

**INFOTEHNOLOOGIA TEADUSKONNA THOMAS JOHANN SEEBECKI  
ELEKTROONIKAINSTITUUDI TEADUS- JA ARENDUSTEGEVUSE AASTAARUANNE  
2011**

## **1. Instituudi struktuur**

Instituudi direktor Toomas Rang

- Elektroonikadisaini õppetool, Chair of Electronics Design, Toomas Rang
- Rakenduselektroonika õppetool, Chair of Applied Electronics, Toomas Parve
- Sensorsignaaltöötluse õppetool, Chair of the Sensor Signals Processing, Olev Märtens

## **2. Instituudi teadus- ja arendustegevuse (edaspidi T&A) iseloomustus**

*(NB! punktid 2.1- 2.6 täidab struktuuriüksus)*

### **Punktid 2.1 ja 2.2.**

#### **Semiconductor Electronics (BaseLab MINAKO, including the Chair Electronics Design)**

Theoretical and experimental study of wide and semi-wide bandgap materials based semiconductor devices; design and fabrication of improved semiconductor components using non-traditional technologies (e.g. DWT) and numerical characterization; Semiconductor components and nanostructures meeting specific ambient and operating requirements; specific investigations (DLTS spectroscopy, numerical experiments) of electro-physical parameters (deep levels and their influence on electrical characteristics) in semiconductor structures.

##### **Most important results:**

- Detection of the new phenomena in semiconductor (SiC, GaAs) structures by the aid of Deep Level Transient Spectroscopy (DLTS) – creation of trap clusters for charge carriers under the diffusion welded contacts, which have strong and specific influence on electrical characteristics and speed parameters of GaAs and SiC based devices. In addition, we formulated the conditions for diffusion welding technology to be used for obtaining polytypic heterostructures in SiC, which widen the horizons for developing of high performance sensing and energy conversion devices.

##### **Selected publications:**

- Ivanov, Pavel; Korolkov, Oleg; Samsonova, Tat'yana; Sleptsuk, Natalja; Potapov, Alexander; Toompuu, Jana; Rang, Toomas (2011). DLTS Measurements on 4H-SiC JBS-diodes with Boron Implanted Local p-n Junctions. Materials Science Forum, 679-680, 409 – 412.
- Korolkov, Oleg; Sleptsuk, Natalja; Toompuu, Jana; Rang, Toomas. Diffusion Welded Contacts and Related Art Applied to Semiconductor Materials. Electronics and Electrical Engineering, 5 (111), 2011, 67 - 70.
- Ivanov, Pavel; Potapov, Alexander; Samsonova, Tatyana; Korol'kov, Oleg; Sleptsuk, Natalja. A DLTS study of 4H-SiC-based p-n junctions fabricated by boron implantation. Pleiades Publusing, Ltd., 2011, 1306 – 1310, Springer.
- Rang, Toomas; Tabun, Indrek; Rang, Galina; Koel, Ants. Generalized analytical model for SiC polytypic heterojunctions. Estonian Journal of Engineering, 17(2), 2011, 151 - 157.
- Paisnik, Kristo; Rang, Galina; Rang, Toomas. Life-time characterization of LEDs. Estonian Journal of Engineering, 17(3), 2011, 241 - 251.

#### **System Electronics, bionics and Signal processing (Baselab SIE, including Chair of Applied Electronics and Chair of the Sensor Signals Processing)**

Design of new signal processing methods and tools for smart instruments; precision circuits and systems (impedance spectroscopy, chirp-signals, etc.); test and measurement methods for diagnostics and medical diagnosis; fabrication methods for microfluidic lab-on-chips and signal processing solutions for analysing of micro-droplets; new impedance measurement based solutions for improvement of energy consumption in portable mobile devices.

##### **Most important results:**

- Novel principles for synthesis, generation and processing of signals used for identification and diagnosing of objects (biological and physiological, chemical and electrochemical, electrically conducting and semi-conducting etc. materials, structures, organs, devices and systems) with the aim to obtain the required information more faster and precisely. The signal processing covers short-time frequency domain methods, implemented for the measurement of transfer functions of the objects performing the broad-band spectroscopy (e.g., impedance spectroscopy) using the designed task specific processors.

