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R&D Council Recognizes 2017 Edison Patent Award Winners and Special Individual Honorees

Individual Awards for Inventor of Hepatitis C Cure Dr. Mike Sofia, Former Merck CEO Dr. Roy Vagelos and Bedtime Math Founder and OFF Chair Laura Overdeck

Chatham, N.J., November 2, 2017: The Research & Development Council of New Jersey ("Council") is proud to honor 14 winners of the 2017 Edison Patent Awards. These winners will be honored tonight at the 38th Edison Patent Awards Ceremony & Reception at the Liberty Science Center in Jersey City.

Avaya, BASF, Ethicon, ExxonMobil, Honeywell, Lexicon Pharmaceuticals, Merck, NJIT, Nokia Bell Labs, Princeton Plasma Physics Laboratory, Princeton University, Rutgers University, Siemens and Stevens Institute of Technology will be awarded for innovative patent work spanning 13 R&D categories, including: biomaterials, biomedical, energy, environmental, imaging systems, industrial process, information technology, instrumentation, materials, medical, pharmaceutical, technology transfer and telecommunications.

For nearly four decades, the Council has placed a call for nominations for its Edison Patent Award. The Council then assembles a committee of top state researchers across STEM (science, technology, engineering and math) disciplines who review the nominations and judge them based on four criteria: the significance of the problem researched, novelty and utility of the patent, and the patent's commercial impact. Those with the highest scores are declared winners and join the ranks of the hundreds of amazing researchers who are Edison Patent Award alumni. Recognizing that New Jersey is home to some of the most cutting-edge patent work dating back to the 1800s, the Council developed this award to memorialize its most prolific inventor, Thomas Alva Edison, and to highlight the Garden State's continuous pipeline of exceptional innovation work.

"The Council's Board is honored to recognize our peers and their employees for their hard work, perseverance, and achievement in innovation," said Adeana R. Bishop, Ph.D., Research & Development Council of New Jersey Chair and ExxonMobil Research and Development Support Services Manager. "With the establishment of the Edison Patent Award by the Council nearly forty years ago, we have made a permanent commitment to highlighting the incredibly innovative and diverse patent work in the state—a pipeline that dates back to Thomas Edison."

The R&D Council will also honor the inventor of Solvaldi, a cure for Hepatitis C, Dr. Michael Sofia; former Merck CEO and Regeneron Board Chair, Dr. P. Roy Vagelos; and Bedtime Math Foundation Founder and Overdeck Family Foundation Chair, Laura Overdeck, for their unique contributions to research and development, to growth in business initiative and STEM education.

Dr. Michael Sofia will receive the R&D Council's highest award, the Science & Technology Medal. This medal is awarded to individuals who have made significant contributions to the advancement of science and technology, while successfully bringing innovation from the laboratory to the marketplace. A recent winner of the Lasker Award, Dr. Sofia led the research team that developed sofosbuvir, brand name Sovaldi, the drug used to cure hepatitis C infection. At the time of the invention, Dr. Sofia was Vice President of Chemistry with Pharmasset in Princeton, NJ. He currently is Chief Scientific Officer at Arbutus Biopharma Inc.

Dr. Vagelos will receive the Chairman's Award. Dr. Vagelos is retired Chairman and CEO of Merck and Chairman of the Board at Regeneron. He is receiving this award for his pharmaceutical leadership at Merck and Regeneron and for supporting New Jersey's higher education system via his service on the Rutgers Board of Governors, his leadership on the Vagelos Commission and his financial contribution to the Rutgers Future Scholars Program.

Bedtime Math Foundation Founder and Chair of the Overdeck Family Foundation (OFF) Laura Overdeck will be honored as Educator of the Year. Through her work at Bedtime Math Foundation, Laura has developed nightly math problems for kids to do online, a math app, written four books, and came up with Crazy 8s, a lively hands-on after-school math club for elementary students. The Overdeck Family Foundation supports math and science education reform throughout the United States, focusing on new school models, new teacher training models, informal STEM learning programs, and early childhood programming.

"These individuals have made tremendous commitments to leadership in STEM" said Council President Anthony Cicatiello. "The commitments of these individuals have impacted millions of people—people's health, people's education, and people's employment. But for the work and vision of these individuals, life would not hold the same hope for all of us. We have so much to thank them for and are truly humbled to honor them with these awards."

