two years.

An ITA associate, Dr. Y. Shinohara (National Institute for Materials Science, Japan) presented a report on the present situation of thermo-module development in Japan.



*Y. Shinohara (Japan)*

Dr. L. Bulat, an ITA academician (ITMO University, Russia), Dr. M. Fedorov, an ITA academician and Dr. Burkov (Ioffe Physical-Technical Institute of the Russian Academy of Sciences, Russia) made a presentation on the development of thermoelectricity in Russia in 2013-2014. In this presentation the results of basic and applied researches carried out in the universities, institutes and at enterprises of the Russian Federation were considered.

The survey on the main achievements in thermoelectricity in Western Europe in 2013 – 2014 was introduced by an ITA academician, Dr. J. Stockholm (Marvel Thermoelectrics, France).



*R. Funahashi (Japan)*



*L. Bulat (Russia)*



*J. Stockholm (France)*

An ITA academician, Dr. J. Snyder (California Institute of Technology, Pasadena, California, USA) reported on the activity in the sphere of thermoelectricity in the USA.



*S. Ašmontas (Lithuania)*



*C. Goupil (France)*



*A. Casian (Moldova)*



*Y. Grin (Germany)*

The work of the Forum was accompanied by interesting discussion which lasted even during the participants' informal communication.

Scientific reports on the physics of thermoelectricity were made by: Dr.S. Ašmontas, an ITA academician (Lithuania) "Peltier effect of hot carriers"; Dr.L.Vykhor, an ITA associate (Ukraine) "Bulk Peltier effect: history, theory and practical applications"; Dr. C. Goupil (France) "Feynman ratchets and thermoelectric systems: harmonic response and feedback".

In thermoelectric material science the reports were made by: Dr. A.Casian, an ITA academician (Moldova) "Prospects of low dimensional organic materials for thermoelectric applications"; Dr. P. Jund (France) "Design of thermoelectric materials via first principles calculations"; Dr.J. Grin, an ITA associate (Germany) "Chemical bonding and thermoelectric ability of materials"; Dr. V. Khovaylo (Russia) "Preparation and power factor of polyacrylonitrile-based nanocomposites"; Dr. A. Kao (Great Britain) "Thermoelectric magnetohydrodynamics in the solidification of alloys"; Dr. Q. Yao (China) "Highly regular and orderly P3HT film with enhanced thermoelectric performance"; Dr. J. de Boor (Germany) "Light-weight  $Mg_2Si_{0.8}Sn_{0.2}$  for thermoelectric energy conversion";



*J. Snyder (USA)*



*L. Vykhor (Ukraine)*



*P. Jund (France)*



*V. Khovaylo (Russia)*



*A. Kao (Great Britain)*



*J. de Boor (Germany)*



*O.H. Урюпин (Russia)*



*A. Воронин (Russia)*



*X. Zianni (Greece)*

Dr. O.Uryupin, an ITA associate (Russia) “Thermoelectric properties of carbon nanotubes/ polyvinylidene fluoride composite”; Dr. J.-C. Tédénac, an ITA associate (France) “High manganese silicides for thermoelectrics. Thermodynamic database for manganese silicides”; Dr. A.Voronin (Russia) “Features of sintering process of  $Ni(M)Sn$  ( $M = Ti, Zr, Hf$ ) half-Heusler alloys”; Dr. A. Maignan (France) “Ceramics of thermoelectric oxides and sulfides: recent results from CRISMAT (crystallography and material science laboratory)”; Dr. H. Funashima (Japan) “Theoretical study of chalcopyrite and derived compounds as thermoelectric materials”; Dr. X. Zianni (Greece) “Modeling the thermoelectric properties of modulated nanocomposites”; Dr. M. Ohtaki (Japan) “Enhanced phonon scattering in nanostructured oxide materials”; Dr. O.I. Lebedev (France) “Evidences and impact of advanced transmission electron microscopy for thermoelectric materials”.

