

TOMASZ J. PETELEZ, PH.D.

DEPARTMENT OF BIOENGINEERING, UNIVERSITY OF UTAH

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PROFESSIONAL EXPERIENCE

UNIVERSITY OF UTAH, Department of Bioengineering, Salt Lake City, UT 1992 – Present

Research Associate Professor *2011 - present*

- **Research interests:** medical device design, bioinstrumentation, cardiopulmonary resuscitation, minimally-invasive diagnostic and therapeutic systems, medical sensors, RF and wireless sensors and systems, drug delivery systems, prosthetic devices with neural control, FDA Regulatory Affairs with focus on medical device design control.

- **Teaching:**

- **bioDesign - lectures, labs – BME 3801/4801**

- bioDesign is an undergraduate Medical Device Design course teaching students the fundamentals of medical device design and Design Controls using an innovative, hands-on, project-based methodology. Students define products, develop, and test prototype and assemble engineering documentation for their projects.

- Role: Co-teaching, curriculum development (team with Drs. Hitchcock and Broadhead)

- **bioInnovate - lectures, labs – BME 6081/6082**

- bioInnovate is a graduate Medical Device Design course that covers advanced medical device design, Design Controls and business development- students learn to identify and evaluate clinical needs, define products, develop, and test prototype systems, develop business models and Business Plans while learning to follow the FDA Design Control process. Best projects gain further University and/or private financial support.

- Role: Co-teaching, curriculum development (team with Drs. Hitchcock and Broadhead)

- **Regulatory Affairs for bioengineers BME 5110**

- Regulatory Affairs course is a 2-semester project-based curriculum focused on the fundamentals of the US regulatory affairs. The course covers Design Control Regulations for medical devices, drugs, biologics, IVDs and combination products.

- Role: Proposed, obtained FDA funding for a 6-mo training fellowship for a junior faculty (Dr.Skousen), developed curriculum and is currently co-teaching the course (w/ Dr.Skousen).

- **bioImmersion**

- bioImmersion is 10-week summer course, supported by a NIH R-25 grant that provides clinical shadowing experience for Bioengineering and Multidisciplinary Design (Architecture) students and trains them in identifying clinical problems and needs, and developing concept solutions.

- Role: program management, curriculum development, lectures, labs

- **Student mentorship:**

- MS committee member and/or chair

- Senior projects
- Undergraduate research projects (UROP)
- Graduate students

Regulatory/medical device design faculty, Center for Medical Innovation **2013 - present**

- Medical device design/development
- Regulatory curriculum (teaching)
- NSF site iCorps Program Co-PI (mentoring teams, managing educational program)

Adjunct Associate Professor **1992 - 2011**

- Teaching: Medical Device Design. Course proposal, planning, development and preparation of course materials, lectures and labs.

Member of the teaching team for the FDA QSR-focused, hands-on Medical Device Development course at the Department of Bioengineering. Co-developed course curriculum, organized the course and co-lectured an undergraduate Medical Device Design course.

- Member, Industrial Advisory Board

RAYTHEON SARCOS, Salt Lake City, UT **2007 – 2011**

Senior Manager, Program Management

- Developed programs, procured and managed projects, prepared proposals, managed biomedical regulatory activities and human factors in device design, and managed RS company regulatory (FDA, FCC) and EHS (Environmental Health and Safety) compliance.

SARCOS RESEARCH CORPORATION, Salt Lake City, UT **1994 – 2007**

Vice President, Medical Projects

- Procured and managed biomedical device / technology development projects, biomedical regulatory activities, and Human Factors.

Technical Director, Medical Projects

- Co-founder / VP of Technology of a spin-off drug delivery company; involved in identifying the company profile, defining products and markets, preparing marketing and financial materials, writing business plans and presenting the plans to potential investors and corporate partners.

IOMED, INC., Drug Delivery Systems, Salt Lake City, UT **1987 – 1994**

Director of Research and Chief Technology Officer **1989 – 1994**

- Organized and managed R&D Department, conducted research and prepared publications, managed collaboration with development partners in the US and Europe, designed clinical studies and cooperated with clinicians, organized and managed Scientific Advisory Board, managed product transition from R&D to production.
- Invented seal technology for new, disposable medical product that was patented and transitioned to production.

