Polish Agency for Enterprise Development (Polska Agencja Rozwoju Przedsiębiorczości, PARP) is a government agency operating under the auspices of the Ministry of Economy. It was established under the Act of 9 November 2000. The aim of the Agency is to manage national and EU funds intended for supporting business and innovation as well as human resources development.

The Agency, which in 2010 celebrated its 10th anniversary, was established in order to implement economic development programs supporting innovation and research activities of the small and medium sized enterprises (SMEs), as well as to support regional development, exports increase, human resources development and the use of new technologies.

In the 2007-2013 financial perspective, PARP is responsible for implementing measures under three Operational Programs: Innovative Economy, Human Capital and Development of Eastern Poland.

One of the Agency’s priorities is to promote innovative attitudes and encourage entrepreneurs to apply modern technologies in their businesses. To this end PARP runs a website devoted to innovation, Portal Innowacji www.pi.gov.pl, and organizes the Polish Product of the Future Competition every year. SME representatives can participate in cyclical meetings of the Innovative Enterprises’ Club. The aim of the PARP Academy Educational Website, www.akademiaparp.gov.pl, is to provide micro, small and medium sized enterprises with access to business knowledge in the form of e-learning. Through web.gov.pl PARP supports the development of e-business. Enterprise Europe Network Centre operates within PARP, offering entrepreneurs information on European Union law and the rules of conducting business activity on the common market.

PARP initiated the creation of networks of regional SMEs support centers, i.e. the National SME Services Network, National Innovation Network and Consultation Centers. These institutions offer information, consulting, training and financial services, free of charge or at preferential rates. Regional Financing Institutions are PARP’s regional partners in the implementation of selected measures.
Polish Agency for Enterprise Development is not responsible for the content of project descriptions. Detailed information concerning awarded products and technologies can be acquired from the authors of respective projects.

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CATALOGUE OF WINNERS

15TH ANNUAL COMPETITION POLISH PRODUCT OF THE FUTURE

The Institute of Medical Technology and Equipment (ITAM) is the only institute in Poland conducting research, development and implementation in the field of medical equipment. Their activities in advanced technologies concentrate, among other things, on diagnostics and therapy of cardiovascular diseases, medical resuscitation and biomedical engineering. The Institute has developed on a global scale new directions of medical technologies including non-invasive electrostimulation methods for heart disease diagnostics and therapy, systems of computer cardiotographic signal analysis, control and supervision systems of patients undergoing heart electrotherapy. ITAM is a triple winner of the “Polish Product of the Future” Annual Competition (1999, 2009, 2011). Awarded systems and equipment have been used by Polish hospitals for years.

The Institute of Mining Technology KOMAG specializes in scientific research and development for the mining sector. They are focused, among other things, on mechanisms of extractive processes, automation and robotisation of technological processes, formation of environmental protection technologies. Their activities also include designing new technical solutions for machines and devices, mechatronic systems, control, diagnostics and monitoring systems. KOMAG is a triple winner of the “Polish Product of the Future” Annual Competition (2002, 2004, 2005). The innovative machines designed by the Institute have been implemented into production and they are used by both Polish and foreign hard coal mines.

The Institute of Electron Technology (ITE) is a leading Polish scientific centre in the field of semiconductor micro- and nanotechnologies. The research conducted by ITE includes, among other things, solid body electronics and physics as well as activities related to development, implementation and promotion of modern micro- and nanotechnologies and their applications in photonics, micro- and nanoelectronics. The Institute develops and sells instruments, scientific and research services and intellectual property rights on the Polish and foreign markets. They have been awarded over 300 various prizes since the Institute was established in 1966. ITE is also a triple winner of the “Polish Product of the Future” Annual Competition (1997, 2011, 2012). Their awarded equipment and technologies are exported to the USA, Switzerland, EU member states etc.

The Company Transition Technologies S.A. delivers software and provides engineering services based on state-of-the-art technologies (including neural networks) for power engineering and gas sectors as well as in industrial automation in Poland and worldwide. Advanced technologies offered by the company are applicable to development of solutions related to management and design for the biggest global automotive, aeronautical, pharmaceutical and military multinational companies. Furthermore, its activities include information systems, prediction models with neural networks, regulators with fuzzy logic, genetic optimisation and advanced validation algorithms. The Company Transition Technologies is a double winner of the “Polish Product of the Future” Annual Competition (2002, 2009). Awarded systems have been implemented by numerous power engineering companies in the USA, Asia and Poland.

VIGO System S.A. is a world leader in the production of uncooled, photon infrared detectors. It offers equipment for applications in industry, medicine, research works and military technology, used for example in production of thermographic cameras for temperature distribution measurement and capture, diagnostics of machines and devices and medical diagnostics. The reference list of the VIGO product users contains the most known global companies and institutions from aeronastrical, space, optical, automotive and electronic industries. VIGO System is a triple winner of the “Polish Product of the Future” Annual Competition (1999, 2001, 2007). Awarded devices have been sold successfully on the Polish market and in the EU countries, as well as in the USA and Asia.

The Institute of Mining Technology

Institute of Medical Technology and Equipment

Zabrze


Institute of Mining Technology KOMAG

Client

Director: Małgorzata Malec, M.Sc. Eng.

Institute of Medical Technology and Equipment

Warsaw


Transition Technologies S.A.

Warsaw

President of the Management Board: Associate Prof Konrad Swierk, D.Sc. Eng.

VIGO System S.A.

Ożarów Mazowiecki


VIGO System S.A.

Zabrze


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Minister of Economy

Honorary Patron

Media Patron

Partner

VIGO System S.A.

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Ożarów Mazowiecki

Bringing up the topic of innovations, I have always emphasized that both conducting research works as well as implementing their results, pose a huge challenge for Polish scientists and entrepreneurs. I am also aware that such activities involve risk, but practical experience shows that many undertakings of such type result in a scientific and market success.

Winners of the “Polish Product of the Future” annual competition, that marks its 15th jubilee this year, make a perfect example of such success. The history of the Competition shows that projects encompassing innovation at every stage, starting from a design phase and ending with implementation, have succeeded.

There are outstanding personalities behind these achievements, including talented engineers and entrepreneurs, who can and want to use their extraordinary scientific and organizational talents to produce innovative solutions. Such people work for research centres and enterprises that have received many awards in the Competition while their products have been accepted by the market, gaining wide recognition from clients and business partners. To recognize such multiple award winners and their contribution to development of innovations in Poland, on the occasion of the 15th anniversary of our Competition, I have established a special prize for them – a Crystal Pyramid Innovation Award.

This jubilee is also a perfect opportunity to express my special thanks to over 200 top Polish experts in technology and economic fields for supporting us during the assessment process of nearly 700 project applications during those years and for their participation in the Competition jury. I would like to thank them warmly for their involvement and efforts put into making this Competition possible as well as for maintaining a high quality level.

I am very proud to present our catalogue, which will introduce you to products and technologies awarded in 15th Competition while also featuring the past winners honoured with a special jubilee award.

Warsaw, June 2012

Bożena Lublińska-Kasprzak
Chairperson of the Competition Jury
President of Polish Agency for Enterprise Development
The “Polish Product of the Future Annual Competition”, organised by the Polish Agency for the Enterprise Development, celebrates the 15th edition in 2012. The objective of the Competition, co-financed by the European Union under the European Social Fund, is to promote and disseminate the information on the achievements of the authors of innovative products and technologies. The target group includes research centres, scientific institutes, innovative enterprises and individual inventors from the EU Member States.

Applicants have to present a new, innovative product or technology in one of the following categories:

- product of the future in the pre-implementation phase,
- technology of the future in the pre-implementation phase,
- product of the future in the implementation phase,
- technology of the future in the implementation phase.

Solutions that are far advanced in the implementation processes can compete for the “Polish Product of the Future” Award in the category of the product and technology of the future at the pre-implementation phase. In the category of solutions at the implementation phase, submitted products should be implemented in production practice for at least 12 months, however, no longer than 21 months prior to submission of the project for the Competition.

The adopted assessment criteria include first of all the degree of innovation, market demand for a given product and its environmental impact. Other important factors in the selection process of the best products and technologies include comparability of the technical parameters against global equivalents, export and employment growth potential, price competitiveness and issues related to industrial property protection.

In each category one main prize and many distinctions are awarded. The winners of the “Polish Product of the Future” Award receive a statuette, a diploma and are entitled to use the logo and the slogan “Polish Product of the Future” for promotion purpose. The Agency also supports the promotion of the winning products and technologies by the following means:

- presentation at the national and international fairs and exhibitions related to innovation,
- presentation in the catalogue of the Competition’s winners in two language versions, Polish and English; the catalogue is broadly distributed in Poland and also abroad by Polish diplomatic posts,
- presentation at the Innovation Portal website www.pi.gov.pl,
- promotion during conferences, seminars and radio and television programs dedicated to innovation.

