

# FCR 20

Office of the President  
February 17, 2023

Members, Board of Trustees:

## PATENT ASSIGNMENT REPORT

Recommendation: that the Board of Trustees accept the patent assignment report for the period October 1, 2022 to December 31, 2022.

Background: At its March 1997 meeting, the Board of Trustees authorized the University of Kentucky Research Foundation to conduct all future copyright and patent filings and prosecutions. Quarterly reports on patent and copyright applications are to be submitted to the Finance Committee of the Board.

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Action taken:  Approved       Disapproved       Other \_\_\_\_\_

PATENT ASSIGNMENTS  
FOR THE PERIOD October 1, 2022 TO December 31, 2022

Patents

The following assignments on behalf of the Board of Trustees of the University of Kentucky Research Foundation have been executed:

- 1. U.S. Patent Application Number:** 17/958,954  
**UKRFID:** 2553  
**Filed:** October 3, 2022  
**Title:** TRANSPARENT ANTIVIRAL AND ANTIMICROBIAL COATING  
**Inventors:** Ambrose Sungseok Seo (College of Arts and Sciences)  
**Description and Application:** The invention is an antiviral and antimicrobial coating for electronic devices. The coating may be elemental copper or a copper alloy, applied with sputtering or pulsed vapor deposition with a thickness between 1 and 10 nm, and provides a disinfecting and sanitizing effect. The advent of touch screens and nano-sized circuitry has resulted in a boom in portable devices. Users are accustomed to using their fingers to interface with these devices and this invention provides another layer of protection for users. The global market for consumer electronics is expected to reach \$990 billion by 2027, with a Compound Annual Growth Rate (CAGR) of 5.3%.  
**License:** N/A
  
- 2. U.S. Patent Application Number:** 17/959,809  
**UKRFID:** 2546  
**Filed:** October 4, 2022  
**Title:** BIOERODIBLE LIFESUPPORT HYDROGELS FOR THE DELIVERY OF VIABLE MITOCHONDRIA  
**Inventors:** Thomas Dziubla, Arif Khan (College of Engineering) Patrick Sullivan, Alexander Rabchevsky, Samirkumar Patel (College of Medicine) and Jason DeRouchy (College of Arts and Sciences)  
**Description and Application:** The invention is a novel method to treat injury by providing healthy mitochondria at the site of the injury. Delivery is accomplished by combining mitochondria with hydrogels to prevent cell death of the mitochondria. This mixture can be applied directly to the injury or surgical incision. This treatment helps to counteract the drop in energy levels due to loss of mitochondria

because of the injury. Traditional methods fail to meet this need due to the short time window for application. The wound care market was \$20.6 billion in 2021 with an expected CAGR of 4.1% until 2030.

**License:** N/A

**3. U.S. Patent Application Number:** 17/963,537

**UKRFID:** 2319

**Filed:** October 11, 2022

**Title:** AURELOIC ACID DERIVATIVES AND METHODS OF USE THEREOF

**Inventors:** Jon Thorson, Jurgen Rohr, Khaled Shaaban, Joseph Eckenrode, Yang Liu (College of Pharmacy) Markos Leggas, Jianjun Zhang and Yinan Zhang (formerly College of Pharmacy)

**Description and Application:** The invention is a treatment for cancer using derivatives of mithramycin (MTM). The relevant compounds are MTM Oxime (MTM-OX) and MTM hydrazine (MTM-HY). The use of these derivatives allows for selective modulation of the activity of a target erythroblast transformation-specific transcription factor in a patient by administering a therapeutically effective amount of the derivative or a related pharmaceutically acceptable salt. This treatment may be effective for prostate, colon and lung cancers, as well as in the treatment of leukemia, lymphoma and Ewing sarcoma. The global oncology market is expected to reach \$581 billion by 2030.