Co-Founder and Director of Product Development **1987 – 1989**

- Managed new product design, testing and regulatory compliance, internal and external collaboration, design / organization of new R&D laboratory with advanced analytical testing capabilities and small animal facility (GLP).
- Organized research program and developed testing methods in support of new product development in cooperation with QA and Manufacturing.
- Managed transition to production of a disposable Iontophoretic electrode product (volume: 140k/mo).

UNIVERSITY OF UTAH, Center for Engineering Design, Salt Lake City, UT

1983 – 1987

- Research Assistant/Graduate student

UNIVERSITY OF UTAH, Kolff Laboratory/Dialysis Center, Salt Lake City, UT

1981 – 1983

- Research Assistant/Graduate student

Biomedical Innovations, LLC, (Principal)

1994 – present

- Consulting - medical device development. Examples of projects include the development of a novel cardiovascular device with abdominal compressions, iontophoretic drug delivery systems, and infusion devices.
- Consulting (medical devices, regulatory)

VITATRON MEDICAL, Dieren, The Netherlands

- Internship training in implantable cardiac pacemaker technology.

EDUCATION

- **Doctor of Philosophy (PhD)**, Bioengineering, University of Utah, Salt Lake, City, UT
- **Master of Science (MS)**, Physics/Microelectronics, Silesian University of Technology, Gliwice, Poland

Training

- CITI training 2014, 2016
- CITI GLP training 2018
- CITI GCP training 2017
- Annual IRB training

AWARDS

- Technology Innovation Award 2004, University of Utah
- Fullbright-Hayes Scholarship, 1981
- Earned Value Management System Certification
- CITI and HIPAA training
- Advanced 3D modeling (Solid Works)
- Multiple grant awards from the NIH, NSF, CDC, MSHA / NIOSH, DoD; over \$6M in research funding

- NSF I-CORPS Site Grant, Center for Medical Innovation, Co-PI (2014 - 2017)
- NSF I-CORPS Site Grant, Center for Medical Innovation, Co-PI (2016 - 2021)
- NSF I-CORPS Site Grant Supplement
- Utah State TCIP grant, Co-PI
- TVC Technology Development grant, Co-PI

SERVICE

- University of Utah Institutional Review Board (IRB) - Member
- Summer bioImmersion course for undergraduate Bioengineering and Multidisciplinary Design (5 yrs)
- Bench to Bedside (B2B) Design Competition Judge
- Applied Bionics and Biomechanics, reviewer
- Veterans Administration Rehabilitation R&D Scientific Review Board, Washington, DC, 2007 - 2014
- Veterans Administration Rehabilitation, Ad hoc reviewer (special reviews) 2019
- IEEE EMBC Conference 2013, 2014, 2016, 2017, 2019, 2020 – Associate Editor (Proceedings) and Reviewer

PROFESSIONAL AFFILIATIONS and PANELIST EXPERIENCE

- NIH Review Panel - ZRG1 SBIB-G (11); ZRG1 SBIB-K (11) 2016 – 2020 - panelist
- NSF Peer Review Panel on Medical Devices and Sensors
- Regulatory Affairs Professional Society (RAPS) - member
- IEEE, Member (past)
- Controlled Release Society, Member (past)
- IEEE Neural Systems and Rehabilitation Engineering – Reviewer
- Journal of Controlled Release – Reviewer

PUBLICATIONS, PRESENTATIONS (43) and PATENTS (30)

Peer Reviewed Journals

- Stephen, R.L.; Maddock, R.K.; Kablitz, C.; Maxwell, G.J.; Jacobsen, S.C.; Petelenz, T.J.; "Stabilization and improvement of renal function in diabetic nephropathy." Diabetic Nephropathy, Vol. 1, No. 2, 1982.
- Petelenz T, Axenti I, Petelenz TJ, Iwinski J, Dubel S. Mini set for iontophoresis for topical analgesia before injection. *Int. J Clin Pharm Ther Tox* 1984; 22:152-5.
- Stephen RL, Petelenz TJ, Jacobsen SC. Potential novel methods for insulin administration: I. Iontophoresis. *Biomed Biochim Acta* 1984; 43:553-8.
- Krueger GG, Wojciechowski ZJ, Burton SA, Gilhar A, Huether SE, Leonard LG, Rohr UD, Petelenz TJ, Highuchi WI, Pershing LK. The development of a rat/human skin flap served by a defined and accessible vasculature on a congenitally athymic (nude) rat. *J Fund Appl Toxicol*, 1985; 5:112-21.
- Bezzant JL, Stephen RL, Petelenz TJ, Jacobsen SC. Painless cauterization of spider veins with the use of iontophoretic local anesthesia. *J Am Acad Dermatol* 1988; 19:869-75.
- Ashburn MA, Stephen RL, Ackerman E, Petelenz TJ, Hare B, Pace NL, Hoffman AA. Iontophoretic delivery of morphine for postoperative analgesia. *J Pain Symptom Management* 1992; 7:27-33.