The thermoelectric applications were reported on by: Dr. D. Woerner (USA) “Another update on the multi-mission radioisotope thermoelectric generator powering the Curiosity rover”; Dr. T. Caillat, an ITA academician (USA) “Advanced thermoelectric

technology for space power generation”;



*Q. Yao (China)*



*J.C. Tedenac (France)*



*A. Maignan (France)*



*H. Funashima (Japan)*



*O.I. Lebedev (France)*



*T. Caillat (USA)*



*G. Gromov (Russia)*



*K.T. Wojciechowski (Poland)*

Dr. L. Vykhor, an ITA associate (Ukraine) “Devices with thermoelectric pumps for supply of astronauts with drinking water during long-term flights”; Dr. G. Gromov, an ITA associate (Russia) “Applications of thermoelectric micromodules: coolers, generators, sensors”; Dr. C.A. Gould (Great Britain) “The modelling and simulation of  $\text{Bi}_2\text{Te}_3$  thermoelectric generators in synopsys TCAD”; Dr. R. Dekhtyaruk (Russia) “Thermoelectrically cooled high power LED for automotive industry”; Dr. K.T. Wojciechowski, an ITA associate (Poland) “Analysis of possibilities of adapting thermoelectric technologies for improvement of energy efficiency of chosen devices in a combined heat and power plant”.

In his presentation Dr. L. Anatyshuk, President of the ITA (Ukraine) provided the results of the comparative analysis of a thermoelectric converter of energy into electricity and other types of converters. The rational areas of electric power, cooling capacity and informativeness parameters were determined which enable the absolute advantages of thermoelectric energy conversion. The requirements to materials were described where the economic expedience of thermoelectricity application is considered; as well as examples of thermoelectric energy converters mass applications with the account of the above approaches.



*M. Ohtaki (Japan)*



*D. Woerner (USA)*



*C.A. Gould (Great Britain)*



*R. Dekhtyaruk (Russia)*



*Dr. L. Anatyshuk, an ITA academician, gives a presentation “ On the promising global applications of thermoelectricity, the related technologies and materials”*

The reports on the scientific activity of the candidates nominated for election as the ITA academicians or associates as well as those from scientists and representatives of the organizations, participating in the contest for the International Thermoelectric Academy Honorary Golden Prize. For election academicians of the International Thermoelectric Academy the reports of the following candidates were made: Dr. R. Funahashi (Japan ) “Development of thermoelectric waste heat recovery at medium and high temperature”; Dr. A. Maignan (France) “From solid state chemistry to thermoelectric materials”; Dr. A. Terekov



*A. Terekov (Russia)*



*E. Rogacheva (Ukraine)*

(Russia), an ITA associate “NPO “Kvant” achievements in the field of thermoelectricity”; Dr. E.I. Rogacheva, an ITA associate (Ukraine) “Size effects in thin-film structures and composites based on the perspective thermoelectric materials”; Dr. A. Burkov (Russia) “State-of-the-art thermoelectric metrology and materials”; Dr. X. Shi (China) “From caged thermoelectric skutterudites to the discovery of



*A. Burkov (Russia)*

abnormal transports in Cu-based materials”; Dr. H. Böttner (Germany) “Thin layers leading to thick changes”. The candidates for the ITA associates presented the following reports: Dr. T. Fröhlich (Germany) “Challenges in measuring the temperature of exhaust gas of combustion engines”; Dr. E. Velmre (Estonia) “Unknown pages in life and scientific activity of Thomas Johann Seebeck”; Dr. R.Kuz (Ukraine) “On computer simulation in thermoelectricity”;



*T. Fröhlich (Germany)*



*R. Kuz (Ukraine)*



*V. Lysko (Ukraine)*



*R. Kobylanskyi (Ukraine)*

Dr. A. Prybyla (Ukraine) “Thermoelements using thermoEMF anisotropy”; Dr. R. Kobylanskyi (Ukraine) “Short-circuited thermoelements and their applications” For being awarded the International Thermoelectric Academy Honorary Golden Prize such reports were made: Dr.S. Ašmontas, an ITA academician (Lithuania) “Thermoelectricity of hot current carriers”; Mrs. R. Gruneisen from SODERN Company (France) “Thermoelectric applications in SODERN company products”.

A general International Thermoelectric Academy meeting took place on May 21, 2015 during the work of the Forum where on the contest grounds and by means of secret vote new academicians were elected, namely: Dr. R. Funahashi, Japan; Dr. A. Maignan, France; Dr. A. Terekov, Russia; Dr.

E. Rogachova, Ukraine, Dr. A. Burkov, Russia; Dr. X. Shi, China; Dr. L. Vykhorr, Ukraine; Dr. H. Böttner, Germany. The following scientists were elected the ITA associates: Dr. T. Fröhlich, Germany; Dr. E. Velmre, Estonia; Dr. R. Kuz, Ukraine; Dr. V. Lysko, Ukraine; Dr. A. Prbyla, Ukraine; Dr. R. Kobylanskyi, Ukraine.