**License:** N/A

**4. U.S. Patent Application Number:** 18/054,387

**UKRFID:** 2632

**Filed:** November 10, 2022

**Title:** CELL SORTING MICROBEADS AS ALTERNATIVE AGENT FOR MAGNETIC RESONANCE IMAGING

**Inventors:** Fanny Chapelin (College of Engineering), Roberto Gedaly, Francesc Marti and Aman Khurana (College of Medicine)

**Description and Application:** The invention is a novel method for tracking and locating cells in the human body. The tracking material is a nanoparticle from 5 nm in diameter to 2  $\mu$ m in diameter composed of superparamagnetic iron oxide. The iron oxide may be coated in antibodies to bind to specific cells. The superparamagnetic iron oxide allows these cells to be tracked using existing MRI technology. The global cell therapy market is expected to reach \$12 billion by 2030.

**License:** N/A

- 5. U.S. Patent Application Number:** 17/927,389  
**UKRFID:** 2449  
**Filed:** November 23, 2022  
**Title:** MACHINE LEARNING DETERMINES PLASMA PROTEINS AS PREDICTORS OF CLINICAL OUTCOMES AND IDENTIFYING DRUG TARGETS IN ISCHEMIC STROKE PATIENTS  
**Inventors:** Keith Pennypacker, Justin Fraser (College of Medicine) and Qiang Cheng (College of Engineering)  
**Description and Application:** This invention includes methods and devices to identify risk factors of cerebral edema and severe infarct volume in a stroke patient. Each year approximately 800,000 individuals have a stroke, of which 87% are ischemic. Ischemic stroke remains one of the most debilitating diseases and is the fifth leading cause of death in the United States. A device for use in identifying risk of cerebral edema includes a combination of probes specific for a panel of cytokines and chemokines. The device can be a microfluidic enzyme-linked immunosorbent assay. The global stroke management market is estimated to reach \$23 billion by 2023 with a CAGR of 7.1%.  
**License:** N/A
  
- 6. U.S. Patent Application Number:** 18/071,920  
**UKRFID:** 2624  
**Filed:** November 30, 2022  
**Title:** AUTOMATED CO<sub>2</sub> CAPTURE PROCESS CONTROL SYSTEM WITH SOLVENT PROPERTY PREDICTION  
**Inventors:** Kunlei Liu, Jonathan Pelgen (College of Engineering), Zhen Fan and Bradley Irvin (Center of Applied Energy Research)  
**Description and Application:** The invention is an automated system for CO<sub>2</sub> capture. The system includes a group of temperature, pH, density and viscosity sensors for a lean carbon capture solvent. This includes a second group of sensors to capture temperature, pH, density and viscosity of the carbon capture solvent after capture of the acid gas and a controller that can make real-time adjustments based on the carbon load of the solvent. The global market for carbon capture is \$4.7 billion with an expected CAGR of 8% to 11% until 2027.  
**License:** N/A

7. **U.S. Patent Application Number:** 18/073,432  
**UKRFID:** 2257  
**Filed:** December 1, 2022  
**Title:** METHOD OF MAKING POLYACRYLONITRILE BASED CARBON FIBERS AND POLYACRYLONITRILE BASED CARBON FIBER FABRIC  
**Inventors:** Matthew Weisenberger and John Craddock (Center for Applied Energy Research)  
**Description and Application:** The invention is a method of producing low thermal conductivity carbon fiber. The produced carbon fiber would replace the need for rayon-based carbon fiber for composite applications. Existing plants could be adapted to produce the required amount of low thermal conductivity carbon fiber. As a result, capital costs associated with plant construction would be greatly reduced. The inventors estimate this would save billions in capital costs. The composite market is over \$72.6 billion globally and is expected to grow at a rate of 8 % until 2022.  
**License:** N/A
8. **U.S. Patent Application Number:** 18/008,085  
**UKRFID:** 2478  
**Filed:** December 2, 2022  
**Title:** ANTIVIRAL MASK AND ANTIVIRAL FILTER MADE FROM A BREATHABLE MICROPOROUS POLYMERIC MEMBRANE  
**Inventors:** Dibakar Bhattacharyya, Thomas Dziubla, Jeffrey Hastings, Matthew Bernard, Rollie Mills (College of Engineering), Yinan Wei (College of Arts and Sciences), Jacob Concolino and RJ Vogler (formerly College of Engineering)  
**Description and Application:** The invention is an antiviral mask or filter with a microporous membrane. The microporous membrane may have a thickness between 30 and 500 microns, a porosity between 20% and 80%, and an average pore size of between 15 and 30nm. The pores may be functionalized with a proteolytic enzyme and virus denaturing agents. The development of smart filtration materials with lower air flow resistance to remove airborne nanoparticles and virus particles will provide immense human health and industrial work-place benefits. The global personal protective equipment market is currently \$51 billion with a CAGR of 6.7% until 2027.  
**License:** N/A