The 38th Edison Patent Award Ceremony & Reception will take place on the evening of November 2, 2017, at the Liberty Science Center. Before 200 guests, our winners will be honored with an original film, followed by a celebratory dinner. For more information visit www.rdnj.org or call 973.274.8336.

As the Research & Development Council of New Jersey, we collaborate among industry, academia and government to grow and strengthen STEM in education, innovation and the economy. The R&D Council is a nonprofit 501(c)(3) organization whose membership includes representatives from academia, government and industry, including several Fortune 500 companies. More information can be found at the R&D Council's website: www.rdnj.org.

Growing STEM. Advancing Innovation. Impacting the World.

2017 Edison Patent Award Winning Patents and Inventors

Avaya and inventors Al Baker, Mehmet Balasaygun, Frank Boyle, Gordon Brunson, Benjamin Jenkins, Pamela Lauber, and Thomas Petsche will receive a patent award in the **information technology** category for "Simultaneous active registration in a SIP survivable network configuration" (U.S. 8,107,361). This patent increases the resiliency of the enterprise communications systems by enabling Avaya's communications devices (e.g. Voice-over-Internet-Protocol phone endpoints) with the ability to receive services from multiple servers. By allowing endpoints to register with multiple servers, the reliability of the communication systems is increased because the loss of one server does not result in the loss of communication service to the phone. This allows critical communication services to survive the loss of a server, data center, or a portion of the public internet due to, for example, storms or terrorist attacks.

BASF and inventors Robert McGuire, Jr., Gary M. Smith, and Bilge Yilmaz will receive a patent award in the **environmental** category for "Boron oxide in FCC processes" (U.S. 9,441,167B2). BASF inventors developed a novel step-change technology that solves the problem of nickel contamination in Fluid Catalytic Cracking Units which produce oil refining products. Nickel deposits on the catalyst and renders it less efficient by catalyzing unwanted reactions. BASF inventors used a boron compound to tie up nickel which resulted in the production of less hydrogen and coke, and an increase in valuable product yields. Technology based on this patent—known as BoroCat™—launched in 2015 and has been commercially successful in over ten refineries globally to date.

Ethicon, a Johnson & Johnson Company, and inventors Howard Scalzo, Jerome A. Fischer, Stephen Rothenburger, Robert Cerwin, and James R. McDivitt will receive the patent award in the **medical** category for "Method of Preparing an Antimicrobial Packaged Medical Device" (U.S. 8,668,867). This patent relates to a novel revolutionary method to impart antibacterial properties on a wide range of implantable medical devices, but was specifically commercialized with surgical suture products. Post-operative or surgical site infections ("SSIs") occur in approximately two to three percent of all cases. This amounts to more than 1.5 million SSIs each year in the United States alone. Globally this total is substantially higher. Through this invention, a medical device within a final sealed package is "automatically" coated by a thin layer of a sublimated antimicrobial agent applied via vapor transfer of the agent from within the package and onto the medical device, rendering the medical device with antibacterial properties. Two associated trademarks with this patent include: MONOCRYL™ Plus Antibacterial (poliglecaprone 25) Suture and PDS™ Plus Antibacterial (polydioxanone) Suture.

ExxonMobil Research and Engineering Company and inventors John Di-Yi Ou, April Ross, Doron Levin, Mohan Kalyanaraman, and Wenyih Frank Lai will receive a patent award in the **industrial process** category for "Xylene Isomerization Process and Catalyst Therefor" (U.S. 8,697,929). This patent describes a novel catalytic process for the production of paraxylene. Paraxylene is a major building block in the chemical industry and is primarily used as a basic raw material in the manufacturing process of polyesters which are used to produce fibers and films that find applications in fabrics for apparel and home furnishings, including bottles that are widely used as a glass replacement for water and carbonated beverages since they are light weight, shatter-resistant and have good barrier properties. Global paraxylene demand in 2014 was ~36.8 million tons and demand is growing at rates greater than GDP growth rates. As the middle class expands, so will demand for products that enable a longer, healthier and better life such as products derived from the polyester chain which in turn will drive the market for paraxylene. This invention converts one of the major processing steps in the production of paraxylene from a vapor phase operation, requiring multiple phase changes, to a liquid phase operation, requiring no phase changes. The elimination of phase changes results in significant energy reduction in the production of paraxylene. This invention was enabled by the discovery and development of a novel, high activity catalyst allowing the desired chemistry to take place at a lower

temperature in the liquid phase. It has been commercialized by ExxonMobil and is also available through licensing to third parties. This novel technology provides direct significant economic benefit to the user as well as environmental benefits through reduced energy consumption, reduced furnace firings and a lower CO_2 footprint.