Promotion activities are performed by the Agency in cooperation with the Foundation of the Polish Promotional Emblem for innovative solutions, “Teraz Polska”.

So far several hundred innovative products and technologies from such areas as medicine, pharmacy, power industry, mechanics, electronic engineering and chemistry have been submitted. The Competition Jury has awarded 36 projects and granted 71 distinctions. The final products developed on the basis of competition applications have been launched in the Polish market and many of them later became valuable export products. The Competition’s winners include companies currently quoted at the New-Connect stock market dedicated to young but very dynamic enterprises with prospects for rapid growth.

We will look forward to receiving your nominations for the future editions of the Competition.
WINNER OF THE 15TH EDITION OF THE POLISH PRODUCT OF THE FUTURE COMPETITION IN 2012

PRODUCT OF THE FUTURE AT THE PRE-IMPLEMENTATION STAGE

06 Winner: QUANTUM CASCADE LASERS
Institute of Electron Technology

08 Distinction: “BREASTLIFE TESTER” – THERMOGRAPHIC TESTER FOR EARLY DETECTION OF BREAST PATHOLOGY, INCLUDING CANCER
Braster S.A.

10 Distinction: INNOVATIVE METATHESIS CATALYSTS FOR APPLICATION IN THE CHEMICAL AND PHARMACEUTICAL INDUSTRIES
Apeiron Synthesis Sp. z o.o.

12 Distinction: ELECTROMYOGRAM-CONTROLLED SINGLE-AXIS ARM EXOSKELETON
Michał Mikulski

14 Distinction: LENPLAST – NEW GENERATION LINEN BANDAGE
Linum Foundation

16 Distinction: PV MODULE MADE OF SILICON CELLS, CONNECTIBLE TO A COLLECTOR
Solar-Energy S.A.

18 Distinction: INTERFACE FOR A VISION AND SOUND ACOUSTICS SYSTEM SUPPORTING BLIND PEOPLE
Lodz University of Technology, Institute of Electronics; GreenPoint LTD

PRODUCT OF THE FUTURE AT THE IMPLEMENTATION STAGE

20 Winner: HARVESTER WITH EXCHANGEABLE ADAPTERS FOR PICKING AND CLEANING OF VEGETABLES
Przedsiębiorstwo Produkcyjno-Handlowo-Usługowe AKPIl Kazimierz Anioł; Industrial Institute of Agricultural Engineering

22 Distinction: NEW RANGE OF WATER-COOLED MODULAR MAGNETRONIC POWER ADAPTERS FOR SOLAR APPLICATIONS
Huettinger Electronic Sp. z o.o.

TECHNOLOGY OF THE FUTURE AT THE PRE-IMPLEMENTATION STAGE

24 Winner: NEW TECHNOLOGY FOR PRODUCTION OF EPICHLOROHYDRIN FROM BIOGLYCERINE
Institute of Heavy Organic Synthesis “Blachownia”, Zakład Chemiczne Zachem S.A.

26 Distinction: HYBRID TECHNOLOGY OF MANUFACTURING COMPOSITE LAYERS IN LOW-TEMPERATURE PLASMA
Warsaw University of Technology; Institute of Precision Mechanics

TECHNOLOGY OF THE FUTURE AT THE IMPLEMENTATION STAGE

28 Winner: TECHNOLOGY FOR MANUFACTURING OF THE ACTIVE SUBSTANCE ALFACALCIDOL
Pharmaceutical Institute

30 CRYSTAL PYRAMID INNOVATION AWARD

CATALOGUE OF WINNERS
2012
QUANTUM CASCADE LASERS

Lasers for application in the construction of portable devices for detecting trace amounts of chemical substances or dangerous gases and in medicine for detecting pathologic markers in exhaled air and for infrared examining.

DESCRIPTION OF THE SOLUTION

The Institute of Electron Technology (ITE) developed a structure and production technology of cascade lasers whose power is three times higher than the power of previous devices. In ambient temperature the pulse power reaches several dozen milliwatts and under cryogenic cooling conditions – even as much as 5 W. The wavelength of emitted radiation is about 9 μm. The structures of lasers are made using a method of molecular beam epitaxy (MBE) from AlGaAs/GaAs. The laser modules are executed with power supply and adapted to a direct use in devices for detecting trace amounts (sub-ppm) of chemical substances and gases.

The quantum cascade lasers (QCL) have been known just for several years and nowadays they are on the doorstep of commercialisation; therefore it can be expected that the scope of their applications will be expanded.

The lasers developed in ITE allow for construction of portable detectors detecting trace amounts of chemical substances, e.g. methane in mines or dangerous gases in chemical industry. Their medical application is also promising. The quantum cascade lasers help detect even the presence of trace amounts of pathologic markers in air exhaled by a patient. Since infrared radiation penetrates through a human body, the lasers allow for its safe examination with resolution bettering the one achieved in ultrasonography and their radiation has not such a destructive effect on tissues as X-rays.

INNOVATION

The original technology developed in the Institute of Electron Technology allows to build lasers optimized for various applications. Owing to their unique parameters it was possible to construct prototypical instruments for monitoring environment, production processes and contamination measurements. The device produced in the Institute of Optoelectronics of the Military University of Technology allows to detect trace amounts of ammonia (NH3) in atmosphere, in concentrations below 1 ppm.

The research and application works in the field of cascade lasers are highly innovative and concern elements practically unavailable for sale. Two companies from Switzerland and Japan are the only manufacturers of cascade lasers. However, it should be emphasised that the scale of their production is small and prices are very high (from 5 to 15 thousand Euro for a single laser and 25 thousand Euro for laser head with power supply). Due of large diversity of designs and wavelength of the emitted radiation, cascade lasers will never become a mass-produced device; this opens a possibility to compete in the market of applications targeting specific clients.

The manufacturing technology of cascade laser structures developed in ITE includes many original solutions enjoying patent protection.

APPLICATION

Medium infrared is a very attractive range of electromagnetic wavelength because
many chemical compounds absorb radiation just from this range. The laser modules manufactured with power supply included are adapted to a direct use in devices for detecting trace amounts (sub-ppm) of gaseous substances. This allows for construction of instruments for monitoring of environment, production processes, contamination measurements, as well as diagnostic medical equipment.

### IMPLEMENTATION STATUS

The technology of structure production has been developed and implemented in ITE on a lab scale. There is a comprehensive technical documentation of all technological processes. The Institute has a complete technological line located in the Centre of Nanophotonics in rooms with complete technological infrastructure. The Institute of Electron Technology has also a laboratory that allows for professional assembly of lasers and a measuring laboratory for testing of their parameters. The implementation and production start-up of cascade lasers will take place in a “spin-off” enterprise established at the Institute of Electron Technology.

### BENEFITS FROM APPLICATION

Availability of domestic subassemblies for lasers emitting medium infrared radiation will allow for development of material-saving and energy-efficient technologies in the field of advanced technologies (high-tech), being simultaneously more environmentally-friendly. Infrared radiation sources developed in ITE are applicable in environmental protection, industry, medicine resulting directly in such advantages as: clean air, clean working environment, non-invasive diagnostics and patients’ comfort.

### COMPARISON WITH THE CURRENT STATE OF TECHNOLOGY

Medium infrared band quantum cascade lasers are subject to intensive research in many laboratories all over the world. They constitute an interesting alternative to other radiation sources operating within a similar wavelength range, such as solid state lasers or optical parametric amplifiers (OPA). The leaders in this field include American, British, German and French laboratories. With regard to its complexity, the cascade laser production technology surpasses significantly all previous technologies used in semiconductor lasers. The cascade lasers from AlGaAs/GaAs developed in ITE are fully comparable to instruments manufactured in leading world laboratories, and in case of some parameters, such as e.g. power in a pulse, even surpass them.
“BREASTLIFE TESTER” – THERMOGRAPHIC TESTER FOR EARLY DETECTION OF BREAST PATHOLOGY, INCLUDING CANCER

It is a world first mobile instrument for functional non-invasive breast cancer screening diagnostics using filtered liquid crystal thermography. Allows for very early detection of functional thermographic markers of cancerous process.

DESCRIPTION OF THE SOLUTION

Thermography is a globally recognised, complementary, non-invasive, clinic functional procedure for imaging of pathologic changes in breast glands in women, dedicated to health screening. It perfectly complements the spectrum of anatomical methods, such as ultrasonography or x-ray mammography.

