

FCR 11

Office of the President
June 19, 2020

Members, Board of Trustees:

PATENT ASSIGNMENT REPORT

Recommendation: that the Board of Trustees accept the patent assignment report for the period January 1, 2020 to March 31, 2020.

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.

Action taken: Approved Disapproved Other _____

PATENT ASSIGNMENTS
FOR THE PERIOD January 1, 2020 TO March 31, 2020

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 Serial Number:** 16/629,340
UKRFID: 2156
Filed: January 8, 2020
Title: LOUPE-BASED INTRAOPERATIVE FLUORESCENCE IMAGING DEVICE FOR THE GUIDANCE OF TUMOR RESECTION
Inventors: Guoqiang Yu, Chong Huang, Nick McGregor, (College of Engineering) Thomas Pittman (College of Medicine)
Description and Application: The invention is a hands-free, wearable, magnifying eye-loupe-based imaging device, which uses fluorescence imaging to identify tumor margins. This invention provides superior fluorescence excitation, specificity, and economy. The technology has the potential to be used in surgical settings beyond tumor resection surgeries. Approximately 700,000 people in the United States are currently living with a brain tumor. Brain tumor patients have the highest per-patient initial cost of care for any cancer group, with an annualized mean net cost of care well over \$100,000.
License: Exclusive option with Bioptics Technology LLC in negotiations.
- 2. U.S. Patent Application Serial Number:** 16/739,821
UKRFID: 1835
Filed: January 10, 2020
Title: PROTECTION OF CELLS FROM DEGENERATION AND TREATMENT OF GEOGRAPHIC ATROPHY
Inventors: Jayakrishna Ambati (formerly College of Medicine)
Description and Application: The invention is a treatment for age-related macular degeneration (AMD). AMD is characterized in the degeneration of the retinal pigmented epithelium (RPE). The invention includes a method of protecting a cell by inhibiting one or more of P2X7, IRAK1, and/or IRAK4. The cell being protected can be an RPE cell, a retinal photoreceptor or a choroidal cell. The global AMD market is expected to attain a value of \$8.9 billion by 2022. Surging geriatric population, growing pipeline of AMD therapeutics, increasing prevalence of chronic diseases, and rising healthcare expenditure are prominent drivers.
License: Exclusive license with Inflammasome Therapeutics, Inc.
- 3. U.S. Patent Application Serial Number:** 16/750,612
UKRFID: 1879
Filed: January 23, 2020
Title: METHODS OF ADMINISTERING IgG1 ANTIBODIES AND METHODS OF SUPPRESSING ANGIOGENESIS
Inventors: Jayakrishna Ambati, Sandro DeFlaco (formerly College of Medicine)

Description and Application: The invention suppresses excessive angiogenesis using intravenous human immunoglobulin (IVIG) and IgG1 antibodies. Excessive angiogenesis has been reported in diseases such as growth and metastasis of malignant tumors, age-related macular degeneration (AMD), rheumatoid arthritis, diabetic retinopathy, psoriasis, and chronic inflammation. The global AMD market is expected to attain a value of \$8.9 billion by 2022. Surging geriatric population, growing pipeline of AMD therapeutics, increasing prevalence of chronic diseases, and rising healthcare expenditure are prominent drivers.

License: N/A

4. U.S. Patent Application Serial Number: 16/751,191

UKRFID: 2266

Filed: January 24, 2020

Title: REG3A AND REG FAMILY MEMBER BIOMARKERS AND METHODS FOR DIAGNOSIS AND TREATMENT OF CANCER

Inventors: Sabine Brouxhon, Ronald Bruntz (College of Medicine), Melvyn Yeoh, Matthew Hoover (College of Dentistry), Stephanos Kyrkanides (formerly College of Dentistry)

Description and Application: The invention is a cancer treatment with human antibodies targeting regenerating islet-derived protein 3 alpha (Reg3A). Administration of human antibodies against Reg3A decreases viability of some cancer cells in culture, and that coadministration of anti-Reg3A antibodies with gemcitabine (a common chemotherapeutic agent) decreases pancreatic cancer cell line growth past that of gemcitabine alone. The National Cancer Institute estimates 1,735,350 new cancer cases and 609,640 deaths in the United States in 2018.