- Maloney MJ, Bezzant JL, Stephen RL, Petelenz TJ. Iontophoretic administration of lidocaine anesthesia in office practice - an appraisal. *J Dermatol Surg Oncol* 1992. ; 18:937-940.
- Petelenz TJ, Buttke JA, Bonds CB, Lloyd LB, Beck JE, Stephen RL, Jacobsen SC, Rodriguez P. Iontophoresis of dexamethasone: laboratory studies. *J Controlled Release* 1992; 20:55-66.
- Petelenz, T, et al, Self-administered Cough Cardiopulmonary Resuscitation in Patients Threatened by MAS Events of Cardiovascular Origin, *Wiad.Lek.*, Vol.51, No 7-8, 1998, pp. 326-336.
- North, K, Kubiak, EN, Rothberg, DL, Lajevardi-Kosh, A, Petelenz, TJ, Hitchcock, RW, Stuart, AR, "Longitudinal monitoring of patient limb loading throughout ankle fracture rehabilitation using an insole monitoring system: a case series.", *Current Orthopaedic Practice*, Vol. 28, No. 2, March/April 2017
- de Gennaro JD, de Gennaro CK, Shaw JM, Petelenz TJ, Nygaard IE, Hitchcock RW. "The Relationship Between Intra-Abdominal Pressure and Body Acceleration During Exercise", *Female Pelvic Med Reconstr Surg*. 2017 Nov 13. doi: 10.1097/SPV.0000000000000523. [Epub ahead of print]. PMID: 29135811
- Niederauer S, de Gennaro J, Nygaard I, Petelenz T, Hitchcock R., "Development of a novel intra-abdominal pressure transducer for large scale clinical studies.", *Biomed Microdevices*. 2017 Aug 26;19(4):80. doi: 10.1007/s10544-017-0211-2. PMID: 28844111
- Lajevardi-Khosh, A & Tresco, B., Stuart, A., Sinclair, S., Ackerman, M., Kubiak, E., Petelenz, T., Hitchcock, R (2018). Development of a Step Counting Algorithm Using the Ambulatory Tibia Load Analysis System for Tibia Fracture Patients. *SAGE*. Vol. 5, 1-11. Article, Refereed Journal, Published, 05/2018.
- Lajevardi-Khosh A., Bamberg S., Rothberg D., Kubiak E., Petelenz T. & Hitchcock R. (2019). Center of pressure in a walking boot shifts posteriorly in patients following lower leg fracture. *Gait and Posture*. Vol. 70, 218-221. Journal Article, Published, 05/01/2019.
- De Gennaro J.D., De Gennaro C.K., Shaw J.M., Petelenz T.J., Nygaard I.E. & Hitchcock R.W. (2019). The Relationship between Intra-Abdominal Pressure and Body Acceleration during Exercise. *Female Pelvic Medicine and Reconstructive Surgery*. Vol. 25, 231-237. Journal Article, Published, 05/01/2019.
- Lajevardi-Khosh A., Stuart A., Ackerman M., Rothberg D., Kubiak E., Petelenz T. & Hitchcock R. (2019). Characterization of compliance to weight-bearing protocols and patient weight-bearing behavior during the recovery period in lower extremity fractures: A pilot study. *Current Orthopaedic Practice*. Vol. 30, 395-402. Journal Article, Published, 07/01/2019.
- Li, H, Li, E, Krishnamurthy, D, Kolbay, P, Chacin, B, Hoehne, S, Cybulski, J, Brewer, L, Petelenz, T, Orr, J, Sakata, D, Clardy, T, Kuck, K, Utah-Stanford Ventilator (Vent4US): Developing a rapidly scalable ventilator for COVID-19 patients with ARDS. doi: <https://doi.org/10.1101/2020.04.18.20070367>, APR 2020.