Imaging is performed through an identification of thermal anomalies, constituting a thermodynamic, functional marker of a separate profile for cancerous and degenerative processes. Simultaneously the thermal characteristic of the marker determines a type of pathological process, allowing to perform a preliminary differential diagnosis. Braster Tester using passive filtered thermography perfectly corresponds with the most recent concept of multimodal diagnostics, comprising several various imaging techniques. Braster Tester allows to reveal an early component of cancerous process, i.e. neoangiogenesis (formation of cancerous vessels), complementing comprehensively a disease image achieved by means of anatomical methods where the presence of already formed solid lump, characterised by different tissue density, is required to identify a pathology. In case of thermography its presence is not a critical factor because the processes generating hyperthermia occur already at a very early stage of cancer formation.

INNOVATION

Owing to the research in the field of physics and chemistry of liquid crystals conducted jointly with the researchers of the Military University of Technology, it was possible to develop new generation CLCF-type grainless passive liquid crystal thermal image screens using a sandwich system. This solution ensures programming of a narrow range of thermochromic mesophase responses and yields a high contrast temperature distribution allowing for unambiguous separation of the anomalies in the thermographic image. In the diagnostic layer, the central issue consisted in a discovery leading to the breakdown of thermographic scale into two working areas where hypothermic and hyperthermic expression markers are revealed separately consequently allowing for construction of passive screens dedicated to screening for a presence of cancerous processes and mild changes separately.

APPLICATION

BRASTER™ Tester employs a non-invasive and completely safe passive thermography method which does not require the use of potentially mutagenic radiation to achieve a functional image of breast glands. Due to this fact, the examination by means of the tester can be repeated any number of times without risk to the patient’s health, improving statistical chances to detect cancer.
already at the early stage. The application of passive filtered thermography allows for performance of preliminary differential diagnostics due to physical separation of detection processes for thermal markers showing the presence of intraorganic mild course pathology and markers connected with an early stage of cancerous process. This makes an essential difference in relation to the previous solutions based on infrared cameras, where imaging was performed at once for the entire range of thermographic scale, making an assessment of achieved results difficult.

IMPLEMENTATION STATUS

Owing to financial involvement of investment funds, the Braster company has been developing a modern passive liquid crystal thermal imaging screen production plant located in Warsaw. If the production plans do not change, BRASTER Tester will be marketed in the course of the year.

BENEFITS FROM APPLICATION

The implementation cost rationalisation factor of advanced diagnostic procedures resulting from contact thermography application in preliminary screenings, correlated with wide availability of these examinations, can play a significant prophylactic role and constitutes an essential element reducing the total social costs of breast cancer incidence, assessed on the basis of cost factor and QUALY (quality-adjusted life-years).

Another major advantage of the Tester application for screenings is the replacement of forced examinations by self-examinations, which is a target solution for the entire EU, not only from economic but, first of and foremost, also from medical point of view. This concept assumes a closer connection between instrumental differential diagnostics and therapy (a shorter path from early diagnosis to immediate treatment).

COMPARISON WITH THE CURRENT STATE OF TECHNOLOGY

Though the thermography has been employed in medicine in various configurations since the seventies, BRASTER Tester introduces a completely new diagnostic potential into the non-invasive breast pathology imaging by means of thermal markers. This potential shall be credited to the applied liquid crystal technology and key discovery that allows for performance of a preliminary differentiation of detected markers attributed to the thermodynamic characteristics of mild and cancerous processes. In this aspect, the tester is a breakthrough solution and lends a completely new quality, especially in terms of medical usefulness. Not only the diagnostic method, examination technique and resultant assessment algorithm in themselves but also the applied breakdown into the matrix for detecting hypothermic and hyperthermic expression changes are innovative as well.
INNOVATIVE METATHESIS CATALYSTS FOR APPLICATION IN THE CHEMICAL AND PHARMACEUTICAL INDUSTRIES

The solution enables producers of valuable chemical compounds and medications to remove efficiently the remains of ruthenium from post-reaction substances. It accelerates product purification process and reduces significantly the costs of the synthesis itself.

■ DESCRIPTION OF THE SOLUTION

The olefin metathesis catalysts developed by Apeiron Synthesis are an innovative solution, enabling effective conduct of metathesis reaction and additionally allowing to remove efficiently the remains of the catalyst and products of its ruthenium-containing degradation from the post-reaction mixture. Their marketing will contribute to a more extensive use of metathesis in the production of high quality chemicals, selected polymers and pharmaceutical agents required to meet high purity standards. An additional advantage of the catalysts is their excellent good water solubility, making the synthesis of polar and bioactive compounds possible in this environmentally-friendly solvent.

The catalysis and catalysts are of great importance in the contemporary world. Nowadays they are used in fabrication of 90% of chemical compounds produced on industrial scale. The value of the market of metal-organic catalysts used in pharmaceutical and chemical sectors amounts to approx. $1.5 billion annually. It is believed that a huge growth potential of this market in the coming years will be related to metathesis catalysts. So far they have been used mainly by researchers in academic institutes. It was not until 2005 and the Nobel Prize in Chemistry awarded for the olefin metathesis reaction researches that they began to be used in the industry more commonly. Developing new, stable catalysts allowing for selective performance of metathesis in mild conditions has enabled their use in the synthesis of fine chemicals and biologically active compounds whose synthesis using the previous methods had been difficult and composed of many stages. It is worth mentioning that lately the olefin metathesis has been also used in the transformation process of renewable materials (like vegetable oils or animal fats) into valuable chemical products difficult to produce by other methods.

■ INNOVATION

Removing the remains of catalyst and by-products of its ruthenium-containing degradation from the post-reaction mixture is one of the problems connected with the use of metathesis and ruthenium catalysts in the industry; this limits their wider application, especially in the pharmaceutical sector, where the content of heavy metals shall not exceed 10 ppm (parts per million) in the final product. For example, the use of classical catalysts (depending on the applied quantity) yields the ruthenium content amounting to 3000 ppm in the raw product! Innovation of the catalysts developed by Apeiron Synthesis consists in the introduction of proper, specially selected functional groups into the catalyst structure, ensuring an efficient and economically effec-
tive elimination of its ruthenium–containing remains. This helps achieve the ruthenium content below 10 ppm in the raw product. Another advantageous feature of the catalysts is their excellent water solubility. According to the forecasts, in 2020 half of new medications will be based on protein structures, for which the preferred reaction environment is plain water. In connection with this fact the catalysts developed by Apeiron Synthesis are likely to become a product of the future.

**APPLICATION**

The innovative catalysts developed by Apeiron Synthesis can be applied in the synthesis of complex compounds, advanced biomaterials used as medication carriers as well as for the synthesis of highly valuable chemical substances, especially flavouring compounds and aromas, additives for cosmetics and agrochemical components, such as pesticides and pheromones.

**IMPLEMENTATION STATUS**

At present Apeiron Synthesis is at the early stage of development. Although active research works did not start before 2010, the first patent applications were filed already in the beginning of 2012, including ones for the aforementioned innovative catalysts. Currently the works on the expansion of the production scale and introduction of the product onto international markets are under way.

**BENEFITS FROM APPLICATION**

Application of innovative metathesis catalysts offered by Apeiron Synthesis will bring significant savings to users through elimination of effort-intensive and time-consuming product purification processes from ruthenium-containing remains. An additional advantage from ecological point of view is comprised by water solubility of the developed catalysts, allowing for performance of metathesis in the environmentally friendly conditions.

**COMPARISON WITH THE CURRENT STATE OF TECHNOLOGY**

Although there are many metathesis catalysts available on the market, owing to their unique properties the products developed by Apeiron Synthesis are unique on a world scale. Application of those products marks a breakthrough progress and eliminates the necessity to use effort-intensive and expensive product purification processes from the ruthenium-containing contaminants after the metathesis reaction. The aforementioned feature, topped by the fact that it is possible to conduct reactions in water, is a genuine breakthrough with regard to metathesis applications in the industry, especially during the production of high quality chemicals and pharmaceutical compounds.
ELECTROMYOGRAFM-CONTROLLED SINGLE-AXIS ARM EXOSKELETON

The device is intended for rehabilitation of limbs, making movement therapy possible for patients with muscular atrophy, multiple sclerosis or patients during the convalescence period. It has a radio link enabling a medical practitioner to diagnose a current state of muscles by means of a computer or a mobile phone.

