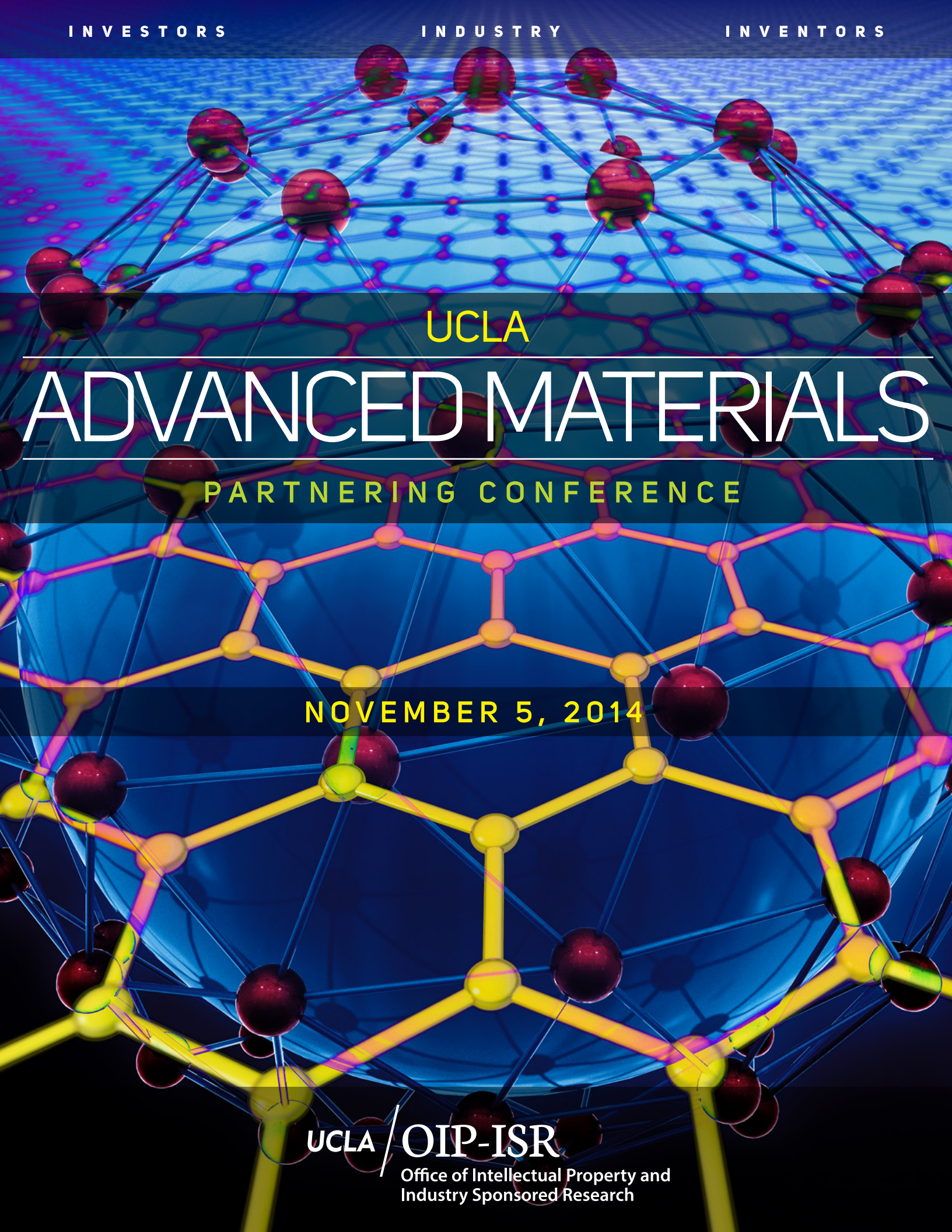
INVESTORS INDUSTRY INVENTORS



UCLA

ADVANCED MATERIALS

PARTNERING CONFERENCE

NOVEMBER 5, 2014

UCLA / OIP-ISR

Office of Intellectual Property and
Industry Sponsored Research

It is with great pleasure that I welcome you to UCLA's Advanced Materials Partnering Conference, which aims to explore challenges and opportunities in the world of advanced materials, including novel polymers, coatings, conductors, and nanomaterials. We have a diverse group of attendees, including representatives from the United States Environmental Protection Agency, public and private companies developing and using advanced materials, leading venture capital firms, and academic research institutions.