#### Selected publications:

- Min, M.; Land, R.; Paavle, T.; Parve, T.; Annus, P.; Trebbels, D. Broadband spectroscopy of dynamic impedances with short chirp pulses. *Physiological Measurement*, 32(7), 2011, 945 - 958.
- Cahill, B.P.; Land, R.; Nacke, T.; Min, M.; Beckmann, D. Contactless Sensing of the Conductivity of Aqueous Droplets in Segmented Flow. *Sensors and Actuators B-Chemical*, 159, 2011, 286 - 293.
- Giannitsis, A.T.; Parve, T.; Min, M. Integration of Biosensors and Associated Electronics on Lab-on-Chip Devices. *Electronics and Electrical Engineering*, 110(4), 2011, 61 - 66.
- Kuusik, A.; Reilent, E.; Lõõbas, I.; Parve, M. Software Architecture for Modern Telehealth Care Systems. *Journal of Advances on Information Sciences and Service Sciences*, 3(2), 2011, 141 - 151.
- Märten, O.; Gordon, R., Rist, M.; Min, M.; Pokatilov, A; Kolyshkins, A. Precise eddy current impedance measurement of metal plates. *Olfa Kanoun (Toim.). Lecture Notes on Impedance Spectroscopy: Measurement, Modeling and Applications*, 2011, (43 - 45). London, UK: Taylor & Francis

#### Patendid

- European Patent **EP2313001A1** (Intention to grant 16.08.2011). Method and device using shortened square wave waveforms in synchronous signal processing. Inventors: Paul Annus, Mart Min, Jaan Ojarand. Owner: Tallinn University of Technology, ELIKO Competence Centre in Electronics-, Info- and Communication Technologies.
- USA Patent **US7894900B2** (granted: 22.02.2011). Device and method for monitoring cardiac pacing rate. Authors: Andres Kink, Indrek Rätsep, Mart Min, Toomas Parve. Owner: SmartImplant OÜ.
- USA Patent **US7970461B2** (granted 28.06.2011). **Method and device for determining relative amount of intracellular or extracellular liquid in living tissue.** Inventor: Kink Andres, Min Mart, Parve Toomas, Rätsep Indrek. Owner: Tallinn University of Technology; SmartImplant OÜ.

#### Patent Applications

- Estonian Patent Application **EE201100054** (filed 30.08.2011). Method and device for broadband analysis of systems and substances. Authors: Raul Land, Paul Annus, Mart Min, Olev Märten, Jaan Ojarand. Owners: Tallinn University of technology, ELIKO TAK.
- USA Patent Application US2011/0095747 A1 (published: 28.04.2011). Method and device for fast measurement of frequency response with scalable short chirp signals. Inventors: Mart Min, Toivo Paavle, Raul Land, Paul Annus, Toomas Parve. Owners: Tallinn University of Technology, ELIKO Competence Centre in Electronics-, Info- and Communication Technologies.
- US Patent Application **US13/177961** (filed 07.07.2011). Method and device for frequency response measurement. Inventors: Olev Märten, Mart Min, Raul Land, Paul Annus, Tõnis Saar, Marko Reidla. Owners: Tallinn University of Technology, ELIKO Competence Centre in Electronics-, Info- and Communication Technologies.

### 2.3 Loetelu struktuuriüksuse töötajate rahvusvahelistest tunnustustest.

#### Toomas Rang:

- Baltic Electronics Conference-general Chairman;
- Electronics 2012-memeber of the Program committee;
- PCIM2013–member of the program Committee.

Mart Min

- Electronics 2012-member of the Program committee;
- Member of the International Committee for Promotion of Research in Bio-impedance and of the International Society of Electrocardiology.
- Science Award of the Republic of Estonia in 2011;
- European Inventor Award 2011 nominant in the category of science.