■ DESCRIPTION OF THE SOLUTION

An electromyogram-controlled single-axis arm exoskeleton arm is a special form of portable robot construction, encasing the user’s limb. It is equipped with an electric actuator realizing the bending and straightening movements of a limb, making movement therapy possible for persons with muscular atrophy, multiple sclerosis or persons during the long convalescence period. In case of the version for lower limbs, the device can be used in gait re-education. Due to the applied measurement method of electrical activity in human muscles, the exoskeleton can support a movement function of healthy persons or take it over completely for persons with a significant impairment of motor activity of the limbs. The developed electromyogram strengthens a muscular signal by over five thousand times enabling a readout of even slight deviations. Apart from the active movement therapy, the device has a radio link, enabling a medical practitioner to diagnose the state of muscles in real time by means of personal computer or portable equipment like a tablet computer/mobile phone.

■ INNOVATION

The device introduces a modern rehabilitation method using the electromyogram as a control and feedback signal. Algorithms of robotic rehabilitations allow for the use of single muscle, e.g. a biceps muscle of arm, or of an antagonistic pair of muscles, e.g. a biceps and a triceps arm muscle. Due to the applied calibration method, the device can cooperate with the patients with muscular weaknesses of various degree, i.e. healthy persons and significantly weakened patients, e.g. suffering from muscular atrophy. The first generation of single-axis exoskeleton encases only the patient’s arm, permitting exercises of elbow joint. However, the developed technology can be easily transferred to other joints, making more advanced therapy possible.

■ APPLICATION

Basic applications of electromyogram-controlled single-axis exoskeletons include support for movement therapy in rehabilitation centres. The use of electrical potentials in the muscles of the patients as the signals controlling the rehabilitation robot improves the process of self-reliant exercise execution, i.e. active rehabilitation. Due to the significant strengthening of the signals and the connection of the patient body with the robot skeleton, it is possible to control the movement of the limbs at every moment of the exercise. The single-axis exoskeletons provide special functionality for:
• muscle spasticity relaxation,
• poizometric relaxation by means of muscle stretching method,
• rehabilitation after tendon rupture,
• therapy of Duchenne’s and Becker’s mus-
cular dystrophy,
- therapy of incomplete spinal cord injury,
- therapy after cerebral crisis,
- therapy after injury of conus of rotators,
- rehabilitation in rheumatological states,
- CPM (continuous passive movement) exercises,
- therapy after ligament reconstruction,
- therapy of multiple sclerosis,
- rehabilitation of muscular atrophy.

**IMPLEMENTATION STATUS**

The works on the first generation prototype have been completed, confirming the adequacy of application of electromyogram for robotic rehabilitation of patients with muscular atrophy and motor dysfunctions. The actions aimed at adopting the second generation prototype in terms of certification of conformity to the Medical Device Directive 93/42/EEC (MDD) have begun. Additionally, a business plan, business model, marketing strategy and worldwide distribution cooperation strategy have been prepared for the target market product.

**BENEFITS FROM APPLICATION**

The main objective of the electromyogram-controlled single-axis exoskeletons is to make the rehabilitation possible for the persons with significant problems of motor activity of the limbs. The gait re-education, strengthening of weakened muscular structure or support of basic activities make the device socially important. Owing to the use of advanced measurement systems, not only more efficient rehabilitation in relation to classical CPM splints but also muscle state diagnostics are possible. In case of rehabilitation centres, the technology of exoskeletons help broaden the range of treated diseases. Furthermore, through its functionality, the exoskeletons prevent social exclusion of the patients.

**COMPARISON WITH THE CURRENT STATE OF TECHNOLOGY**

There are already some rehabilitation robots present in the global market. However, in most cases they do not use biomedical signals for the control purposes. It should be mentioned that the robots repeating specific activities, i.e. activities related to passive rehabilitation, are popular due to lower costs and lesser complexity. The use of electromyogram contributes to a stronger involvement of the patients in the rehabilitation process, increasing its positive effects.
LENPLAST – NEW GENERATION LINEN BANDAGE


**DESCRIPTION OF THE SOLUTION**

The bandage uses a fabric made of linen fibre coming from oil flax of Linola variety into which three gens of synthesis of flavonoids (organic substances appearing in plants fulfilling, among others, the function of antioxidants) were introduced. The increase of the level of enzymes included in them contributes to increased accumulation of phenylpropanoid compounds, having strong antioxidant properties, accompanied by a better ability of the modified fibre to absorb reactive forms of oxygen. It should be mentioned that the increased enzymes production concerns only the compounds naturally present in linen cells.

**INNOVATION**

In the present practice, wounded spots are dressed with aseptic compresses made of cotton gauze. However, such gauze is pure cellulose devoid of bioactive properties ne-cessary to prevent free-radical reactions and do not have curative effects on body injuries. Therefore there is a need to provide a material that protects and supports treatment of wounds at the same time. Inflammatory processes in the wound lead to dys-regulation of balance between formation and inactivation of reactive forms of oxygen, damaging living cells. This results in their excessive accumulation, and consequently, oxidative stress, regarded as a factor favouring the formation of many diseases.

The fabric used in LENPLAST bandages is characterised by features that distinguish it from other materials:

- In contrast to presently used cotton fibres, new generation linen fibres are bio-active due to presence of double kind of antioxidants: hydrophilic and hydrophobic, eliminating free oxygen radicals and the most aggressive lipid radicals,
- contains lignans (one of the strongest antioxidants) having not only anti-inflammatory effects but also promoting proliferation of fibroblasts, i.e. multiplication of cells producing collagen fibres and basic substance of connective tissue,
- contains cannabidiol characterised by activity inhibiting pro-inflammatory signalling, i.e. analgesic,
- all components are synthesised in a natural process,
- acts at all stages of healing,
- linen bandage is produced using an innovative technology: linen fibres used in production of dressing fabric are exposed to tumbling and mechanical cleaning in a standard procedure; then the fibres constituting a base of bandage, as opposed to standard methods used in textile industry, are not exposed to leaching, bleaching and other chemical processes that can remove compounds of anti-oxidative activity,
- coarsely woven linen lets air into the wound preventing development of anaerobic bacteria

**APPLICATION**

LENPLAST bandage is intended to accelerate the treatment and healing of chronic
wounds. It can be used to support treatment of all body injuries, including wounds arising from physical and chemical injuries. There are various causes of chronic wounds; but the most frequently encountered wounds arise as a result of venous ulceration, sclerosis, diabetic foot syndrome and bedsores. Chronic immunologic, hematologic wounds and malignant cutaneous wounds appear more rarely.

**IMPLEMENTATION STATUS**

In order to be able to implement the product, Linum Foundation cooperates with companies that conduct research and development works on new generation linen, coordinate the bandage implementation process and process plant materials. The manufactured prototypical bandages were applied for detailed pilot examinations in patients with chronic wounds. The LENPLAST bandage obtained the CE Certificate in 2010; presently the start-up process of its production line is under way.

**BENEFITS FROM APPLICATION**

The planned implementation of the innovative production technology of LENPLAST bandage has been substantiated by a market analysis. Information provided by organizations monitoring the state of health, statistical data and reports prepared by companies carrying out pharmaceutical market surveys demonstrate that due to the progressive number of civilization-related diseases, the demand for innovative bandages will continue to grow in the coming years, both in Poland and abroad. Contemporary medicine and pharmaceutical industry are also oriented toward search for innovative solutions, based on natural components. The simplicity of the production process of LENPLAST bandage (without application of chemical treatment stages) and low costs of its manufacturing ensure its wide use by patients, who receive an innovative product supporting the healing process.

**COMPARISON WITH THE CURRENT STATE OF TECHNOLOGY**

So far there has been no equivalent to LENPLAST among products available on the market; additionally the currently marketed products do not demonstrate the complex effect at all stages of wound healing. Manufacturing of dressing fabric based on linen fibres is an innovative concept on a global scale; the properties of the fabric make it a virtually perfect dressing.
**PV MODULE MADE OF SILICON CELLS, CONNECTIBLE TO A COLLECTOR**

An innovative module for solar energy production, thinner than traditional modules. When connected to a water thermal collector it generates two kinds of energy.

### DESCRIPTION OF THE SOLUTION

The project developed by Solar-Energy S.A. entails production of a globally innovative PV Module made of thin silicon monocrystalline or polycrystalline cells, connectible to a high-performance collector. The innovative technology allows to produce photovoltaic modules, built of silicon cells of 130 to 150 μm thickness. A typical photovoltaic cell made of monocrystalline or polycrystalline silicon, manufactured with traditional technologies, is a silicon semiconductor wafer whose thickness is within 200-400 μm and efficiency ranges between 12% and 14%. The performance ratio of the modules produced by Solar-Energy S.A., exceeds 16%, when connected to the heat collector.