Honeywell and inventors Scott Martin Hacker, Ph.D, Yonghong Ruan, Ph.D., and Paul Chi Lem will receive a patent award in the **materials** category for "Asphalt Binder Composition and Methods to Make and Use Same" (U.S. Patent 9,267,038). Conventional asphalt materials suffer from various types of distress modes due to exposure to environmental conditions, such as permanent deformation, creep and rutting at high temperatures, and brittleness and cracking at low temperatures. The invention relates to the use of novel polymer additives to significantly improve the performance of asphalt binders used in road pavements and roofing and broadening their Useful Temperature Interval (UTI). The novel polymer additives when blended with asphalt binder compositions result in an improvement in permanent deformation, creep, and rutting behavior at high temperatures and reduction in brittleness and cracking at low temperatures. This invention has resulted in tremendous costs savings to road owners (state or local municipality or property owner), pavement contractors, and important environmental benefits including reduction in fuel costs and VOC/CO2 emissions. The trademark name associated with this patent is Honeywell Titan®.

Lexicon Pharmaceuticals and inventors Bryce A. Harrison, S. David Kimball, Ross Mabon, David B. Rawlins, and Nicole C. Goodwin will receive a patent award in the **pharmaceutical** category for "Inhibitors of Sodium Glucose Co-transporter 2 and methods of their use" (U.S. 7,781,577). This patent describes a diabetes treatment using the synthesis and utility of novel L-xylose derivatives as dual inhibitors of both the SGLT1 and SGLT2 glucose transporters. The glucose transporter SGLT2 is primarily responsible for the reabsorption of glucose in the kidney and several selective inhibitors of this transporter are available to patients for the treatment of Type 2 diabetes. These inhibitors reduce blood glucose levels by causing excretion of glucose into urine. A second glucose transporter SGLT1 is present in the GI system and is responsible for glucose absorption in the intestine. Based on studies with knock-out mice lacking either the SGLT1 or SGLT2 glucose transporters or both, Lexicon hypothesized that dual inhibitors of SGLT1 and SGLT2 would provide better glucose control in diabetics via the dual action of both reducing glucose uptake by the intestine and by causing excretion of glucose into urine. The lead compound selected from this patent, Sotagliflozin, is in Phase 3 clinical studies for type 1 and type 2 diabetes. Sotagliflozin with its second mechanism of inhibition of SGLT1 in the intestine has been shown to work well in diabetics with lower kidney function, broadening the range of diabetics that can be successfully treated. Global pharmaceutical company, Sanofi, has taken a worldwide license for Sotagliflozin, and will continue to work with Lexicon as this treatment comes to market.

Merck and inventors Wensheng Yu, Ling Tong, Joseph A. Kozlowski, Oleg B. Selyutin, Lei Chen, Jae-Hun Kim, Deyou Sha, Razia K. Rizvi, and Banderpalle B. Shankar will receive a patent award in the **pharmaceutical** category for "Heterocycle-substituted Tetracyclic Compounds and Methods of Use Thereof for Treatment of Viral Diseases" (US 9,555,038). US 9,555,038 discloses MK-8408, a novel NS5A inhibitor that is currently in Phase 2 clinical trials for the treatment of Hepatitis C Virus (HCV). The diversity of genomes present within HCV virus provides a significant challenge in developing an effective treatment. Over time it became appreciated that the diversity of HCV infection might best be addressed through administration of a combination of direct-acting antiviral agents (DAAs), each targeting a distinct step, or mechanism critical in the life cycle of the virus. From this strategy, three major categories of drugs have found utility in the clinic including NS3/4A protease inhibitors, NS5A replication complex inhibitors and NS5B polymerase nucleotide and non-nucleotide inhibitors. MK-8408, a novel NS5A inhibitor, is unique in that it has a "flat" profile with respect to genotype-(GT) 1 resistance-associated substitutions (RASs). The term "flat" describes such a pan-genotype inhibitor with a minimal potency loss (~10-fold) between the

wild-type virus and clinically relevant polymorphisms. Its excellent potency and overall pharmacokinetic properties translate to a once-daily dosing of 60-180 mg, for use in combination with other DAAs. MK-8408 has already demonstrated significant lowering of viral levels in patients infected with HCV from genotype 1 and other genotypes. The trade name associated with this patent is Ruzavir.