Southern California is internationally recognized as an innovation hub, where novel technologies are developed and deployed to address unmet needs on both a local and global scale. UCLA is not alone in its research capabilities in the advanced materials arena and, consequently, we have partnered with local academic institutions for this meeting to highlight the breadth of available technologies across the region. Researchers at UCLA are currently developing and employing novel materials to address a variety of problems, including those outlined in the first of UCLA's Grand Challenge Initiatives, titled "Thriving in a Hotter Los Angeles". Examples of such UCLA advanced materials technologies range from thermoelectric materials for more efficient energy management to novel membranes that will provide affordable, potable water in environments where clean water is expensive and scarce.

We anticipate this conference will provide the opportunity for fruitful conversations between individuals from the commercial sector, government, and inventors from UCLA and our partner institutions. Furthermore, we expect this event will continue to develop and grow as a powerful forum for fostering partnering around advanced material technologies. Thank you for joining us today.

Sincerely,

Brendan Rauw
President and CEO, Westwood Technology Transfer
Associate Vice Chancellor and Executive Director of Entrepreneurship

CONFERENCE PROGRAM

9:15 AM	**REGISTRATION/NETWORKING**
10:00 AM	**WELCOME**
10:15 AM	**ADVANCED MATERIALS REGULATORY PANEL** PREPARING TO BRING NEW MATERIALS TO MARKET United States Environmental Protection Agency | California Environmental Protection Agency
11:15 AM	**INVESTOR PANEL** ADVANCED MATERIALS STARTUP FUNDING Phoenix Venture Partners | BASF Venture Capital America | Dow Chemical
12:15 PM	**LUNCH**
1:15 PM	**ADVANCES IN MATERIALS SAFETY TESTING** André Nel, Director, UC Center for Environmental Implications of Nanotechnology
2:00 PM	**NETWORKING**
2:30 PM	**STARTUP AND TECHNOLOGY PITCHES**
3:15 PM	**NETWORKING**
4:00 PM	**EVENT CLOSE**

NOTES:

CONTENTS

Maria J. Doa, Ph.D.

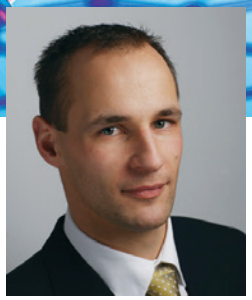
DIRECTOR, CHEMICAL CONTROL DIVISION, OFFICE OF CHEMICAL SAFETY AND POLLUTION PREVENTION UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Maria J. Doa, Ph.D. is the Director of the United States Environmental Protection Agency's Chemical Control Division in the Office of Chemical Safety and Pollution Prevention. She leads activities for the assessment and management of a wide range of industrial chemicals and nanoscale materials under the Toxic Substances Control Act. She was key to the development of ChemView which provides more streamlined access to information on chemicals, improving chemical safety. She is the United States lead for the Organization for Economic Cooperation and Development Working Party on Manufactured Nanomaterials. Previously, she led EPA programs to reduce risk to lead, PCBs, mercury and asbestos. She also led EPA's Toxics Release Inventory Program — a key community right-to-know program about toxic chemicals. She has a doctorate in organic chemistry.