### INNOVATION

The advantage of connecting a photovoltaic module to a flat plate water heat collector consists in the possibility to reduce operation temperature of the cells (cooling of the module during its exposure to solar energy radiation) on the one hand, and – among other things – in the increase of electric power of the output photovoltaic module resulting from lower temperature of its operation, generation of thermal energy coming from cooling of the glass plate covered with cells and absorption of radiation reaching the medium through gaps between them, on the other.

### APPLICATION

Reduction of power losses in PV modules, related to increased cell temperature, is supported by a PV/T (photovoltaic and thermal) system, being an integrated, hybrid system of silicon module and water thermal collector. It is employed to cool the cells and to achieve higher photovoltaic efficiency, output electric power and additional heat stream where the photovoltaic module (PV) is integrated with the thermal collector (T) to cool rear surfaces of the cells with a flowing fluid (air or liquid). The described system generates electric energy, which can be used for direct supply of receivers and/or energy storage (batteries, super-condensers); as well as a bank of energy bank used by connected electric power network and of heat, which can be used in heating or air conditioning system in buildings.

### IMPLEMENTATION STATUS

The project is at the prototypical stage. The basic design solution of hybrid module is already developed and the BOM (bill of materials) is being completed; the BOM includes all components of the product and it is 90% ready. At present a qualification process of their deliverers is carried out. A prototype will be built in 2012 and then the technical documentation of the product will be prepared. After preparation of the prototype, an initial validation of the product and completion of technical documentation will be carried out; the technology and process documentation will be drawn up on
the basis of the technical documentation. Due to the fact that the basic assumptions include the use of the existing production infrastructure to a maximum extent possible, the hybrid module will be manufactured on the basis of the design of a typical PV module.

**BENEFITS FROM APPLICATION**

The construction of a hybrid PV/T system, combining the functions of a module (PV) and thermal collector (T) in a single device allows to achieve two kinds of energy, increasing electric efficiency of the module, and making generation of additional thermal energy possible at the same time.

**COMPARISON WITH THE CURRENT STATE OF TECHNOLOGY**

On the European market there already are certain solutions based on the combination of PV modules and cooling system. However, the idea of using a water jacket for this purpose in the form of thermal collector integrated with a photovoltaic module in a single frame, patented within the framework of basic solution, is a unique development, characterised by significant increase of energy conversion efficiency.

A PV module made of silicon cells with heat recovery option – the design of the device.

A SE-PVT 240 set – PVT photovoltaic modules with heat exchanger
INTERFACE FOR A VISION AND SOUND ACOUSTICS SYSTEM SUPPORTING INDEPENDENT MOVING OF BLIND PEOPLE

An innovative electronic device composed of a camera system, sound module and processor, assisting blind people. The device communicates with a computer and its elements are built in the spectacle frame.

■ DESCRIPTION OF THE SOLUTION

The device is made of a stereoscopic 2 MPix resolution camera system, a sound module, an inertial sensor system and a micro-controller monitoring the recording of images and signals coming from the sensors. It communicates with a computer through a USB port. The device prototype is an element of a sound obstacle warning system for the blind people.

■ INNOVATION

The operation of the interface for a vision and sound acoustics system consists in a passive recognition of the surroundings (it does not emit laser light or ultrasounds). Owing to the recording of stereoscopic images it is possible to determine the distance between the system’s user and obstacles. The data bus in the design is based on a USB standard. Its bandwidth ensures a simultaneous transfer of image data and signals from the inertial sensors to a personal computer. The device is powered directly from the USB port. The current consumed by the system does not exceed 450 mA and a wide range of operating temperatures ensures operation in various atmospheric conditions.

The cameras record images synchronically. The time difference between the capture of pairs of images is not more than 0.1 ms. An integrated circuit is used in the sound module to integrate the sound board with the USB bus. The module includes an ear-piece output and microphone input intended for the user’s communication with the system. The board supports a 16-bit sound standard with the maximum sampling frequency of 48 kHz.

The use of integrated gyroscopes and accelerometers allows to track the position of obstacles detected by imaging methods regardless of the user’s head movements. It is facilitated by a sound presentation of the surroundings in the developed obstacle warning system for the blind people. The applied three-axis gyroscope is characterised by very small dimensions (4.4 x 7.5 x 1.1 mm) and low energy consumption. It has three analogue outputs generating angular speed signals. The linear acceleration data are received from the three-axis accelerometer, which includes a 16-bit A/C transducer; the resultant resolution is sufficient to track precisely the movement of electronic module for ±6 g accelerations.

■ APPLICATION

The developed interface for a vision and sound acoustics system supporting the blind people is the first solution of its type integrating various electronic systems. The designed prototype is an element of a sound obstacle warning system which may replace companion dogs in the future.
Owing to the interface shape and small weight users may work wear it for a long time without feeling tired. The device does not emit light or ultrasound signals and operates across a wide temperature range.

**IMPLEMENTATION STATUS**

Previous versions of the presented device have been successfully tested with the participation of the blind people and a new prototype is at the next stage of testing. Now works are under way on the integration of software modules for determination of depth map, detection of objects in the scene and generation of sound streams representing them.

**BENEFITS FROM APPLICATION**

About 80 thousand blind and vision-impaired people currently live in Poland and nearly 42 million in the world. Though many devices supporting visually impaired people in everyday life are available on the market today, there is no device enabling their self-sufficient movement in unknown surroundings. The inventors are convinced that the solution design opens the way leading to its construction.

**COMPARISON WITH THE CURRENT STATE OF TECHNOLOGY**

The idea and realization of the interface for a vision and sound acoustics system supporting the blind people include a number of innovative solutions. A similar system has been designed e.g. at the University of Southern California, with stereo vision cameras located on a helmet. The device is composed of two cameras installed on the helmet and a waistcoat where four vibrators (small eccentric motors) are built-in. They are connected to a computer determining a map of surroundings, detecting obstacles and then informing the user of them through activation of relevant vibrators. A parallel variant of the system was designed and tested by the authors of the project here described in 2009. Owing to continued research, works are currently under way on the device built in the spectacle frame.
**HARVESTER WITH EXCHANGEABLE ADAPTERS FOR PICKING AND CLEANING OF VEGETABLES**

The most modern device in Poland for picking root vegetables. Compared to solutions developed by renowned foreign companies, it is more innovative in terms of durability, safety and operational functionality.

**DESCRIPTION OF THE SOLUTION**

The harvester with exchangeable adapters for picking and cleaning of vegetables has been implemented by PPH.U. AKPIL Kazimierz Anioł Pilzno, as a result of an earmarked project co-financed by the Ministry of Science and Higher Education in Warsaw via the Innovation Centre of the Chief Technical Organization, and deployed jointly with the Industrial Institute of Agricultural Engineering in Poznań.

The basic harvester’s subassemblies include: a frame bearer with running gear and latch, an adapter for picking root vegetables, adapter for picking onions, screening and cleaning conveyers, scraper rollers, selection table, hydraulic drive and control system, mechanical drive system of operating assemblies and automatic furrow tracking device.

The harvester corresponds with the newest global development tendencies and is the most modern machine of such a type produced in Poland. It is characterised by good ergonomics and operational safety, especially within the scope of aggregation with a tractor, adjustment of operational parameters, machine refitment, maintenance and operation. The research and development works have been realised mainly using highly advanced computer techniques. Virtual modelling and detailed computer engineering analyses based on finite-element method as well as experimental tests have been carried out. These efforts have ensured high quality of design solutions and achievement of reliability, durability and operational functionality by the device.

**INNOVATION**

The design of the harvester assemblies is based on a system of horizontal conveyers (instead of a lifting wheel); this is a state-of-the-art solution on a global scale and is characterised by significantly lesser extent of damage to vegetables and higher vegetable cleaning degree at the same time. The invention – PL patent no. 208559 and utility design – PL protection right No. 64484, granted by the Patent Office of the Republic of Poland to PPH.U. AKPIL Kazimierz Anioł Pilzno, have been applied in the harvester. The invention concerns the root vegetable hoe assembly, which the picking adapter is equipped with. Furthermore, the innovative elements include: disposable operating adapters for vegetables picking, automatic furrow tracking device, assemblies for cleaning and soil separation (screening and cleaning conveyers, selection table) and a harvest torsion axle.

The harvester is compliant with international standards meeting the requirements, among other things, of the European Union Directive 2006/42/EC of 17 May 2006 on machinery. It is also compliant with the most recent norms of the European Union (EN) and international standards (ISO) with-
in the scope of safety and environmental protection and the norms harmonised with the Machinery Directive.