## 2.5 Aruandeaasta tähtsamad T&A finantseerimise allikad.

Täiendavalt Eesti teekaardi projektidele avati finantseerimine, kus TTU on esindatud partnerina: CERN-projekt (koordinaator Mart Min, projektijuht KBFI) ja ESS projekt (koordinaator Toomas Rang, projektijuht TU).

## 2.6 Hinnang

Instituut osaleb Eesti Teadustippkeskuse CEBE töös, kus koos koordinaatoriga Arvutitehnika instituudist ja Tehnomeedikumist, ning on 3-aastase eksisteerimise vältel saanud märkimisväärsed tulemused, mille tunnistuseks on 2011. a. lõpul toimunud rahvusvahelisel evalveerimisel kõikide kriteeriumite järgi saadud hinded “väljapaistev”.

Kaitsti 3 doktoritööd (S. Strik, A. Kasemaa, Natlja Sleptsuk), kus kõigi kolme juhendajaks oli Prof. Toomas Rang.

Uue sihtfinantseerimise teema taotlus läks edukalt (Mart Min) ning instituuti õnnestus juurde võita ka üks ETF grant (Rauno Gordon).

Kokkuvõttes oli piisavalt edukas aasta.

## 2.7 Instituudi teadus- ja arendustegevuse teemade ja projektide nimetused (*Eesti Teadusinfosüsteemi, edaspidi ETIS, andmetel*)

- Haridus- ja Teadusministeerium

sihtfinantseeritavad teemad:

- T737, Missioonikriitiliste sardsüsteemide elektroonsed komponendid ja alarmsüsteemid, Min Mart

baasfinantseerimise toetusfondist rahastatud projektid (sh TTÜ tippkeskused):  
riiklikud programmid:

- Teiste ministeeriumide poolt rahastatavad riiklikud programmid:
- Uuriija-professori rahastamine:
- SA Eesti Teadusfond

grandid:

- ETF8592, Laia keelutsooniga materjalidel baseeruvad integreeritud Schottky ja heterosiirded: tehnoloogiad ja modelleerimine, Toomas Rang

- ETF8905, Adaptiivselt ülevõendatud ja moduleeritud signaalide muundamise ja töötlemise algoritmide uurimine, Olev Märten

ühisgrandid välisriigiga:

järeldoktorite grandid (SA ETF ja Mobilitas):

- MJD5, Development of a Microfluidic lab-on-chip for bioimpedance measurements on droplet-based bioreactors, Giannitsis Athanasios

tippteadlase grandid (Mobilitas):

- Ettevõtluse Arendamise SA

eeluuringud:

arendustoetused:

- SA Archimedesega sõlmitud lepingud

infrastruktuur (nn „mini-infra“, „asutuse infra“):

- AP737, Missioonikriitiliste sardsüsteemide elektroonsed komponendid ja alamsüsteemid, Min Mart
- ÜLTAP61, Integreeritud elektroonsed süsteemid ja komponendid (SARS2), Toomas Rang
- ÜLTAP15-3, Mikro- ja nanostruktuursed sardsüsteemid ja komponendid (SARS3), Toomas Rang
- 

Eesti tippkeskused:

- TAR8077IE, Integreeritud elektroonikasüsteemide ja biomeditsiinitehnika tippkeskus, Mart Min

riiklikud programmid:

- AR10126, Energiasüsteemi talitluse optimeerimine muutuvkoormuste tasakaalustamiseks, Toomas Rang, Tõnu Lehtla, Heiki Tammoja; Aadu Paist; Aleksander Kilk

muud T&A lepingud:

- SA Keskkonnainvesteeringute Keskusega sõlmitud lepingud:
- Siseriiklikud lepingud:
- EL Raamprogrammi projektid:
  - VFP463, Microfluidic Chip (MicroFluChip), Giannitsis Athanasios
  - VFP494, SafeMetal, Märten Olev
- Välisriiklikud lepingud:
  - VE402, Intelligent Battery Management, Land Raul

**2.8** Struktuuriüksuse töötajate poolt avaldatud sihtfinantseeritava teadusteema taotlemisel arvestatavad eelretsenseeritavad teaduspublikatsioonid (*ETIS klassifikaatori alusel 1.1, 1.2, 1.3, 2.1, 2.2, 3.1, 3.2, 3.3, 4.1 ja 5.1*).