Presentations, Abstracts and Conference Proceedings

- Petelenz, T.J.; et al; *TEMED Journal*, 1978 – 1981. Four (4) papers in Polish on implantable heart pacemaker technology and dialysis equipment.
- Petelenz, T.J.; National Meeting on Hemodialysis Equipment, Zabrze, 1979. Paper on the construction and performance of HDN-301 artificial kidney.

- Petelenz, T.J.; Proceedings of the 1st National Conference on Hybrid Technology - Cracow. 1980, "Potential of Application of Thick Film Technology in Medical Equipment".
- Kablitz, C.; Stephen, R.L.; Jacobsen, S.C.; Maxwell, J.G.; Harrow, J.J.; Petelenz, T.J.; "Transperitoneal insulin absorption." ASAIO Transactions, Vol. 6, No. 4, Nov. 1982, p. 478.
- Kablitz, C.; Stephen, R.L.; Jacobsen, S.C.; Maxwell, J.G.; Harrow, J.J.; Petelenz, T.J.; "Transperitoneal insulin absorption in non-diabetic swine." Proceedings. International Symposium on Kinetic Modeling in Artificial Organs, Rostock-Warnemunde, 1982.
- Petelenz, T.J.; Shettigar, U.R.; Harrow, J.J.; Stephen, R.L.; Kolff, W.J.; "Time sequenced hemofiltration/hemodialysis." 35th ACEMB Proceedings, Sept. 1982.
- Yamada, A.; Bishop, N.D.; Harrow, J.J.; Palmer, J.; Shettigar, U.R.; Petelenz, T.J.; Kolff, W.J.; "Disposable ultrafiltration cell used for continuous monitoring system for hemodialysis." ASAIO Transactions, 29th Annual Meeting, Canada, 1983.
- Stephen RL, Petelenz TJ, Kim SW, Jacobsen SC. Two novel methods for insulin administration: Iontophoresis and self regulation. XI International Karlsburg Symposium, Sept. 19-21, 1983.
- Wojciechowski ZJ, Burton SA, Petelenz TJ, Krueger GG. Role of micro circulation in percutaneous absorption. Clin Res 1985; 33:21A.
- Huether SE, Wojciechowski ZJ, Petelenz TJ, Leonard LG, Krueger GG. A model for measuring skin blood flow. Clin Res 1985; 33:92A.
- Petelenz TJ, Stephen RL, Jacobsen SC. Iontophoresis as a potential method of insulin administration. International Symposium on Artificial Organs, Biomedical Engineering & Transplantation in honor of the 75th birthday of W.J. Kolff, Salt Lake City, UT Jan. 30-31, 1986.
- Petelenz TJ, Dzelzkals RR, Stephen RL, Hare BD, Jacobsen SC. Iontophoresis of morphine. I. Preliminary analysis. Presentation, 39th ACEMB, Baltimore, MD Sept. 1986.
- Ashburn MA, Stephen RL, Petelenz TJ, Jacobsen SC. Controlled iontophoretic delivery of morphine. Presentation, ASA Annual Meeting, Sept. 1988.
- Ashburn MA, Stephen RL, Petelenz TJ, Hoffman AA. Controlled iontophoretic delivery of morphine HCl for postoperative pain relief. Anesthesiology 1988; 69:A348.
- Petelenz TJ, Beck JE, Buttke JA, Bonds C, Jacobsen SC, Lloyd LB, Stephen RL. Iontophoresis of dexamethasone sodium phosphate. Presentation, Annual APTA Meeting, Los Angeles, CA Jun. 1990.
- Petelenz TJ, Madsen R, Beck JE, Bonds CB, Parkinson TM. Development of a versatile and practical iontophoretic research system. US - Japan Symposium on Drug Delivery, Maui, HI, Dec. 1991.
- Petelenz TJ, Lloyd LB, Beck JB, Bonds CB, Szlek M, Parkinson TM, Stephen RL, Jacobsen SC. Iontophoretic administration of drugs: Development of a practical delivery system. US - Japan Symposium on Drug Delivery, Maui, HI, Dec. 1991.
- Petelenz TJ, Bonds C, Buttke JA, Lloyd LB, Beck JE, Jacobsen SC. Iontophoresis of lidocaine: a laboratory study with new hydra table gel electrode. Presentation, Controlled Release Society, Orlando, FL, Jul. 1992.