Steve Hahn

SENIOR RESEARCH SCIENTIST, VENTURES AND BUSINESS DEVELOPMENT GROUP, DOW CHEMICAL

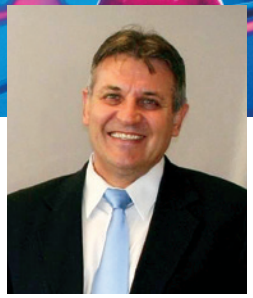
Steve Hahn is a Senior Research Scientist in the Ventures and Business Development organization at the Dow Chemical Company. His responsibilities include the identification of new science and technology opportunities that are consistent with Dow's strategic interests and developing Dow businesses around new emerging technologies. He has 26 years of industrial experience in corporate and business research functions and has developed and commercialized several new materials at Dow. Steve Hahn graduated from Michigan Tech with a B.S. in Chemistry and from Central Michigan University with a Masters in Chemistry. He is a member of the American Chemical Society and has published 35 articles in refereed journals 4 textbook chapters and 32 patents.



Dr. Björn Heinz

INVESTMENT MANAGER, BASF VENTURE CAPITAL AMERICA INC., CA, USA

Björn Heinz joined BASF Venture Capital in April 2013 and works as an Investment Manager in Fremont/ USA. He started his career at BASF 2009 in formulation research where he led projects on tertiary oil recovery. Later he worked on the development and build-up of a production plant for solar cell metallization products. Björn studied chemistry and received his PhD in physics at the Ludwig-Maximilians University in Munich.



Dr. André Nel

PROFESSOR OF MEDICINE AND CHIEF/FOUNDER OF THE DIVISION OF NANOMEDICINE AT UCLA DIRECTOR OF THE UC CENTER FOR THE ENVIRONMENTAL IMPLICATIONS OF NANOTECHNOLOGY (UC CEIN) & UCLA CENTER FOR NANO BIOLOGY

Dr. Nel obtained his medical and Doctorate of Medicine (M.D.) degrees at Stellenbosch University in Cape Town, South Africa, and did Clinical Immunology training with board certification in the U.S. Dr. Nel is peer-selected member of Best Doctors of America since 1998, and has been the recipient of the John Salvaggio Memorial Award recognizing his outstanding service to the specialty and science of Allergy and Immunology. He is a recipient of the Harry Truman Award from Sandia National laboratories, and on behalf of UC CEIN received the Governor's Economic and Environmental Leadership Award in California in 2013. He is serving as a panel member for the U.S. President's Council of Advisors for Science and Technology (PCAST) for the review on the National Nanotechnology initiative (NNI), and has represented the NIH and the NNI in cooperative research agreements with Japan, the Chinese Academy of Sciences and Russia. He is an Honorary Foreign Professor in the Chinese Academy of Sciences, and is Associate Editor of ACS Nano. Dr. Nel and his collaborators have developed several nanotechnology patents and he is an advisor to PCAST, industry, U.S. federal agencies and EU nanosafety centers.

Zach Jonasson, Ph.D.

GENERAL PARTNER, PHOENIX VENTURE PARTNERS

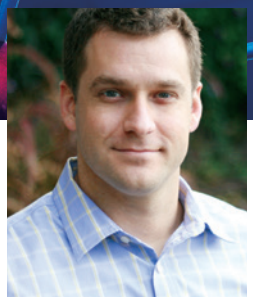
Dr. Jonasson is a Partner and co-founder of Phoenix Venture Partners (PVP). He brings over 25 years of experience in start-up investments and start-up executive, R&D, and business development operating roles. Previously, he was a General Partner and Kauffman Fellow at Seaflower Ventures, where he built a successful track record sourcing and leading investments in advanced materials start-ups focused on life science applications. Prior investments include Serenex (acquired), BioVlave, MetaWorks (acquired), where he played a successful turnaround role leading to the company's acquisition, and Valeritas, where he successfully reorganized the company around a $70 M series C round. He is the co-founder and CEO of ReForm Biologics, a company developing next generation formulations technologies for biotherapeutics. He is also the co-founder, and former VP Business Development, of Crop Enhancement, a start-up developing a chemistry platform for agrochemical formulation. Earlier in his career, while still a doctoral student, Dr. Jonasson was part of the initial five-person team at RCM (acquired), where he designed process optimization instrumentation for major chemicals and energy companies, including Eastman Chemical, Shell, and Sempra. Dr. Jonasson earned a BS from Georgetown University, where he was a Rhodes Scholarship Finalist, and an AM and PhD from Harvard University, where he was a Sackler Scholar.