License: N/A

5. U.S. Patent Application Serial Number: 16/773,081

UKRFID: 2348

Filed: January 27, 2020

Title: APPARATUS AND METHOD FOR POWER GENERATION AND VALUABLE ELEMENT RECOVERY FROM COMBUSTION BY-PRODUCTS

Inventors: Rick Honaker, Joshua Werner (College of Engineering), Wencai Zhang (formerly College of Engineering)

Description and Application: The invention is an apparatus that allows for efficient energy production from the combustion of coal-based materials while also allowing for enhanced recovery of rare earth metals from the combustion by-products. The apparatus allows for the production and recovery to occur at a single facility. Rare earth metals are crucial to various modern technologies, including clean energy, consumer electronics, computers and networks, advanced transportation, communications, healthcare, environmental mitigation, and national defense. The global rare earth metals market is likely to experience notable growth in the future, owing to the increasing demand and escalating adoption of rare earth metals in the magnet industry. The global rare earth metals market is expected to be approximately \$14.43 billion by 2025.

License: N/A

- 6. U.S. Patent Application Serial Number:** 16/798,007
UKRFID: 2300
Filed: February 21, 2020
Title: HIGH SPEED MULTI-AXIS MACHINE TOOL
Inventors: Julius Schoop (College of Engineering)
Description and Application: The invention is an improved multi-axis shaper for planning of curved features into a workpiece at high peak cutting forces. This invention would improve machining capabilities for complex aerospace components that require high tolerances. The machining market is currently approximately \$341.91 billion globally and is expected to grow at a rate of 6 percent until 2022. The precision machining market holds a market size of 70 percent and is expected to increase.
License: N/A
- 7. U.S. Patent Application Serial Number:** 16/806,326
UKRFID: 2257
Filed: March 2, 2020
Title: METHOD OF MAKING POLYACRYLONITRILE BASED CARBON FIBERS AND POLYACRYLONITRILE BASED CARBON FIBER FABRIC
Inventors: Matthew Weisenberger, 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 percent until 2022.
License: N/A
- 8. U.S. Patent Application Serial Number:** 16/825,281
UKRFID: 2332
Filed: March 20, 2020
Title: ALGAE CULTIVATION MEDIUM AND METHOD OF INCREASING CARBON SHUTTTLING IN AN ALGAE CULTIVATION MEDIUM
Inventors: Jesse Thompson, Michael Wilson, Mark Crocker, Moushumi Sarma, Kunlei Liu (Center for Applied Energy Research), Leland Widger (formerly Center for Applied Energy Research)
Description and Application: The invention relates to a system for increasing CO₂ uptake in algae-containing media. The system uses amine solvents commonly used to convert CO₂ to bicarbonate. The bicarbonate can then more easily be shuttled into the algae-containing media through a designed complex that mimics the mechanism of the carbonic anhydrase enzyme found in human lungs. As a result of the equilibrium between bicarbonate and CO₂, the bicarbonate will increase the concentration of CO₂ in the media. The biomimetic complex has been shown to be stable at operating conditions (high temperature, flue gas contaminants) that would otherwise not be favorable for carbonic anhydrase. The market

for algae products is currently \$3.98 billion globally and is expected to grow at 5 percent per year until 2023. The market for carbon capture is currently approximately \$4.25 billion and is expected to grow by 13 percent until 2021.