NJIT and inventors Treena Arinzeh, Ph.D., Yee-Shuan Lee, Ph.D., and George Collins, Ph.D. will receive a patent award in the **biomedical** category for "Method for nerve growth and repair using a piezoelectric scaffold" (U.S. 9,334,476). The best hope for complete or nearly complete recovery from a spinal cord injury is to coax the damaged nerves to regrow. This patent describes a novel combination strategy wherein the piezoelectric scaffold is combined with neural cells to regenerate nerve tissue in spinal cord injuries. The piezoelectric material is a smart material where electrical activity can be generated due to minute deformations in the material which can result from cell attachment, migration and/or physiological movement. The advantage is that electrical stimulation can be provided in this material without the use of an external energy source or electrodes and can be fabricated into a fibrous form which can provide additional contact guidance for cell attachment and axonal growth. Moreover, the scaffold can support neural cell growth and attachment, which can promote axon regrowth and achieve integration with the host synaptic pathways. This technology is highly innovative by combining smart biomaterials with tissue engineering approaches utilizing neural cells.

Nokia Bell Labs and inventors Peter Winzer and Alan Gnauck will receive a patent award in the **telecommunications** category for "Receiver Algorithms for Coherent Detection of Polarization-Multiplexed Optical Signals "(U.S. 8,526,831). This patent extended Nokia Bell Lab's predecessor Alcatel-Lucent's capabilities in coherent communications technologies to 16-QAM, which is the basis of the first commercial products generating more than 100 Gb/s per wavelength channel. Signaling rates in optical fiber communication systems reached 40 Gb/s by the mid-2000s. All systems over the previous years used binary signaling, meaning each transmitted "symbol" (e.g. a pulse of laser light) represented one bit of information. It became clear that by around 2010 that signaling rates would need to be extended to beyond 100 Gb/s per wavelength. The solution to this problem would be to introduce more complex signaling formats to coherent systems, such as quadrature amplitude modulation (QAM). Such modulation formats transmit multiple bits of information per symbol and consequently can transmit more information without the need for increasing the underlying signaling rates. However, receiving and "interpreting" higher-order modulation formats introduced many unsolved problems, including correctly determining the phases of the various symbols and untangling the two polarizations that are inherently mixed while propagating in the fiber. This patent addresses and solves such problems with digital signal processing (DSP) algorithms, in particular for the complex 16-QAM format. The 16-QAM format has been adopted across the telecommunications industry today. The trade name for this technology is Nokia PSE 400G (2013) and PSE2s (2016).

Princeton Plasma Physics Laboratory and inventors Manfred Bitter, Kenneth Hill, and Philip Efthimion will receive a patent award in the **imaging systems** category for "Objective for EUV Microscopy, EUV Lithography, and X-Ray Imaging" (U.S. 9,329,487). This patent is for a 2-D X-ray imaging apparatus for extreme ultraviolet (EUV) spectroscopy, EUV microscopy, EUV lithography and X-ray imaging. This system consists of two concentric spherical reflectors, which in the case of X-rays are spherically bent crystals. Its important new feature is that the Bragg condition − a necessary condition for the reflection of X-rays with short wavelengths in the range of 1.0 to 1.5 nanometers − is simultaneously fulfilled at every point on the two crystal surfaces. This new imaging apparatus could also be equipped with multilayer structures rather than crystals to be applied to EUV lithography at longer wavelengths in the range from 10 to 15 nm, which is presently being developed for the manufacturing of the next-generation integrated circuits. With prior technology, a computer chip must be printed by multiple scanning of an EUV beam since the Bragg condition is satisfied only locally over a small area of the two reflectors. With this invention, it may now be possible to print a whole computer chip at once.