9. **U.S. Patent Application Number:** 18/011,330  
**UKRFID:** 2451  
**Filed:** December 19, 2022  
**Title:** SUBTALAR ARTHRODESIS NAIL IMPLANT SYSTEM  
**Inventors:** Arun Aneja, Gavin Hautala, Arjun Srinath (College of Medicine) and Lorenzo Deveza (Baylor College of Medicine)  
**Description and Application:** The invention is a subtalar nail implant system with a subtalar nail, a spacer adapted to fit in a subtalar joint, and a plurality of fasteners to secure the nail to the talus and to the calcaneus across the subtalar joint. The nail implant system also includes a wedge-shaped trial and a cooperating guidewire outrigger. When the trial is positioned in the subtalar joint, the guidewire outrigger is adapted for placement of a guidewire from the calcaneus into the talus through a guidewire receiver. This device addresses primary and revision subtalar arthrodesis surgery for arthritic conditions and calcaneal fractures. Current state of the art treatment requires non-weight-bearing on the affected extremity while healing, this novel implant allows for a more stable fusion construct, compression at the fusion site, and immediate weight-bearing. The global market for foot and ankle devices is \$1.6 billion with a CAGR of 8%.  
**License:** N/A
10. **U.S. Patent Application Number:** 18/146,513  
**UKRFID:** 2381  
**Filed:** December 27, 2022  
**Title:** ANTIMICROBIAL COMPOUNDS, COMPOSITIONS AND METHODS  
**Inventors:** Sylvie Garneau-Tsodikova (College of Pharmacy) and Octavio Gonzalez (College of Medicine)  
**Description and Application:** The invention is a novel zafirlukast derivative that can be used as an antimicrobial agent to target *P. gingivalis* with greater specificity and decreased cytotoxicity compared to the parent zafirlukast. *P. gingivalis* is a major oral pathogen involved in periodontal disease, which affects nearly half of the adult population. The novel zafirlukast derivative better maintains the oral microbiome than traditional treatments. The combined global markets for oral care, toothpaste and mouthwash are \$54 billion with an average growth rate of 5.5% annually.  
**License:** N/A

- 11. U.S. Patent Application Number:** 18/147,838  
**UKRFID:** 2279  
**Filed:** December 29, 2022  
**Title:** CONCRETE REPAIR COATING  
**Inventors:** Thomas Robl, Robert Jewell, Anne Oberlink and Tristana Duvalliet (Center for Applied Energy Research)  
**Description and Application:** The invention relates to an innovative concrete repair coating with unique and beneficial qualities. The inventive concrete repair coating has both a calcium sulfoaluminate cement and a Portland cement, wherein the aggregate component includes coarse aggregates between 62.5 and 500 microns in diameter and fine aggregates between 62.5 to less than 5 microns in diameter. The global concrete market is expected to reach \$972 billion by 2030.  
**License:** N/A
  
- 12. U.S. Patent Application Number:** 18/003,802  
**UKRFID:** 2453  
**Filed:** December 29, 2022  
**Title:** METHOD OF FUSING A TIBIOTALAR JOINT AND FUSED TIBIOTALAR JOINT  
**Inventors:** Arun Aneja, Arjun Srinath, Eric Abbenhaus (College of Medicine) and Lorenzo Deveza (Baylor College of Medicine)  
**Description and Application:** The invention is a method to fuse a tibiotalar joint of a patient with an intramedullary device while leaving adjacent talocalcaneal or subtalar joint intact. The method includes placing an intramedullary nail through a talus and into a tibia of the patient without violating a posterior facet of the adjacent subtalar joint and fixing the intramedullary nail to the talus and the tibia. The incidence of geriatric ankle fractures is increasing with the aging population, and currently there is no consensus on the optimal management of these fractures. Current treatment methods of open reduction are invasive and require prolonged periods of immobilization. A tibiotalar nail would allow for fracture stabilization and immediate weight-bearing. The global market for foot and ankle devices is \$1.6 billion with a CAGR of 8%.  
**License:** N/A