*H. Böttner (Germany)*



*E. Velmre (Estonia)*



*A. Prybyla (Ukraine)*



*R. Gruneisen (France)*



*Awarding Dr.S. Ašmontas, an ITA academician (Lithuania) the ITA Honorary Golden Prize*



*Awarding Dr. M. Min (Estonia) the ITA Honorary Golden Prize*



*Awarding Mr. Kocher, the representative of the SODERN Company (France), the ITA Honorary Golden Prize*

The ITA Honorary Golden Prize was given to Dr.S. Ašmontas, an ITA academician (Lithuania) in the nomination “For fundamental contribution into development of thermoelectricity”; the SODERN Company (France) in the nomination “For thermoelectric products quality and technologies”; Dr. M. Min (Estonia) in the nomination “For active promotion of thermoelectricity”.



*Before the unveiling of the monument to Jean-Charles Peltier in Ham*

The key event at the Forum was the unveiling of the monument to Jean-Charles Peltier in Ham, his native town, 130 km away from Paris. The International Thermoelectric Academy acted as the founder of the monument. The monument was fabricated due to the donations of 35 ITA members from 15 countries. Their names are carved on the monument. Other sponsors of the monument are also 19



LE MONUMENT DE L'ACADÉMIE INTERNATIONALE  
DE THERMOÉLECTRICITÉ REPRÉSENTÉE PAR:

ANATYCHUK – UKRAINE	NIKOLAEVA – MOLDOVIE
AHISKA – TURKIE	PASTORINO – ITALIE
ASMontAS – LITHUANIE	PUSTOVALOV – RUSSIE
BULAT – RUSSIE	RAZINKOV – UKRAINE
CASIAN – MOLDOVIE	ROGACHEVA – UKRAINE
L. CHEN – CHINE	SEMENYUK – UKRAINE
CHERKEZ – UKRAINE	SHINOHARA – JAPON
CHERNYSH – MOZAMBIQUE	SMOLYAR – UKRAINE
GRABOV – RUSSIE	SNYDER – USA
GRIN – ALLEMAGNE	STADNYK – UKRAINE
GROMOV – RUSSIE	STOCKHOLM – FRANCE
GUTSUL – UKRAINE	TEREKOV – RUSSIE
HODOVANIUK – UKRAINE	TEUT – KAZAKHSTAN
JACYZYN – UKRAINE	URYUPIN – RUSSIE
KAHRAMANOV – AZERBAIJAN	VAINER – UKRAINE
LOBUNETS – UKRAINE	VYKHOR – UKRAINE
MELNYCHUK – UKRAINE	WOJCIECHOWSKI – POLOGNE
MYKHAILOVSKY – UKRAINE	

LES SOCIÉTÉS THERMOÉLECTRIQUES:

ALTEC-M – UKRAINE	MODUL – UKRAINE
CRYSTAL – RUSSIE	RIF – RUSSIE
DGTU – RUSSIE	RMT – RUSSIE
FERROTEC – JAPON	SELENIUM – AZERBAIJAN
GENTHERM – USA	SMARTTHERMOELECTRICS – RUSSIE
ITE – UKRAINE	SODERN – FRANCE
LASHKARYOV ISP – UKRAINE	THERMION – UKRAINE
KELK – JAPON	THERMOPRYLAD – UKRAINE
MARLOW INDUSTRIES – USA	Z-MAX – JAPON
TRANSCARGO SERVICES – KAZAKHSTAN	

*Thermoelectric company - sponsors monument  
Jean Charles Peltier*

*ITA members, sponsors the monument to Jean-Charles Peltier*

thermoelectric companies from different countries. The festivities on the unveiling of the monument took place on May 22, 2015. The monument embodies a thermocouple cooling based on the Peltier effect.



*Unveiling of the monument to Jean-Charles Peltier*



*After the unveiling of the monument to Jean-Charles Peltier:  
G. Labille, the Mayor of Ham, Dr. L. Anatyshuk, ITA President,  
Dr. M. Min, Professor of the Tallinn University of Technology*

The working model of the Peltier experiment is also installed at the monument. The monument was unveiled in the solemn atmosphere on May 22, 2015.



*The Peltier effect demonstration*



*Taking photos at the monument to Peltier*



*The monument to Jean-Charles Peltier*

In this way the grateful thermoelectricity associates honoured the memory of Jean-Charles Peltier, an outstanding scientist.