Jeffrey Wong, Ph.D.

FORMER CHIEF SCIENTIST FOR THE CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL, CALIFORNIA EPA

Jeffrey Wong, Ph.D., has served in various positions for the California Department of Toxic Substances Control (DTSC) at the California Environmental Protection Agency including Chief Scientist, Acting Deputy Director for new Safer Products and Workplaces Program, Deputy Director for Science, Pollution Prevention, and Green Technology, Science Advisor to the Director and Chief Toxicologist.

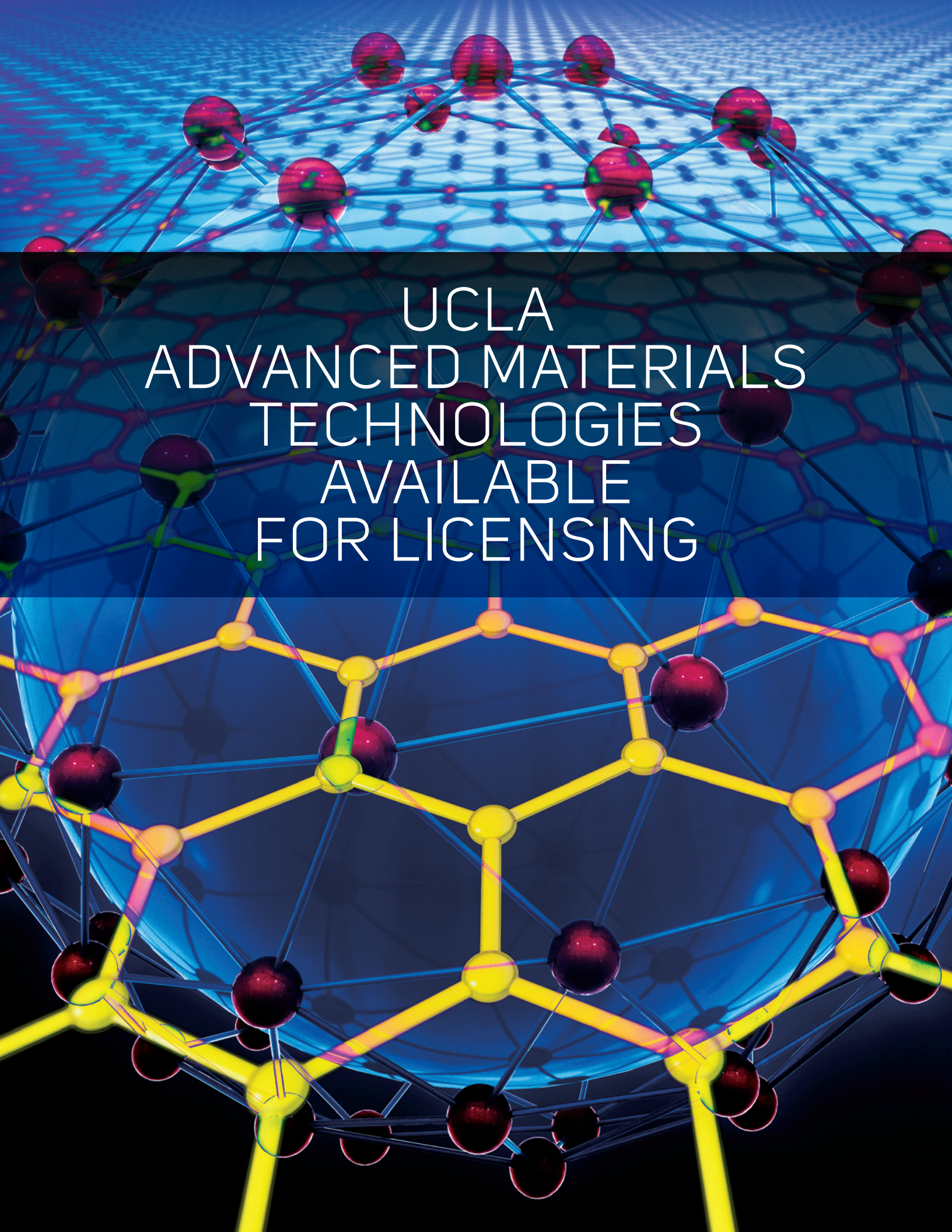
For more than 30 years, he has managed DTSC's efforts in the areas of environmental measurements, biological and exposure monitoring, toxicology and risk assessment, pollution prevention and technologies, nanomaterials and safer products. He advised executive management on matters of science and policy. Prior to this, Dr. Wong was involved in forensic investigations for law enforcement and later, pesticide regulation. Dr. Wong has served on study committees for the National Academy of Sciences, the US EPA, US DOD and US DOE. By appointment of President W. J. Clinton, Dr. Wong served on the US Nuclear Waste Technical Review Board. Dr. Wong did his graduate work at the University of California, Davis.