1.1

- Min, M.; Land, R.; Paavle, T.; Parve, T.; Annus, P.; Trebbels, D. (2011). Broadband spectroscopy of dynamic impedances with short chirp pulses. *Physiological Measurement*, 32(7), 945 - 958.
- Cahill, B.P.; Land, R.; Nacke, T.; Min, M.; Beckmann, D. (2011). Contactless Sensing of the Conductivity of Aqueous Droplets in Segmented Flow. *Sensors and Actuators B-Chemical*, 159, 286 - 293.
- Korolkov, Oleg; Sleptsuk, Natalja; Toompuu, Jana; Rang, Toomas (2011). Diffusion Welded Contacts and Related Art Applied to Semiconductor Materials. *Electronics and Electrical Engineering*, 5 (111), 67 - 70.
- Ivanov, Pavel; Korolkov, Oleg; Samsonova, Tat'yana; Sleptsuk, Natalja; Potapov, Alexander; Toompuu, Jana; Rang, Toomas (2011). DLTS Measurements on 4H-SiC JBS-diodes with Boron Implanted Local p-n Junctions. *Materials Science Forum* , 679-680, 409 - 412.
- Molder, A.; Martens, O. (2011). Image Processing in the Woodworking Industry: Challenges, Solutions and Platforms. *Electronics and Electrical Engineering*, 7, 43 - 46.
- Giannitsis, A.T.; Parve, T.; Min, M. (2011). Integration of Biosensors and Associated Electronics on Lab-on-Chip Devices. *Electronics and Electrical Engineering*, 110(4), 61 - 66.
- Trebbels, D.; Fellhauer, F.; Jugl, M.; Haimerl, G.; Min, M.; Zengerle, R. (2011). On-line Tissue Discrimination for Transcutaneous Needle Guidance Applications Using Broadband Impedance Spectroscopy. *IEEE Transactions on Biomedical Engineering*, 99, 1 - 10. [ilmumas]
- Saar, T. (2011). Robust Piezo Impedance Magnitude Measurement Method. *Electronics and Electrical Engineering*, 7(113), 107 - 110.
- Kuusik, A.; Reilent, E.; Lõõbas, I.; Parve, M. (2011). Software Architecture for Modern Telehealth Care Systems. *Journal of Advances on Information Sciences and Service Sciences*, 3(2), 141 - 151.
- Anton, J.; Saar, T. (2011). Three-Dimensional Cell Counting based on Two Dimensional Cross-Section Images. *Electronics and Electrical Engineering*, 6(112) , 89 - 94.
- Ivanov, Pavel; Potapov, Alexander; Samsonova, Tatyana; Korol'kov, Oleg; Sleptsuk, Natalja (2011). A DLTS study of 4H-SiC-based p-n junctions fabricated by boron implantation . Pleiades Publusing, Ltd. (1306 - 1310).Springer

## 1.2

- Krivoshei, A. (2011). Bio-Impedance Signal Decomposer (BISD): enhanced accuracy and reduced latency solution. *Estonian Journal of Engineering*, 17(3), 201 - 219.
- Rang, Toomas; Tabun, Indrek; Rang, Galina; Koel, Ants (2011). Generalized analytical model for SiC polytypic heterojunctions. *Estonian Journal of Engineering*, 17(2), 151 - 157.
- Paisnik, Kristo; Rang, Galina; Rang, Toomas (2011). Life-time characterization of LEDs. *Estonian Journal of Engineering*, 17(3), 241 - 251.
- Mõlder, H.; Järvik, J.; Janson, K.; Gordon, R.; Vaimann, T. (2011). Method for mixing molten metal and compatible electric arc furnace. *Estonian Journal of Engineering*, 220 - 240.

Giannitsis, A.T. (2011). Microfabrication of biomedical lab-on-chip devices. *Estonian Journal of Engineering*, 17(2), 109 - 139.