License: N/A

- 9. U.S. Patent Application Serial Number:** 16/827,270
UKRFID: 2324
Filed: March 23, 2020
Title: GENE SILENCING KILLS EMERALD ASH BORER, AN EXOTIC, INVASIVE TREE-KILLING INSECT
Inventors: Lynne Rieske-Kinney (College of Agriculture, Food and Environment), Thais Rodrigues (formerly College of Agriculture, Food and Environment)
Description and Application: This invention relates to the use of gene silencing to cause mortality of emerald ash borer (EAB) adults and larvae. Ingestion of double-stranded ribonucleic acid (dsRNA) can silence genes in emerald ash borer, leading to insect death. Eleven dsRNA were found to increase beetle mortality by more than 50 percent due to target gene silencing. When EAB-specific dsRNAs were tested in non-target organisms, there was no detectable effect. The EAB is a highly invasive species of beetle discovered in North America in 2002; currently, it is found in 35 U.S. states and 5 Canadian provinces. Due to its prolific ability to infest and kill ash trees, the invasive beetle is estimated to have caused \$10 billion in damage in North America by 2019. The market for pest management globally is approximately \$91.8 billion and it expected to increase by 5 percent per year until 2025.
License: N/A
- 10. U.S. Patent Application Serial Number:** 16/832,157
UKRFID: 2347
Filed: March 27, 2020
Title: METHOD FOR RECOVERING VALUABLE ELEMENTS FROM PRE-COMBUSTION COAL-BASED MATERIALS
Inventors: Rick Honaker (College of Engineering), Wencai Zhang (formerly College of Engineering)
Description and Application: This invention is a method for recovering valuable rare earth metals from pre-combustion coal-based materials. The process includes grinding the pre-combustion coal-based material, roasting the ground pre-combustion coal-based material, submerging the roasted ground pre-combustion coal-based material in a solution of lixiviant, and then filtering and recovering the rare earth metals. Rare earth metals are crucial to various modern technologies, including clean energy, consumer electronics, computers and networks, advanced transportation, communications, healthcare, environmental mitigation, and national defense. The global rare earth metals market is likely to experience notable growth in the future, owing to the increasing demand and escalating adoption of rare earth metals in the magnet industry. The global rare earth metals market is expected to be approximately \$14.43 billion by 2025.
License: N/A

- 11. International Application Number:** PCT/US2020/18431
UKRFID: 2349
Filed: February 14, 2020
Title: N-ARYL BENZENESULFONAMIDES FOR USE IN TREATING CANCERS, BACTERIAL DISEASES, METABOLIC DISEASES, AND TRAUMATIC BRAIN INJURY
Inventors: David Watt, Roberto Gedaly, Brett Spear, Chunming Liu, Francesc Marti, Patrick Sullivan, Wen Zhang (College of Medicine), Yang Yang-Hartwich (Yale University College of Medicine)
Description and Application: The invention is a cancer treatment using N-aryl benzenesulfonamides. Specifically, the use of N-aryl benzenesulfonamides has been shown effective in mouse models of hepatocellular carcinoma and *in vitro* efficacy against traumatic brain injury, bacterial infections, and metabolic syndrome. N-aryl benzenesulfonamides have lower toxicity and are cheaper to produce than other treatments. The markets for this treatment are a combined \$290 billion globally and are expected to increase by low single digits until 2024.
License: N/A
- 12. U.S. Patent Application Serial Number:** 16/834,764
UKRFID: 2355
Filed: March 30, 2020
Title: LIPOSOMAL COMPOUNDS AND METHODS OF USE THEREOF
Inventors: Vincent Venditto, Ahmed Abdel-Latif, Ahmed Al-Darraj, Dave Feola (College of Pharmacy), Ahmed Abdel-Latif, John Gensel (College of Medicine)
Description and Application: The invention relates to a drug formulation of liposomal azithromycin that has anti-inflammatory properties capable of decreasing death associated with traumatic inflammatory conditions such as heart attacks, spinal cord injury, and lung infections. The liposomal azithromycin avoids the cardiac toxicity typically associated with azithromycin. This formulation has applications in many different markets totaling approximately \$122 billion with average growth potential.
License: N/A
- 13. U.S Patent Application Serial Number:** 16/824,451
UKRFID: 2357
Filed: March 19, 2020
Title: AN IMMOBILIZED MULTI-ENZYMATIC HALOGENATION SYSTEM
Inventors: Sylvie Garneau-Tsodikova, Oleg Tsodikov, Shogo Mori (College of Pharmacy), Michael Burkart, James La Clair (University of California San Diego)
Description and Application: The invention relates to a multi-enzymatic halogenation system. Halogenation is a chemical modification that is required to increase the bioavailability and specificity of new small molecule drugs. The inventive system includes an agarose scaffold system containing immobilized halogenases, which can be used to add halogen atoms to hard-to-reach areas on small molecules targets. The use of specific halogenases allows the system to be compatible with a broad range of substrates, including approximately one-third of all currently prescribed drugs. In addition, this invention system is reusable and could assist with lead optimization during small molecule drug discovery. The global market for organic chemical manufacturing is \$145 billion. In addition, lead

optimization is the most lucrative component of small molecule discovery, which is an ideal application of this invention.