**APPLICATION**

The harvester is intended for the of a single-stage root vegetable harvest technology for carrot, parsley, parsnip and red beet using a method that consists in cutting the top leaves, hoing the roots, then ploughing them up and moving onto the screening and cleaning conveyers and selection table, from which the vegetables are transported to the container. The harvester is also adapted to pick the onions in a double-stage system, which consists in ploughing them up, e.g. using a digger, and then – after drying in the field – collecting them using an adapter picking the vegetables up onto the harvester conveyer.

**IMPLEMENTATION STATUS**

So far P.P.H.U. AKPIL has manufactured and sold 34 harvesters, including 12 harvesters for foreign markets. They have been sold to such countries as e.g. Italy, Russia, Ukraine, Slovakia and Croatia, therefore, establishing a high position of the manufacturer.

**BENEFITS FROM APPLICATION**

Deployment of the project enabled a more effective use of the potential of employed workers and of the manufacturing capacities. The implementation of the new product into production has widened the range of machinery offered by AKPIL (resulting in creation of 15 new jobs in the plant). Moreover, introduction of the harvester into the offer has helped the company gain a new market sector, enter West and East European outlets and strengthen its domestic position. Implementation of the device into production has resulted in company development and income growth. Other beneficiaries included the cooperating parties, which deployed the investment and supplied the materials and parts, and Polish farmers, who have gained access to the technologically advanced, ecological and safe device offered at a competitive price.

Batch production of the harvester does not make any environmental impact on the company’s surroundings and is compliant with the binding legal regulations related to environmental protection. The concept of a single-stage harvest reduces the adverse impact on soil structure to the minimum (traditional harvest consists of 2-3 stages), while its high effective capacity (0.4 ha/h) translates into energy savings, reduction of fuel consumption, and of fume and noise emission by the cooperating tractor.

**COMPARISON WITH THE CURRENT STATE OF TECHNOLOGY**

Owing to the innovative solutions and high utility value, compared to solutions developed by renowned foreign companies, the harvester is more innovative in terms of the applied technologies. Therefore, taking its competitive price into account, the device may safely compete in the global markets. The technical parameters related to productivity, durability as well as additional equipment are comparable with parallel products manufactured by the leading foreign manufacturers.
NEW RANGE OF WATER-COOLED MODULAR MAGNETRONIC POWER ADAPTERS FOR SOLAR APPLICATIONS

The state-of-the-art power adapters for plasma treatment processes, applied to production of solar cells and panels.

■ DESCRIPTION OF THE SOLUTION

The demand for modern magnetronic power adapters has been continually growing in connection with intensive development of plasma treatment technologies in sectors of advanced technologies. HÜTTINGER Electronic has developed a range of water-cooled power adapters with modern operating system of arcs formed in plasma. The power adapter has been developed in cooperation with the Electrical Engineering Institute of Control and Industrial Electronics of the Warsaw University of Technology within the framework of the ear-marked project entitled “A new range of water-cooled modular magnetronic power adapters for solar applications.”

■ INNOVATION

The designed power adapters are unique devices on a national and global scale, while the Compensateline method patented by HÜTTINGER Electronic is an arc operating system highly rated by the clients; its parameters surpass solutions used by competitors. In terms of the technologies applied, the power adapter TruPlasma DC Series 3000 NEW is a highly advanced device. The developed arc operating system allows to reduce the impact of inductance on arc extinction process. As an additional advantage the power adapter marks an innovative approach to cooling electronic elements. Typical air cooling was replaced with water cooling. Power electronic elements are located on a water-cooled copper radiator. It ensures better heat collection and consequently allows to locate the elements closer to each other and to miniaturise the entire device. The power adapter is tightly sealed, preventing penetration of potential contaminants. Because it is not necessary to supply air continually to the device (for cooling purposes), it does not have to be placed in an air-conditioned room equipped with additional cleaning systems. Furthermore, water cooling solves the problem of short service life of fans used in air cooling.

■ APPLICATION

The presented power adapters are applied in plasma treatment processes in the economy sectors using advanced technologies, including in particular:

- electronic industry (LCD monitors, DVDs/CDs, microprocessors),
- automotive industry (car glass)
- building industry (building glass)
- energy generation from renewable sources (solar panels, solar cells)
- tool industry (tools covered with titanium compounds, etc.)

■ IMPLEMENTATION STATUS

The company has completed the implementation of the device into production.
using the existing infrastructure. The company has drawn up the technical, technological and process documentations. Commercial sale of power adapters started in 2011. The purchasers of the product include enterprises from all over the world, including ones from the United States, Germany, Japan, Switzerland, China and Korea. At the turn of April and May 2012 the new power adapters were presented in the Silicon Valley in American Santa Clara, where they attracted great interest.

### BENEFITS FROM APPLICATION

The products resulting from the project have increased the competitiveness of HUETTINGER Electronic offer. Due to their innovation and technological advancement, the power adapters have contributed to sales growth and expansion to the new markets, while also influencing the employment size time (creation of 8 new jobs in the company is planned owing to the project deployment). The implementation of the new type of device has strengthened the company's position as a leader in the magnetronic plasma power adapter market as well. Owing to the modular structure of the power adapters TruPlasma DC Series 3000 NEW, it is possible to use easily and quickly their subassemblies when designing other types of power adapters, e.g. TruPlasma Bipolar Series 4000. This shortens significantly the time of their implementation and marketing, while also improving and stabilising the product quality. The device is employed in solar cell and panel production processes. This fact has a significant and positive influence on renewable source power engineering development and, consequently, on natural environment as well. Proecological advantages of the power adapters are connected also with ZVS (Zero Voltage Switching) and the specialist arc operating system (ensuring arc energy collection and its re-use). These elements have improved the efficiency of the power adapters, first of and foremost reducing their demand for electricity.

### COMPARISON WITH THE CURRENT STATE OF TECHNOLOGY

Owing to the above-described properties, the power adapter TruPlasma DC Series 3000 NEW is an innovative device and one of the best products of its kind available on the international market. Furthermore, it corresponds with the global trend focusing on ecological products. The device is a unique solution on a national and global scale. No other company in Poland designs or produces magnetronic power adapters for plasma treatment. The HUETTINGER Electronic product is also highly competitive compared to similar solutions marketed by foreign companies.
NEW GENERATION OF EPICHLOROHYDRIN FROM BIOGLYCERINE

A production technology of epichlorohydrin from waste products and by-products: glycerine and hydrogen chloride. Advantages include lower production costs and substantial reduction in pollutant emission to the environment.

■ DESCRIPTION OF THE SOLUTION

The technology allows to produce the highest quality epichlorohydrin form waste glycerine, obtained during manufacturing of biodiesel from renewable materials and hydrogen chloride formed as by-product in hydrocarbon chlorination processes. It consists in application of cheaper by-products, i.e. bioglycerine and hydrogen chloride instead of traditional materials – chlorine and propylene of petrochemical origin. This solution reduces production costs owing to: simplified technological process, method basing on renewable material, i.e. bioglycerine, and reduced energy consumption. Its effects also include a radical decrease of waste effluents and waste products in the form of chloroorganic compounds (as glycerine derivatives they are less toxic and easier to recycle). The new generation of epichlorohydrin production technology results from research works conducted by ICSo “Blachownia” and Zakłady Chemiczne Zachem S.A. – CIECH Chemical Group.

■ INNOVATION

Innovation of the new generation epichlorohydrin technology consists mainly in the use of renewable and easily available material (bioglycerine) and hydrogen chloride formed as by-product during production processes. The new solutions include:
• original production method of concentrated dichloropropanols, comprising: pressure-less, wet bioglycerine hydrochlorination by means of hydrogen chloride dissolved in liquid distillate of diluted dichloropropanols and pressure, dry hydrochlorination of mixture composed of monochlorohydrins and unreacted glycerine from the previous stage in the presence of acetic acid,
• pressure hydrochlorination reactor construction ensuring proper distribution of hydrogen chloride in reaction mixture and complete glycerine conversion,
• application of modern construction materials based on chemoresistant PTFE plastics, glass enamels, carbon plastics and zirconium,
• production of epichlorohydrin of the highest purity at the level of 99.95% (product deprived of contaminants present in commonly used propylene method)

■ APPLICATION

The new technology is deployed in Zakłady Chemiczne Zachem S.A., the only producer in Poland manufacturing epichlorohydrin using propylene method since 1982. Its global output exceeds 1,2 million tonnes annually and still grows, mainly due to the increased demand for epoxy resins, whose production uses over 75% of the obtained epichlorohydrin. Both products are among those to be used for many years to come because they are employed by the most important sectors, i.e.: IT, electronic, automotive, aerospace and building industries. The start-up of epichlorohydrin production from cheaper renewable materials will improve the competitiveness of Zachem on the global market and help it join the nar-
row group of leading companies applying this product. The high technological level of the implemented process and its innovative solutions, applied for patent protection in Poland and abroad, ownership of reference installation and the team of experienced researchers and specialists in the field of epichlorohydrin production, provide an opportunity to sell this technology abroad.