- 13. International Application Number:** PCT/US2022/80339  
**UKRFID:** 2627  
**Filed:** November 22, 2022  
**Title:** NOVEL PIEZOELECTRIC TRANSITION METAL HALOMETALLATES  
**Inventors:** Aron Huckaba, Michael Wells and Jacob Hempel (College of Arts and Sciences)  
**Description and Application:** The invention is new organic-inorganic halometallates that function as piezoelectric materials. These new materials are effective in single-crystalline and porous composite films. Piezoelectric materials are used as sensors and energy harvesters where strain, force or pressure are converted into electric charge. The piezoelectric market is projected to reach \$40 billion by 2027.  
**License:** N/A
- 14. International Application Number:** PCT/US2022/52038  
**UKRFID:** 2592  
**Filed:** December 6, 2022  
**Title:** DIAMINOBUOTOXY-SUBSTITUTED ISOFLAVONOIDS AS MITOCHONDRIAL COMPLEX I INHIBITORS FOR CANCER TREATMENT  
**Inventors:** Chunming Liu, Peter Spielmann (College of Medicine), David Watt (formerly College of Medicine) and Xifu Liu (Hebei Normal University)  
**Description and Application:** This invention is a novel compound to treat colorectal cancer by administering diaminobutoxy-substituted isoflavonoids. The diaminobutoxy-substituted isoflavonoids treat cancer by acting as mitochondrial complex I inhibitors. The global market for colorectal cancer treatment is expected to reach \$18 billion by 2027.  
**License:** N/A

Patent Activities  
Fiscal Year to Date as of December 2022

<b>Total FY2022-23</b>					
	FY23Q1	FY23Q2	FY23Q3	FY23Q4	Total FY23
Invention Disclosures <sup>i</sup>	23	34	0	0	57
Full Patent Applications <sup>ii</sup>	23	14	0	0	37
Provisional Patent Applications <sup>iii</sup>	23	20	0	0	43
Patents Issued	8	6	0	0	14
License Income	\$317,370.67	\$172,263.56	\$0	\$0	\$489,634.23
New Licenses and Options Executed	7	4	0	0	11
New UK Startups Formed	3	0	0	0	3

Patent Activities  
FY2021-22 as of June 30, 2022

<b>Total FY2021-22</b>					
	FY22Q1	FY22Q2	FY22Q3	FY22Q4	Total FY22
Invention Disclosures	13	20	25	33	91
Full Patent Applications	24	20	19	12	75
Provisional Patent Applications	18	21	13	16	68
Patents Issued	9	12	5	6	32
License Income	\$925,684.76	\$73,397.91	\$204,789.15	\$91,141.99	\$1,295,013.81
New Licenses and Options Executed	8	2	10	10	30
New UK Startups Formed	0	1	2	1	4

Patent Application Summary Table

Inventors	College(s)	Title	Brief description
<b>Biomedical</b>			
Jon Thorson, Jurgen Rohr, Khaled Shaaban, Joseph Eckenrode, Yang Liu, Markos Leggas, Jianjun Zhang and Yinan Zhang	College of Pharmacy	Aureloic acid derivatives and methods of use thereof	A treatment for cancer using derivates of mithramycin.
Keith Pennypacker, Justin Fraser and Qiang Cheng	College of Medicine	Machine learning determines plasma proteins as predictors of clinical outcomes and identifying drug targets in ischemic stroke patients	A novel method to identify risk factors of cerebral edema and severe infarct volume in a stroke patient.
Arun Aneja, Gavin Hautala, Arjun Srinath and Lorenzo Deveza	College of Medicine	Subtalar arthrodesis nail implant system	A subtalar nail implant system allowing immediate weight-bearing.