Miles Gerson (Moderator), JD, MBA

MANAGING OFFICER, BUSINESS DEVELOPMENT
UCLA OFFICE OF INTELLECTUAL PROPERTY & INDUSTRY SPONSORED RESEARCH

Miles Gerson joined UCLA's OIP-ISR in 2012 as the Managing Officer for Business Development. In this role, he serves as public representative for the Office, helping to promote UCLA intellectual property, identify potential industry sponsors, and expand licensing, spin-out & entrepreneurial activity at UCLA. Prior to UCLA, Miles helped to launch Surefire Medical Inc., a medical device company in Colorado, and served as an analyst for multiple investment firms including, High Country Venture, the CSU Management Fund, a venture fund for emerging research at Colorado State University, and Dag Dvergsten AS, a private equity/venture firm based in Oslo, Norway. Miles holds a JD/MBA from the University of Wisconsin, Madison, where he specialized in strategic management in life and engineering sciences, and worked with WARF to help guide the commercialization of academic research. Miles also holds a Bachelors and Masters degree in Neuroscience from Wesleyan University.



UCLA ADVANCED MATERIALS TECHNOLOGIES AVAILABLE FOR LICENSING

BIOMATERIALS

Graphene Based Catalysts for Biomimetic Generation of Antithrombotic Species

Professor Duan and colleagues have devised a graphene-based conjugate tandem catalyst that catalyzes the formation of nitric acid (HNO), a well-known reducer of blood clots, from internal glucose and the amino acid L-arginine. Nitric acid has been recognized as a potent antithrombotic agent but related materials suffer from a short life time. Successful design and utilization of HNO for biomedical applications remains challenging. UCLA researchers developed a graphene-hemin-glucose oxidase conjugate as a tandem catalyst. The graphene scaffolding successfully supports the glucose oxidase as it locally catalyzes the production of peroxide in the blood. Endogenous and readily abundant glucose and L-arginine produce HNO that acts to prevent blood clotting. The graphene conjugate tandem can be applied as a coating onto biomedical devices. Antithrombotic properties can be added onto catheters, vascular grafts, heart valves, and biosensors.

UCLA Case No. 2014-521

Lead Inventor: Xiangfeng Duan

Patent Status: Pending

Enantioseparation of Amino Acids Using a Chiral Recognition Polymer

Researchers at UCLA have developed a new chiral recognition polymer. It allows for direct separation of free amino acids, can be used as a chiral sensor, and can potentially be adapted for pharmaceutical separations. This new polymer strongly interacts with one enantiomeric form of an amino acid or component in a racemic mixture enabling chiral separations. An efficient way of employing the polymer to separate amino acid enantiomers is to use a column containing a high-surface-area of the polymer. Experimental data has shown a separation factor of alpha = 8.4 for dl-phenylalanine using a 250mm column, where alpha > 2 is considered to be potentially useful commercially.