- Petelenz TJ, Jacobsen SC, Beck JE, Lloyd LB, Stephen RL, Buttke JB, Bonds C. Development of iontophoretic electrode technology. Presentation, Controlled Release Society, Orlando, FL, Jul. 1992.
- Bonds C, Szlek M, Evans R, Buttke JA, Petelenz TJ. Comparison of drug distribution in iontophoresis of lidocaine in hairless mouse and human skin. Presentation, Controlled Release Society, Orlando, FL, Jul. 1992.
- Petelenz TJ, Lloyd LB, Jacobsen SC, Janata J, Langmeyer J, Beck J, Hause R. Electrochemistry of iontophoretic electrodes: Review of design issues. Presentation, Electrochemical Society, Inc., Toronto, Canada, Oct. 1992.
- Petelenz TJ. Development and characterization of a practical iontophoretic drug delivery system. Presentation, Annual Meeting AAPS, San Antonio, Texas, Nov. 1992.
- Petelenz TJ, Szlek M, Evans R, Buttke JA, Lloyd LB. In vitro measurements of percutaneous penetration of drugs delivered by iontophoresis. Presentation, Prediction of Percutaneous Penetration, Third International Conference, La Grande Motte, France, Apr. 1993.
- Petelenz, TJ, Gordon Research Conference on Barrier Properties of Mammalian Skin, Plymouth, NH. Presentation on iontophoretic drug delivery. Aug. 1993.
- Petelenz TJ, Hause RF, Hisatake JA, Horsley R, Lloyd LB, Parkinson TM. Measurements of Current Distribution of Iontophoretic Electrodes. Presentation, 21st International Symposium on Controlled Release of Bioactive Materials, Nice, France, June 1994.
- Cupo, M., Sheredos, S., Jacobsen, SC, Petelenz, TJ, "Development of AdVantage Arm." Presentation at the American Academy of Orthotics and Prosthetics, Miami, April 1998.
- Petelenz, TJ, et al., "Non-invasive cardiopulmonary sensor for determination of changes in cardiac output.", "Advanced Technologies for Combat Casualty Care Conference, ATACCC 2003, St.Pete, Florida, August 2003
- Petelenz, TK, Criley, JM, Petelenz, TJ, et al., "Cough Cardiopulmonary Resuscitation – a life-saving strategy for patients at high risk of Sudden Circulatory Arrest." ESC Congress 2004, presentation.
- Petelenz, TJ, et al., "Non-invasive cardiopulmonary sensor for determination of changes in cardiac output.", "Advanced Technologies for Combat Casualty Care Conference, ATACCC 2004, St.Pete, Florida, August 2004
- Petelenz, TK, Petelenz, TJ, Chrusciel, P, Wolkowski, J, "Simultaneous Abdominal Compression CPR improves clinical outcomes of resuscitation: Results of a 3-year clinical study, ESC 2005 Congress, Abstr. #83622, Stockholm 2005.
- Petelenz, TJ, Sikorski, K, Jacobsen, SC, "Power Limitations in Embedded Systems – Impact of Signal Acquisition and Data Processing Strategies", HCMDSS Conference Proceedings, 2005
- Petelenz, TJ, Sikorski, C, "Potential alternative signal sampling and reconstruction strategies for low power embedded sensors." Proceedings of the 2007 Joint Workshop on High Confidence Medical Devices, Software and Systems, and Medical Plug-and-Play Interoperability, Cambridge, MA, IEEE Society Press, 2007, pp.194 – 197.
- Petelenz, TJ, et al., "RF-based Non-Invasive Continuous Cardiac Output Tracking", "Advanced Technologies for Combat Casualty Care Conference, ATACCC 2007, St.Pete, Florida, August 2007