Princeton University and inventors Craig Arnold, Euan Mcleod, Alexandre Mermillod-Blondin and Christian Theriault will receive a patent award in the **technology transfer** category for "Tunable Acoustic Gradient Index of Refraction Lens and System" (U.S. 8,194,307). This patent represents the first time that sound has been used to make a controllable lens for imaging and materials processing applications. Instead of relying on a physical change of a surface or interface to redirect light, this patent uses sound to travel through a material, causing small, coordinated density fluctuations which lead to a well-defined index of refraction that can be easily controlled by the user to produce the desired optical effect. Princeton University has licensed this patent and corresponding family of patents to TAG Optics Inc., a New Jersey start-up that commercialized this technology under the trade name "TAG Lens". The patented TAG Lens works by using a piezoelectric material to generate sound in a liquid resulting in an index of refraction profile that creates a simple lens element. This versatile device is the world's fastest variable focus lens with the ability to scan over a complete range of focal lengths in only microseconds. The TAG Lens has been transforming the field of biological imaging for health and medical applications; it also is creating a large impact in the industrial inspection, manufacturing and machine vision markets.

Rutgers, The State University of New Jersey and inventors Joachim Kohn, Durgadas Bolikal, Don K. Brandom, Lioubov Kabalnova, and Ernest G. Baluca will receive a patent award in the **biomaterials** category for "Biocompatible Polymers for Medical Devices" (U.S. 8,252,887). This invention provides the materials foundation for the development of the world's first fully resorbable and X-ray visible stent. Coronary stents are one of the most widely used medical implants. Currently most stents are made of metal and are easily detectable by X-ray imaging. X-ray visibility is critical since the clinician must be able to see the position of the stent within the body of the patient. The key purpose of the stent is to keep the blood vessel open after angioplasty. Most recent clinical studies have shown that the danger of blood vessel closure (re-stenosis) diminishes over time and in principle, after several months, the stent is no longer needed. In fact, the permanent presence of a non-degradable metal stent can become a significant long-term risk factor for the patient. This patent covers the polymer that enabled the development of the world's first X-ray visible polymer stent by REVA Medical, Inc

Siemens and inventors Dr. Upul P. DeSilva and Dr. Heiko Claussen will receive a patent award in the **energy** category for "Active Measurement of Gas Flow Velocity or Simultaneous Measurement of Velocity and Temperature, Including in Gas Turbine Combustors" (U.S. Patent 9,556,791). This invention uses an active acoustic method to measure temperature and velocity at any part of the gas turbine combustor. Several dozens of time-frequency controlled acoustic signals are continually transmitted and received across the extremely hot gas flowing at significantly high velocities which is the measurement volume. Time of flight information of these acoustic waves is used to infer speed of sound locally and the dependency of speed of sound on temperature is used to obtain temperature values and then tomographically visualized into a 3D temperature map. As for the velocity, each vector is decomposed into three dimensions and velocity maps in each plane and are visualized using similar tomographic techniques. These temperature and velocity maps are continuously obtained several times a second thereby providing the ability to use this invention in controlling the combustion process of the gas turbine engine to optimize it to be most efficient and lower the pollutant gaseous emissions such as Nitrogen Oxides (NO_x).

Stevens Institute of Technology and inventors Zhihua Yang and Athula Buddhagosha Attygalle will receive a patent award in the **instrumentation** category for "Analyte Ionization by Charge Exchange for Sample Analysis Under Ambient Conditions" (U.S. Patent 8,664,000). To carry out mass spectrometric analysis gaseous ions must be generated. There are many ways to generate gaseous ions for mass spectrometry. In some of these methods, gaseous ions are generated by chemical ionization under atmospheric conditions by exposing volatilized samples to an electrical discharge. The high voltage required to generate a discharge can

be lowered if the source is engulfed with helium. Gaseous ions are generated when molecules are exposed to the plasma of helium generated in this way. Stevens' invention, which they call Helium-Plasma Ionization (HePI), reduces the consumption of helium for plasma generation by 50 to 100 times without compromising the efficiency of ion generation. This method is more economical and environmentally friendly because it significantly reduces the consumption the very limited resource of helium. Moreover, the HePI source can be miniaturized and has the potential of being incorporating into portable mass spectrometers. When installed in mass spectrometry, it provides a very sensitive method of detecting specific compounds in samples without the need for extensive sample preparation.