UCLA Case No. 1998-601

Lead Inventor: Ric Kaner

Patent Status: Issued #6,265,615

Assessing the Toxic Potential of Materials at the Nanolevel

Professor Andre Nel and colleagues have developed a comprehensive and highly reliable safety-assessment platform that evaluates oxidative stress-based cellular injury responses to nanomaterials *in vitro*. The platform utilizes a tiered approach to evaluate nanomaterial hazard based on incremental levels of oxidative stress. There is now substantial scientific evidence linking the development of nanoparticle-induced reactive oxygen species, oxidative stress and inflammation in cells to disease pathogenesis *in vivo*. By implementing these standardized protocols, industries producing or utilizing nanomaterials that could lead to adverse health effects in humans and animals, can expeditiously assess the biological injury potential in a quantitative, uniform and predictive manner. Moreover, the use of these alternative test strategy protocols can easily be automated to provide high throughput screening, with the ability to process large batches of nanomaterials for hazard ranking and grouping that can be used as a substitute for animal studies in regulatory decision-making and safer design of nanomaterials.

UCLA Case No. 2006-276

Lead Inventor: Andre E. Nel

Patent Status Issued: #8,512,943

Engineering a Novel Aluminum-Based Immune Adjuvant by Designed Synthesis of AlOOH Nanoparticles

Drs. Andre Nel and Tian Xia have developed a more effective adjuvant through the designed synthesis of Aluminum oxyhydroxide (γ-AlOOH) nanoparticles with well-defined shape, crystallinity, and hydroxyl ligand content that significantly improves upon current Alum-based adjuvant materials. These γ-AlOOH nanorods demonstrate stronger adjuvant effects in animals, with enhanced humoral and cellular immune responses that are significantly higher than commercial Alum. In addition, the use of γ-AlOOH nanorods with well-defined physicochemical properties can lead to a better understanding of Alum immunostimulation effects, as well as the development of more effective vaccine adjuvants when combined with other stimulants. These materials will have broad application potential for the development of more effective vaccines than Alum to treat infectious diseases and cancer.

UCLA Case No. 2014-108

Lead Inventor: Andre E. Nel

Patent Status: Pending

Safer-by-Design Doped Pyrogenic Silica Nanoparticles

Professor Andre Nel and colleagues have identified pyrogenic (fumed) silica nanoparticles (NPs) as a potentially hazardous form of non-crystalline silica, and have developed safer-by-design strategies to enhance the biocompatibility of fumed silica. The team demonstrated that the high cytotoxic potential fumed silica is the result of formation of highly reactive surface silanols during high temperature flame spray pyrolysis. By doping the fumed silica during pyrogenic synthesis with small amounts of metal oxide dopants, the team has demonstrated a drastic reduction in the reactive surface silanol groups that contribute to oxygen radical production, decreased cell viability and pro-inflammatory responses (e.g., IL-1 production). In spite of the reduced surface reactivity, the safer designed fumed silica materials maintain most of their desirable material characteristics. These physicochemical attributes should enable the doped materials to be used as a safer alternative in many applications (e.g., fillers, thickeners, desiccants, abrasives, and anti-caking agents) by the tire, cosmetic, and food industries.

UCLA Case No. 2014-783

Lead Inventor: Andre E. Nel

Patent Status: Pending

Materials and Methods for Improving Bone-Titanium Integration of Dental Implants

Professor Takahiro Ogawa and colleagues have developed materials and simple methods to greatly improve the anchorage of dental implants, while also shortening the healing time. The main problem with currently available dental implants is the long three to six month healing time for the implant to assimilate to the bone during which the patient must wear a removable prostheses. This protracted healing time adds cost to the treatment and great inconvenience to the patient. These methods and materials are inexpensive, quick, safe and reliable and could be quickly applied to clinical practice making dental implant therapy a more accessible and appealing option to the general population.

UCLA Case No. 2005-307

Lead Inventor: Takahiro Ogawa

Patent Status — Notice of Allowance Received Published Application #20090283701

Bioactive Tissue Engineering Scaffolds

Professor Takahiro Ogawa and colleagues have developed a UV-activated titanium scaffold with a super hydrophilic surface. Through *in vitro* and *in vivo* tests, it has proven to have remarkably increased water and lipid infiltration capability, resulting in a considerable increase in cell attachment. It is known that cells to make soft and hard tissues act differently. The scaffold is shown to be effective to in both soft and hard tissue. Furthermore, *in vivo* experiments in the rat femur demonstrate its successful tissue generation ability as it enabled the formation of 2 mm bone tissue three weeks after implantation.