- North, K, Kubiak, E.N., Hitchcock, R.W, Petelenz, T.J. “Load monitoring system for partial weight bearing therapy for rehabilitation of lower extremity fractures.” 35th Annual International IEEE EMBS Conference, July 2013, Osaka, Japan.
- North K, Kubiak EN, Hitchcock RW, Petelenz TJ. Load Monitoring System for Partial Weight Bearing Therapy for rehabilitation of lower extremity fractures. Conf Proc IEEE Eng Med Biol Soc. 2013;2013:152-5.
- North K, Kubiak EN, Hitchcock RW, Petelenz TJ. Load Monitoring System for Partial Weight Bearing Therapy for rehabilitation of lower extremity fractures. Conf Proc IEEE Eng Med Biol Soc. 2013;2013:152-5.
- Loftus, P, Elder, CT, Sorensen, MW, Shipman, J, D'Ambrosio, T, Petelenz, T, Langell, J, Creating a benchmark medical technology entrepreneurship competition, NCIIA Proceedings of the Annual Conference, 1-8, 2014.
- Technology podcast: Loftus P, Elder C, Sorenson M, Shipman J, D'Ambrosio T, Petelenz T, Hitchcock R, Langell, JL (22 MAR 2014). Creating a Benchmark Medical Technology Entrepreneurship Competition [Web]. Proceeding of the NCIIA (peerreviewed). Available: <http://NCIIA.org/open/wp-content/uploads/2013/10/langell.pdf>.
- Langell JT, Hitchcock R, Petelenz T (21 Mar 2014). *“Teaching innovation and Entrepreneurship: A multidisciplinary approach” Oral paper presentation, National Collegiate Inventors and Innovators Alliance (NCIIA) Open 2014, San Jose, CA [Abstract]. Proceeding for the National Collegiate Inventors and Innovators Alliance, OPEN 2014.*
- Lajevardi-Kosh, A, Tresco, BI, Ackerman, M, Petelenz, T, Hitchcock, R, Acquisition and Analysis of Underfoot Data from Lower Extremity Fracture Patients, Proceedings of the BMES Conference, 2015
- Vandersteen, E, Petelenz, T, Hitchcock, R, The Design and Development of a Portable Pressure sensing Insole for out-of-Clinic Load Capture, Proceedings of the BMES Conference, 2015
- Stuart AR, Lajevardi-Khosh A, Chen NK, Presson AP, Petelenz TJ, Hitchcock RW, Kubiak EN. Loading and Ambulatory Behavior of Lower Extremity Fracture Patients. Military Health Services Research Symposia, Orlando, FL, Aug 2016
- Niederauer, S, DeGennaro, J, Petelenz, T, Hitchcock, RW, Acquisition of Intraabdominal Pressure as a Predictor of Pelvic Floor Disorders in Post-partum Women, Proceedings of the BMES Conference, 2016

Patents granted (30)

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| 1. | 10,595,748B2 | Systems, devices and methods for providing foot loading feedback to patients and physicians during a period of partial weight bearing |
| 2. | 8,721,559 | Non-invasive method and device for measuring cardiac output |
| 3. | 8,191,421 | Digital ballistic impact detection system |
| 4. | 8,056,391 | Digital wounding detection system |
| 5. | 7,727,180 | Method and apparatus for presetting device operating levels with display |
| 6. | 7,206,639 | Cochlear drug delivery system and method |

7. 6,433,690 Elderly fall monitoring method and device
8. 6,223,075 Iontophoretic delivery device with integral hydrating means
9. 6,198,394 System for remote monitoring of personnel
10. 6,165,155 Multipathway electronically-controlled drug delivery system
11. 6,160,478 Wireless health monitoring system
12. 6,086,562 Disposable automatic injection device
13. 6,045,534 Disposable fluid injection module
14. 5,860,957 Multipathway electronically-controlled drug delivery system
15. 5,730,716 Iontophoretic delivery device with integral hydrating means
16. 5,558,632 Electrodes for iontophoresis
17. 5,374,241 Electrodes for iontophoresis
18. 5,328,455 Rehydratable product and method of preparation thereof
19. 5,281,287 Method of making a hydratable bioelectrode
20. 5,248,295 Bioelectrode seal
21. 5,236,412 Rehydratable product and method of preparation thereof
22. 5,196,002 Implantable drug delivery system with piston actuation
23. 5,167,625 Multiple vesicle implantable drug delivery system
24. 5,087,242 Hydratable bioelectrode
25. 5,059,175 Implantable drug delivery system with piston actuation
26. 5,037,380 Iontophoretic electrode with solution containment system
27. 4,979,938 Method of iontophoretically treating acne, furuncles and like skin disorders
28. 4,968,297 Iontophoretic electrode with solution containment system
29. 4,915,685 Methods and apparatus for iontophoresis application of medicaments at a controlled pH through ion exchange
30. 4,886,489 Flow-through methods and apparatus for iontophoresis application of medicaments at controlled pH
31. 4,752,285 Methods and apparatus for iontophoresis application of medicaments

Patents pending **3**