Vedru, Jüri; Gordon, Rauno; Humal, Leo Henn; Trolla, Jaanus (2011). Modelling of an inductive sensor of the Foucault cardiogram. *Estonian Journal of Engineering*, 17, 252 - 270.

Paavle, Toivo (2011). Short-time chirp excitation for wideband identification of dynamic objects. *Estonian Journal of Engineering*, 17(2), 169 - 179.

Ivanov, Pavel; Potapov, Alexander; Samsonova, Tatyana; Korol'kov, Oleg; Sleptsuk, Natalja (2011). Исследование р-п-переходов на основе 4H-SiC, изготовленных имплантацией бора, методом нестационарной емкостной спектроскопии. *Физика и техника полупроводников* (1358 - 1362).Российская академия наук

### 1.3

#### 2.1

#### 2.2

Gordon, R. (2011). *Virtual Heart: Modelling of Cardiac Dynamics and Intracardiac Bioimpedance*. Saarbrücken, Germany: LAP LAMBERT Academic Publishing

### 3.1

Min, M.; Land, R.; Annus, P.; Ojarand, J. (2011). Chirp pulse excitation in the impedance spectroscopy of dynamic subjects - Signal modelling in time and frequency domain. Olfa Kanoun (Toim.). *Lecture Notes on Impedance Spectroscopy: measurement, Modeling and Applications* (79 - 82). London: Taylor & Francis

Gordon, R; Rist, M; Märten, O; Min, M. (2011). Measurement of the electric conductivity of highly conductive metals. *Lecture Notes on Impedance Spectroscopy* (35 - 40).Taylor & Francis

Gordon, R.; Rist, M.; Märten, O.; Min, M. (2011). Measurement of the electric conductivity of highly conductive metals with 4-electrode impedance method. Olfa Kanoun (Toim.). *Lecture Notes on Impedance Spectroscopy: Measurement, Modeling and Applications* (35 - 40). London, UK: Taylor & Francis

Märten, O.; Gordon, R., Rist, M.; Min, M.; Pokatilov, A; Kolyshkins, A. (2011). Precise eddy current impedance measurement of metal plates. Olfa Kanoun (Toim.). *Lecture Notes on Impedance Spectroscopy: Measurement, Modeling and Applications* (43 - 45). London, UK: Taylor & Francis

Rist Marek, Annus Paul, Min Mart, Land Raul (2011). Active electrodes for broadband bioimpedance spectroscopy. *International Multi-Conference on Systems, Signals & Devices, Tunesia*, 2011. , 2011, 275.

Martens, O; Land, R; Gavrijaseva, A; Molder, A. (2011). Adaptive-Rate Inductive Impedance Based Coin Validation . In: *Proceedings: IEEE INTERNATIONAL SYMPOSIUM ON INTELLIGENT SIGNAL PROCESSING: WISP2011, GRAND HOTEL EXCELSIOR 2011 FLORIANA, MALTA, September 19-21,2011.* (Toim.) Annam?ria R. V?rkonyi-Kóczy. Floriana,Malta: IEEE, 2011, 122 - 125.

Kasemaa, Argo; Rang, Toomas; Annus, Paul (2011). CMOS low power current source with reduced

circuit complexity. In: NEWCAS2011 Conference Proceedings: IEEE-NEWCAS2011, Bordeaux-France, 26-29 June 2011. Bordeaux: IEEE Operations Center, 2011, 17 - 20.

Ojarand, J.; Giannitsis, A.T.; Min, M.; Land, R. (2011). Front-end electronics for impedimetric microfluidic devices. SPIE Bioelectronics, Biomedical, and Bioinspired Systems V; and Nanotechnology, V, 18-20 April 2011, Prague, Czech Republic. Spie - International Society For Optical Engineering, 2011.

Land, R.; Cahill, B.P.; Parve, T.; Annus, P.; Min, M. (2011). Improvements in Design of Spectra of Multisine and Binary Excitation Signals for Multi-frequency Bioimpedance Measurement. 33rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC '11), Boston, USA, Aug. 30 - Sept. 3. IEEE, 2011, 4038 - 4041.