<b>Inventors</b>	<b>College(s)</b>	<b>Title</b>	<b>Brief description</b>
Sylvie Garneau-Tsodikova and Octavio Gonzalez	College of Pharmacy	Antimicrobial compounds, compositions, and methods	A novel zafirlukast derivative that can be used as an antimicrobial agent to target <i>P. gingivalis</i> .
Arun Aneja, Arjun Srinath, Eric Abbenhaus and Lorenzo Deveza	College of Medicine	Method of fusing a tibiotalar joint and fused tibiotalar joint	A method for fusing a tibiotalar joint of a patient with an intramedullary device while leaving adjacent talocalcaneal or subtalar joint intact.
Chunming Liu, Peter Spielmann, David Watt and Xifu Liu	College of Medicine	Diaminobutoxy-substituted isoflavonoids as mitochondrial complex I inhibitors for cancer treatment	A novel compound to treat colorectal cancer by administering diaminobutoxy-substituted isoflavonoids.
<b>Engineering</b>			
Thomas Dziubla, Arif Khan, Patrick Sullivan, Alexander Rabchevsky, Samirkumar Patel and Jason DeRouchy	College of Engineering	Bioerodible life support hydrogels for the delivery of viable mitochondria	A novel method of treating injury by providing healthy mitochondria at the site of the injury.

Inventors	College(s)	Title	Brief description
Fanny Chapelin, Roberto Gedaly, Francesc Marti and Aman Khurana	College of Engineering	Cell sorting microbeads as alternative agent for magnetic resonance imaging	A novel method for tracking and locating cells in the human body.
Kunlei Liu, Jonathan Pelgen, Zhen Fan and Bradley Irvin	CAER, College of Engineering	Automated CO <sub>2</sub> capture process control system with solvent property prediction	An automated system for CO <sub>2</sub> capture.
Matthew Weisenberger and John Craddock	CAER	Method of making polyacrylonitrile based carbon fibers and polyacrylonitrile based carbon fiber fabric	A method of producing low thermal conductivity carbon fiber.

<b>Inventors</b>	<b>College(s)</b>	<b>Title</b>	<b>Brief description</b>
Dibakar Bhattacharyya, Thomas Dziubla, Jeffrey Hastings, Matthew Bernard, Rollie Mills, Yinan Wei, Jacob Concolino and RJ Vogler	College of Engineering	Breathable microporous polymeric membrane	An antiviral mask or filter with a microporous membrane.
Thomas Robl, Robert Jewell, Anne Oberlink and Tristana Duvallet	CAER	Concrete repair coating	A concrete repair coating with unique and beneficial qualities.
<b>Inventors</b>	<b>College(s)</b>	<b>Title</b>	<b>Brief description</b>
<b>Arts and Sciences</b>			
Ambrose Sungseok Seo	College of Arts and Sciences	Transparent antiviral and antimicrobial coating	A novel antiviral and antimicrobial coating for electronic devices.
Aron Huckaba, Michael Wells and Jacob Hempel	College of Arts and Sciences	Novel piezoelectric transition metal halometallates	Novel organic-inorganic halometallates that function as piezoelectric materials.

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<sup>i</sup> Invention disclosures include new technologies and intellectual property disclosed to the Office of Technology Commercialization (OTC) that do not fall under an existing technology number. This number captures the potential new intellectual property disclosed to OTC.

<sup>ii</sup> Full patent applications, as used by OTC, include nonprovisional patent application filings at the United States Patent and Trademark Office (USPTO), Patent Cooperation Treaty filings, and foreign patent application filings. These are technologies that are assigned to the University of Kentucky that OTC has identified to invest further into in an effort to obtain patent protection and are described in more detail in the patent assignment section above.

<sup>iii</sup> Provisional patent applications are legal documents filed at the USPTO that establish a filing date and protect the owner from anticipated publication of the technology, but do not mature into an issued patent unless the applicant files a full patent application within one year. Although owned by the University of Kentucky, the provisional patent applications are not included in the patent assignment descriptions as they will not mature into full patent applications without further action and investment.