**IMPLEMENTATION STATUS**

The construction of pilot and production installation of 10 thousand Mg/year scale has been completed in Zakłady Chemiczne Zachem S.A. in Bydgoszcz – CIECH Chemical Group. The production is planned to commence soon.

**BENEFITS FROM APPLICATION**

Implementation of the innovative method will bring measurable economic effects in the first place, ones stemming from reduction of epichlorohydrin production costs through the management of glycerine by-product and waste hydrogen chloride as well as the simplification of technological process compared to the propylene and chlorine method. The technology will also entail positive environmental effects. Its application will ensure reduction of contaminant emission, including in particular discharge gases, chloroorganic waste and waste effluents. The glycerine method (applied in parallel with the traditional process at the current stage) implemented in Zachem will help decrease the propylene, chlorine and electricity consumption factor by 28 % and the amount of waste by 24 %. 12 thousand Mg of renewable material – bioglycerine and over 9 thousand Mg of waste hydrogen chloride are used.

**COMPARISON WITH THE CURRENT STATE OF TECHNOLOGY**

The new generation of epichlorohydrin technology resulting from research works conducted by ICSO “Blachownia” and Zakłady Chemiczne Zachem S.A. is the only one of its kind in Poland and one of very few in the world. The first plants for epichlorohydrin production based on bioglycerine were started up by two foreign companies in 2007 using the pressure-less glycerine hydrochlorination process. Initially the technology implemented in Zachem in Bydgoszcz will be used in parallel with the traditional propylene method. Then it is planned to apply the process based on glycerine only.
HYBRID TECHNOLOGY OF COMPOSITE LAYERS MANUFACTURING IN LOW-TEMPERATURE PLASMA

An innovative technology for manufacturing of surface layers with anti-abrasive and anticorrosive properties with high hardness and heat resistance. Reduces energy consumption and uses ecological reactive atmospheres.

● DESCRIPTION OF THE SOLUTION

The innovative technology enables manufacturing of surface layers on finished products with pre-determined microstructure, chemical composition, phase composition and state of residual stresses, adjusting them to specific operating requirements. It accords with the current development trends in surface engineering focused on developing technologies for manufacturing of multi-component and composite layers of properties that cannot be achieved in presently used materials and surface layers produced by traditional methods.

The treatment in low-temperature plasma is a thermal and chemical process yielding surface layers with diversified structure. They are characterised by high hardness, good resistance to frictional wear and corrosion resistance, as well as – in case of steel and titanium alloys – by improved fatigue strength of treated details.

● INNOVATION

The developed hybrid technologies are innovative on a global scale, based on patents and patent applications. The technologies of glow-discharge assisted oxynitriding of titanium and its alloys, including the treatment of titanium alloys with so-called shape memory, are innovative on a global scale and can be applied in the manufacturing of new generation biomaterials – e.g. osteous and cardiological implants. They can be also applied to the treatment of aluminium and magnesium alloys, which is a new and long-term trend. These technologies have ecological value too, due to the used reactive atmosphere enabling the treatment of details with complicated shapes, yielding electricity savings and treatment time shortening thus fundamentally reducing CO2 emissions to atmosphere.

● APPLICATION

The processes are based on the use of treatment technology in low temperature plasma, i.e. a process of glow discharge nitriding and its modification. They can be applied in medicine, aerospace industry (for the manufacturing of elements of motors made of nickel and titanium alloys operating in high temperatures) or extractive industry (e.g. elements of hydraulics operating in corrosive conditions).

The manufacture of anti-abrasive, anticorrosive layers of high hardness and heat resistance allows to widen significantly the application range of various steel grades, titanium, aluminium, magnesium alloys as well as polymer plastics. Therefore it is possible to replace expensive constructional and functional materials with cheaper ones with surface layer produced, e.g. one characterised by higher fatigue strength or appropriate properties like e.g. biocompatibility or thermal conductivity. Due to wide range of possible combinations, the hybrid technologies can be employed in many applications: from biomaterials to kitchen utensils.
IMPLEMENTATION STATUS

The developed technologies and instruments for their deployment constitute the implementation basis for producers. The technology implementation costs including the required equipment depend on the production size of treated products, e.g. small elements, such as rings, heart valves, medical instruments made of stainless steel and titanium alloys and stomatologic implants. The latter can be manufactured using the device implemented at the Warsaw University of Technology and developed by the Institute of Precision Mechanics. Any possible batch production will require construction of new plants.

BENEFITS FROM APPLICATION

Technological, economical competitiveness and ecological value of the solution result from a number of advantages, including such major ones as:

- possibility of precise microstructure adjustment of manufactured layers,
- diffusive character of layers,
- easiness of manufacture of so-called composite layers, consisted of a number of sub-layers, made in a single technological process,
- possibility to perform the processes in low temperatures,
- possibility to treat materials that are difficult to nitride,
- possibility to treat details with complicated shapes,
- reduced processing time due to quick heating of treated details to the required treatment temperature and electric activation of gaseous environment and treated batch surface,
- significant power energy savings reducing CO₂ emissions to atmosphere;
- use of ecologic reactive atmospheres.

COMPARISON WITH THE CURRENT STATE OF TECHNOLOGY

The present-day industrial technologies witness a growing interest in hybrid manufacturing technologies of composite (multi-component) layers. Data analyses confirm that such technologies increase significantly the durability of treated materials (increase by 50-300% depending on work character). Apart from the already known ones, such as hardness, resistance to frictional wear and fatigue strength, the requirements include also an increased corrosion resistance, plasticity of layers and additionally – in relation to very precise parts – lack of dimensional changes, maintenance of high quality class of surface roughness and favourable state of residual stresses. The technologies combining the nitriding processes with other surface engineering methods, give the materials the unique properties, e.g. resistance to oxidation in higher temperatures, thermal shock resistance, significant load strength or friction factor reduction.
TECHNOLOGY FOR MANUFACTURING OF THE ACTIVE SUBSTANCE ALFACALCIDOL

A new original synthesis method of alfacalcidol compound, used in treatment of many diseases for improvement of structure and function of skeletal system. Provides a significant price reduction of a ready-made medication for patients.

■ DESCRIPTION OF THE SOLUTION

The project aimed to develop a new technology for manufacturing of alfacalcidol – an active substance from vitamin D derivatives group. Alfacalcidol is a precursor of active metabolite of vitamin D3 – a calciotriol acting as a regulator of metabolism of calcium and phosphates. Alfacalcidol is used to supplement calciotriol deficiencies, especially in case of renal failure. Its surplus is excreted in urine and faeces in the form of inactive metabolites.

Alfacalcidol is administered in treatment of the following diseases: rickets and osteomalacia (in case of insusceptibility to vitamin D), postmenopausal and senile osteoporosis, calcium metabolism disorders (especially in persons with chronic kidney diseases), renal osteodystrophy, hypoparathyroidism, hipoalcemia (especially in persons with chronic kidney diseases), nephrotic syndrome in children after chronic glycoorticosteroid treatment.

■ INNOVATION

The new, completely original synthesis method of the alfacalcidol compound is composed of 7 stages. Its innovation consists in obtaining an advanced semi-product, so-called cholesterol adduct of alfacalcidol, which is the base material for receiving ready alfacalcidol, from synthetic vitamin D3 and commercially available chemical materials. The method for obtaining alfacalcidol from cholesterol adduct is a completely new one, resulting in production of a high purity product with high productivity.

Alfacalcidol is released from cholesterol adduct through chemical change and then it is separated in the course of column chromatography. Raw alfacalcidol is exposed to a series of 2-3 crystallisations and then a specification and pharmacopoeial monograph test is carried out. The described process differs fundamentally from precious synthesis methods used by other manufacturers. Alfacalcidol obtained with the new method does not contain contaminants in the form of triazolines due to triazolines are not used during the synthesis. The only produced contaminants include trans-alfacalcidol and 1-β-calcidol. Such sequence is not only different from the one used previously but it is extremely favourable too, owing to very high alfacalcidol purity. Not only the scale, semi-products, or the whole cleaning strategy but also process efficiency are new.