Reilent, E.; Kuusik, A.; Lõõbas, I.; Ross, P. (2011). Improving the data compatibility of PHR and telecare solutions. In: 5th European Conference of the International Federation for Medical and Biological Engineering 14 - 18 September 2011, Budapest, Hungary: (Toim.) Jobb?gy, ?.. Springer, 2011, (IFMBE Proceedings; 37), 925 - 928.

Paavle, T.; Min, M.; Trebbels, D. (2011). Low-Energy Chirps for Bioimpedance Measurement. In: Proc. of 34th International Conference on Telecommunication and Signal Processing, IEEE Catalog No CFP1188P-CDR: 34th International Conference on Telecommunication and Signal Processing, Budapest, Hungary, August 18-20, 2011. IEEE, 2011, 398 - 402.

Annus, P.; Min, M.; Ojarand, J.; Paavle, T.; Land, R.; Ellervee, P.; Parve, T. (2011). Multisine and Binary Multifrequency Waveforms in Impedance Spectrum Measurement - A Comparative Study. 5th European IFMBE MBEC 2011, Budapest, 14-18 Sept. , 2011, 1265 - 1268.

Min, M.; Paavle, T.; Ojarand, J. (2011). Time-Frequency Analysis of Biological Matter Using Short-Time Chirp Excitation. In: Proceedings of European Conference on Circuit Theory and Design 2011 (ECCTD'11): European Conference on Circuit Theory and Design 2011 (ECCTD'11), Linköping, Sweden, August 29-31, 2011. IEEE, 2011, 585 - 588.

Martens, O; Saar, T; Gavrijaseva, A., Molder, A (2011). Variable-resolution image processing for validation of coins . In: Proceedings: IEEE INTERNATIONAL SYMPOSIUM ON INTELLIGENT SIGNAL PROCESSING: WISP2011, GRAND HOTEL EXCELSIOR 2011 FLORIANA, MALTA, September 19-21,2011. (Toim.) Annam?ria R. V?rkonyi-Kóczy,. Floriana, Malta: IEEE, 2011, 176 - 179.

### 3.2

### 3.3

### 4.1

Min, Mart (2011). Cardiac Pacemakers - Biological Aspects, Clinical Applications and Possible Complications. Rijeka, Croatia: INTECH

Min, M. (2011). Estonian Journal of Engineering. Special Issue on Electronics, Vol. 17, No. 2.

Min, M. (2011). Estonian Journal of Engineering: Special issue on electronics, Vol.17, No. 3.

### 5.1

Mizsei, J?nos; Korolkov, Oleg; Sleptsuk, Natalja; Toompuu, Jana; Rang, Toomas (2011). Investigation of Additional States in the Silicon Carbide Surface after Diffusion Welding. In: 2011 International Conference on Silicon Carbide and Related Materials Abstract Book: ICSCRM2011 Cleveland Ohio, USA, September 11-16, 2011. Cleveland, USA: Trans Tech Publications Ltd, 2011, 356.

Koel, Ants; Rang, Toomas; Rang, Galina (2011). Simulation of Deep Energy Traps to Explain the VAC Temperature Dependence Anomaly of Diffusion Welded Schottky Contacts. In: 2011 International Conference on Silicon Carbide and Related Materials Abstract Book: ICSCRM2011 Cleveland Ohio, USA, September 11-16, 2011. Cleveland, USA: Trans Tech Publications Ltd, 2011, 340.