License: N/A

Patent Activities
Fiscal year to date as of March 31, 2020

	Q1FY20	Q2FY20	Q3FY20	Q4FY20	Total FY20
Full Patent Applications	11	16	13		40
Provisional Patent Applications	28	14	25		67
Patents Issued	7	11	7		25
License Income	\$1,365,221.64	\$66,754.90	\$1,478,971.84		\$2,910,948.38 ¹
	FY19Q1	FY19Q2	FY19Q3	FY19Q4	FY19Total
Full Patent Applications	7	7	7	7	28
Provisional Patent Applications	10	16	10	30	66
Patents Issued	2	6	7	11	26
License Income	\$1,176,827.69	\$75,162.99	\$1,149,705.55	-\$74,643.49	\$2,327,052.74

¹ Financial data retrieved April 6, 2020

Patent Application Summary Table

Inventors	College(s)	Title	Brief description
Biomedical			
Guoqiang Yu, Thomas Pittman, Chong Huang, Nick McGregor	Engineering, Medicine	Loupe-based intraoperative fluorescence imaging device for the guidance of tumor resection	An eye-loupe-based imaging device, using fluorescence imaging to identify tumor margins.
Jayakrishna Ambati	Medicine	Protection of cells from degeneration and treatment of geographic atrophy	Treatment for age- related macular degeneration.
Jayakrishna Ambati, Sandro De Flaco	Medicine	Methods of administering IgG1 antibodies and methods of suppressing angiogenesis	The suppression of excessive angiogenesis using intravenous human immunoglobulin and IgG1 antibodies.
Sabine Brouxhon, Stephanos Kyrkanides, Melvyn Yeoh, Ronald Bruntz, Matthew Hoover	Medicine, Dentistry	Reg3A and Reg family member biomarkers and methods for diagnosis and treatment of cancer	The treatment of cancer with human antibodies targeting regenerating islet- derived protein 3 alpha.
David Watt, Roberto Gedaly, Brett Spear, Yang Yang- Hartwich, Chunming Liu, Francesc Marti, Patrick Sullivan, Wen Zhang	Medicine	N-aryl benzenesulfonamides for use in treating cancers, bacterial diseases, metabolic diseases, and traumatic brain injury	The treatment of cancer and other diseases using N-aryl benzenesulfonamides.
Vincent Venditto, Ahmed Abdel-Latif, Ahmed Al-Darraji, Dave Feola, John Gensel	Medicine, Pharmacy	Liposomal compounds and methods of use thereof	A drug formulation of liposomal azithromycin with anti-inflammatory properties capable of decreasing death associated with traumatic inflammatory conditions such as heart attacks, spinal

			cord injury, and lung infections.
Sylvie Garneau-Tsodikova, Oleg Tsodikov, Shogo Mori, Michael Burkart, James La Clair	Pharmacy	An immobilized multi-enzymatic halogenation system	A multi-enzymatic halogenation system.
Engineering			
Rick Honaker, Joshua Werner, Wencai Zhang	Engineering	Apparatus and method for power generation and valuable element recovery from combustion by-products	An apparatus that allows for efficient energy production from the combustion of coal-based materials while also allowing enhanced recovery of rare earth metals from the combustion by-products.
Julius Schoop	Engineering	High speed multi-axis machine tool	An improved multi-axis shaper for planning of curved features at high peak cutting forces, useful in aerospace applications.
Matthew Weisenberger, 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 and fabric.
Jesse Thompson, Leland Widger, Michael Wilson, Mark Crocker, Moushumi Sarma, Kunlei Liu	CAER	Algae cultivation medium and method of increasing carbon shuttling in an algae cultivation medium	A system for increasing CO ₂ uptake in algae-containing media.

Rick Honaker, Wencai Zhang	Engineering	Method for recovering valuable elements from pre-combustion coal-based materials.	A method for recovering valuable rare earth metals from pre-combustion coal-based materials.
Agriculture, Food and Environment			
Lynne Rieske-Kinney, Thais Rodrigues	Agriculture, Food and Environment	Gene silencing kills emerald ash borer, an exotic, invasive tree-killing insect	The use of gene silencing to kill emerald ash borer (EAB) adults and larvae.