■ APPLICATION

Alfacalcidol is administered as a medication to supplement deficiencies of calcitriol being a regulator of metabolism of calcium and phosphates. The application of alfacalcidol causes improved calcium absorption from alimentary canal, an increase of its concentration in blood and excretion in urine. Curative effects first of all concern improvement of structure and function of the skeletal system.
IMPLEMENTATION STATUS

The developed manufacturing technology on the scale of approx 10-12 g from the batch and production capacity of 80-120 g/year was implemented in the Pharmaceutical Institute in 2011. The manufactured alfacalcidol is purchased by the pharmaceutical manufacturers in Poland and abroad (Italy, Greece, Thailand, China). At present the implementation of the new substance manufacturing method is completed and the current production is for commercial purposes.

BENEFITS FROM APPLICATION

Owing to the new synthesis method, alfacalcidol is manufactured at lower cost and without infringing patent rights of third parties. As a credible and reliable supplier the Pharmaceutical Institute can compete with the original manufacturer of alfacalcidol. Such competition is advantageous for patients, who now can purchase the ready-made medication containing alfacalcidol at a reduced price.

COMPARISON WITH THE CURRENT STATE OF TECHNOLOGY

The new concept of alfacalcidol synthesis is innovative on a global scale and this fact has been recognised both by several contractors and the European Directorate for the Quality of Medicines and HealthCare (EDQM), which draws up monographs of active substances. EDQM has asked the Pharmaceutical Institute to participate in an update of the alfacalcidol monograph and granted a Certificate of Suitability (CEP) for alfacalcidol.

All the principles concerning the analysis, manufacturing practice, substance purity are compliant with global regulations, Pharmacopoeia and GMP requirements. This is confirmed by certificates granted for alfacalcidol produced in the Pharmaceutical Institute: Good Practice Manufacturing Certificate issued by the Main Pharmaceutical Inspectorate – Certificate No. GIW-N-4022/162/09 and Certificate of Conformity confirming compliance of alfacalcidol with the monograph in the European Pharmacopeia – publisher: the European Directorate for the Quality of Medicines and Health Care (EDQM) – Certificate No. R1-CEP 2000-399-Rev 01.

Metabolism of vitamin D and alfacalcidol ("Osteoporosis in dialogue: 100 questions, 100 answers", Author: Johann D. Ringe)
The Institute of Heavy Organic Synthesis “BLACHOWNIA” (ICSO) is one of the leading Polish research institutes, specialising in the field of organic chemistry. ICSO cooperates with partners in Poland and from all over the world on development, implementation, improvement of technology, production and for sales of chemical products. In late 2011 its achievements included over 850 technologies implemented into industry, over 1500 obtained patents, nearly 2000 research studies and 12 contracts for sale of own technologies outside Poland. ICSO is a triple winner of the “Polish Product of the Future” Annual Competition (2004, 2010, 2012). Awarded innovative technologies and preparations are applied successfully by the Polish enterprises.

The Pharmaceutical Institute (IF) specialises in research and development works and manufacture of selected active substances in the scale from tens of grams to hundreds of kilograms. The conducted works concern both generic medicine technologies and original (innovative) ones. So far IF has implemented over 300 active substance and medicine manufacturing technologies. IF is a six-time winner of the “Polish Product of the Future” Annual Competition (1997, 2002, 2005, 2009, 2010, 2012). Awarded products and technologies are implemented by IF or in cooperation with Polish and foreign manufacturers. The Institute exports its product to the EU member states and Asia (excluding Japan, China and Thailand), Australia and Africa.

The Institute for Engineering of Polymer Materials and Dyes (IIMPiB) specialises in scientific activities covering polymer materials, elastomers, rubbers and dyes, paints and lacquers. In particular, the research is focused on plastic material engineering, technologies of their manufacture and application, recycling and utilisation. The Institute is also active in design, construction, prototyping and experimenting in machines, devices, technological lines and new technologies meeting the environmental protection requirements, including the reuse of waste materials. IIMPiB is a triple winner of the “Polish Product of the Future” Annual Competition (1998, 2002, 2004). Awarded technological lines and production methods have been implemented by Polish companies and enterprises in Ukraine.
CATALOGUE OF WINNERS

15TH ANNUAL COMPETITION POLISH PRODUCT OF THE FUTURE

The Institute of Medical Technology and Equipment (ITAM) is the only institute in Poland conducting research, development and implementation in the field of medical equipment. Their activities in advanced technologies concentrate, among other things, on diagnostics and therapy of cardiovascular diseases, medical resuscitation and biomedical engineering. The Institute has developed on a global scale new directions of medical technologies including non-invasive electrostimulation methods for heart disease diagnostics and therapy, systems of computer cardiological signal analysis, control and supervision systems of patients undergoing heart electocardiography. ITAM is a triple winner of the “Polish Product of the Future” Annual Competition (1999, 2009, 2011). Awarded systems and equipment have been used by Polish hospitals for years.

The Institute of Mining Technology KOMAG specializes in scientific research and development for the mining sector. They are focused, among other things, on mechanisation of extractive processes, automation and robotisation of technological processes, formation of environmental protection technologies. Their activities also include designing new technical solutions for machines and devices, mechatronic systems, control, diagnostics and monitoring systems. KOMAG is a triple winner of the “Polish Product of the Future” Annual Competition (2002, 2004, 2006). The innovative machines designed by the Institute have been implemented into production and they are used by both Polish and foreign hard coal mines.

The Institute of Electron Technology (ITE) is a leading Polish scientific centre in the field of semiconductor micro- and nanotechnologies. The research conducted by ITE includes, among other things, solid body electronics and physics as well as activities related to development, implementation and promotion of modern micro- and nanotechnologies and their applications in photonics, micro- and nanoelectronics. The Institute develops and sells instruments, scientific and research services and intellectual property rights on the Polish and foreign markets. They have been awarded over 100 various prizes since the Institute was established in 1966. ITE is also a triple winner of the “Polish Product of the Future” Annual Competition (1997, 2011, 2012). Their awarded equipment and technologies are exported to the USA, Switzerland and EU member states etc.

The Company Transition Technologies S.A. delivers software and provides engineering services based on state-of-the-art technologies (including neural networks) for power engineering and gas sectors as well as industrial automation in Poland and worldwide. Advanced technologies offered by the company are applicable to development of solutions related to management and design for the biggest global automotive, aeronautical, pharmaceutical and military companies. Furthermore, its activities include inrasomatics, prediction models with neural networks, regulators with fuzzy logic, genetic optimisation and advanced validation algorithms. The Company Transition Technologies is a double winner of the “Polish Product of the Future” Annual Competition (2002, 2009). Awarded systems have been implemented by numerous power engineering companies in the USA, Asia and Poland.

VIGO System S.A. is a world leader in the production of uncooled, photon infrared detectors. It offers equipment for applications in industry, medicine, research works and military technology, used for example in production of thermographic cameras for temperature distribution measurement and capture, diagnostics of machines and devices and medical diagnostics. The reference list of the VIGO’s product users contains the most known global companies and institutions from aeronautical, space, optical, automotive and electronic industries. VIGO System is a triple winner of the “Polish Product of the Future” Annual Competition (1999, 2001, 2007). Awarded devices have been sold successfully on the Polish market and in the EU countries, as well as in the USA and Asia.

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Polish Agency for Enterprise Development (Polka Agencja Rozwoju Przedsiębiorczości, PARP) is a government agency operating under the auspices of the Ministry of Economy. It was established under the Act of 9 November 2000. The aim of the Agency is to manage national and EU funds intended for supporting business and innovation as well as human resources development.

The Agency, which in 2010 celebrated its 10th anniversary, was established in order to implement economic development programs supporting innovation and research activities of the small and medium sized enterprises (SME), as well as to support regional development, exports increase, human resources development and the use of new technologies.

In the 2007-2013 financial perspective, PARP is responsible for implementing measures under three Operational Programs: Innovative Economy, Human Capital and Development of Eastern Poland.

One of the Agency’s priorities is to promote innovative attitudes and encourage entrepreneurs to apply modern technologies in their businesses. To this end PARP runs a website devoted to innovation, Portal Innowacji www.pi.gov.pl, and organizes the Polish Product of the Future Competition every year. SME representatives can participate in cyclical meetings of the Innovative Enterprises’ Club. The aim of the PARP Academy Educational Website, www.akademiaparp.gov.pl, is to provide micro, small and medium sized enterprises with access to business knowledge in the form of e-learning. Through web.gov.pl PARP supports the development of e-business. Enterprise Europe Network Centre operates within PARP, offering entrepreneurs information on European Union law and the rules of conducting business activity on the common market.

PARP initiated the creation of networks of regional SMEs support centers, i.e. the National SME Services Network, National Innovation Network and Consultation Centers. These institutions offer information, consulting, training and financial services, free of charge or at preferential rates. Regional Financing Institutions are PARP’s regional partners in the implementation of selected measures.