## **2.9** Struktuuriüksuses kaitstud doktoriväitekirjade loetelu (*NB! struktuuriüksus lisab struktuuriüksuse töötaja juhendamisel mujal kaitstud doktoriväitekirjade loetelu*)

**Argo Kasemaa**, Thomas Johann Seebecki elektroonikainstituut

Teema: *Analog Front End Components for Bio-Impedance Measurement: Current Source Design and Implementation* (Bioimpedantsi mõõteseadme analoogosa komponendid: vooluallika disain ja realisatsioon)

Juhendaja: prof Toomas Rang

Kaasjuhendaja: vanemteadur Paul Annus

Kaitses: 3.06.2011

Omistatud kraad: filosoofiadoktor (elektroonika)

**Natalja Sleptšuk**, Thomas Johann Seebecki elektroonikainstituut

Teema: *Investigation of Intermediate Layer in Metal-Silicon Carbide Contact Obtained by Diffusion Welding* (Difusioonkeevitusega valmistatud metalli ja ränikarbiidi vahelise üleminekuala vahekihi uurimine)

Juhendaja: prof Toomas Rang

Kaasjuhendaja: vanemteadur Oleg Korolkov

Kaitses: 3.06.2011

Omistatud kraad: filosoofiadoktor (elektroonika)

**Sergei Strik**, Thomas Johann Seebecki elektroonikainstituut

Teema: *Battery Charging and Full-Featured Battery Charger Integrated Circuit for Portable Applications* (Mobiilsete seadmete aku laadimine ja rikkalike omadustega akulaadija integraalskeem)

Juhendaja: prof Toomas Rang

Kaitses: 3.06.2011

Omistatud kraad: filosoofiadoktor (elektroonika)

## **2.10** Struktuuriüksuses järeldoktorina T&A-s osalenud isikute loetelu (*ETIS-e kaudu esitatud taotluste alusel*)

MJD5, Development of a Microfluidic lab-on-chip for bioimpedance measurements on droplet-based bioreactors, Giannitsis Athanasios

## **2.11** Struktuuriüksuses loodud tööstusomandi loetelu



**EE201100054**

Meetod ja seade süsteemide ja substantside laiaribaliseks analüüsimiseks.

Taotlus esitatud: 30.08.2011

Autorid: Raul Land, Paul Annus, Mart Min, Olev Märetns, Jaan Ojarand

Omanikud: TTÜ, ELIKO TAK

Instituut: IE

**US2012007583A1 (US13/177961)**

Meetod ja seade sageduskarakteristiku mõõtmiseks

Taotlus esitatud: 07.07.2011

Autorid: Olev Märtens, Mart Min, Raul Land, Paul Annus, Tõnis Saar, Marko Reidla

Omanikud: TTÜ, Eliko TAK

Instituut: IE

**US7970461B2**

Meetod ja seade rakusisese ja rakuvälise vedeliku suhtelise hulga määramiseks elavkoes

Patent välja antud: 28.06.2011

Autorid: Andres Kink, Mart Min, Toomas Parve, Indrek Rätsep

Omanikud: TTÜ, SmartImplant OÜ

Instituut: IE

**US7894900B2**

Device and method for monitoring cardiac pacing rate

Patent välja antud: 22.02.2011

Autorid: Andres Kink, Mart Min, Toomas Parve, Indrek Rätsep

Omanik: SmartImplant OÜ

Instituut: IE

**3. Struktuuriüksuse infrastruktuuri uuendamise loetelu**

- Veresoonte endoteeli toonuse, 15.04.2011, 17 256 €
- HF2TA Current Amplifier, 30.06.2011, 2 350 €
- Plasmasöövitaaja Matrix 303, 21.07.2011, 71 304 €
- Vaakumpump Iib-204, 21.07.2011, 5 133 €
- Difusioonkeevitusseade erineva, 22.08.2011, 100 900 €
- Krüostaat LN2 / AII-207, 19.10.2011, 21 565 €
- Laiaribaline faasimürade analü, 28.10.2011, 62 610 €
- Faasimürade generaator-, 3.11.2011, 115 928 €
- Mikroskoop SteREO Discovery V8, 14.11.2011, 4 385 €
- Kõrgepingeline mõõtja, 30.11.2011, 9 220 €
- Diskreet- ja digitaalsignaale, 12.12.2011, 16 999 €
- 3D-el. magnetväljade simulats., 20.12.2011, 19 490 €
- Impulsslaser lisadega, signaalide andmehõive summas , 25 144 €