UCLA Case No. 2013-715

Lead Inventor: Takahiro Ogawa

Patent Status: Pending

A Fast-Setting Moisture-Tolerant Root Canal Retrofilling and Repair Material

Professor White and colleagues have developed a new endodontic root-end filling, repair, obturating, and pulp capping material. The filling material has none of the disadvantages of currently used materials, such as mineral trioxide aggregate (MTA) and resin-modified glass-ionomers. Yet, it boasts additional advantages such as moisture friendliness a quick light-cure command set, wide clinical application, and low cost. The technology has applications in dental offices as an alternative to existing materials for root end-filling during root canal surgery and other dental procedures.

UCLA Case No. 2013-309

Lead Inventor: Shane White

Patent Status: Pending

Bioactive Endovascular Coils

Professor Wu and colleagues have developed a detachable endovascular coil system with increased biological activity. These coil materials are inherently bioactive and can be further coated with, or act as a delivery vehicle for, bioactive or therapeutic agents, such as drugs to control the inflammatory reaction inside the aneurysm. The innovation maintains the mechanical flexibility of the coils, ensuring that they highly effective at preventing blood flow. These improvements will accelerate aneurysmal healing and minimize their rate of recurrence.

UCLA Case No. 2011-135

Lead Inventor: Benjamin Wu

Patent Status: Pending - Published Application #WO2013006298

Atomized Bioactive Spiral Coil Coating

Professor Wu and colleagues have developed a unique, detachable aneurysm coil system. Compared to previous methods, this technology possessing advantages included preserving mechanical flexibility, a polymer coating that promotes wound healing through intrinsic polymer properties, as well as providing a potential vehicle for drug delivery. The coil system can be applied to medical treatment of intracranial aneurysms.

UCLA Case No. 2012-874

Lead Inventor: Benjamin Wu

Patent Status: Pending - Published Application #2013047713

The Manufacturing of Dislocation-Free Strained Si Thin Films

Researchers at UCLA have developed a method to fabricate strained Si thin films without introducing dislocation. The method utilizes a bi-layer system that consists of a stressor layer attached to a thin silicon film. Dislocation is avoided by limiting the thickness of the Si layer to a critical value that depends on stressor material and strain level. Furthermore, the achievable strain level in silicon is controllable and can even be larger than that achievable in the stressor layer.

UCLA Case No. 2006-004

Lead Inventor: Ya-Hong Xie

Patent Status: Issued #7,754,008

Antimicrobial Activity of Core-Shell Structured Silver-Mesoporous Silica Nanoparticles

Recent efforts involving bactericides have been focused on ways to aid in the delivery of this material to sites that can benefit from its application. Incorporating antimicrobial materials into bandages for use in wound and burn treatment and into membranes for water purification are some of the attractive opportunities for these materials. Researchers at UCLA have identified a method for encapsulating antimicrobial nanoparticles inside of mesoporous silica particles, to allow for the controlled release of chemicals for antimicrobial applications. The robust mesoporous silica shell protects the core antimicrobial nanoparticles from aggregation and fast dissolution, and provides support for surface modification with functional groups.

UCLA Case No. 2009-002

Lead Inventor: Jeffrey Zink

Patent Status: Pending - Published Application #20120021034

CATALYSIS & SYNTHESIS METHODS

Size and Morphology Control of Nanocatalysts by Aromatic Compounds

Professor Huang and colleagues have synthesized platinum nano-tetrahedrons crystals using aromatic polyphenols as a growth surfactant. The performance of a catalyst can be greatly enhanced by reducing the dimensions of the catalytic material to increase its surface area. Nanocrystals are promising candidates for next generation catalysts but achieving uniform size remains a challenge. In this technology, UCLA researchers developed the use of aromatic polyphenols to grow uniformly dispersed 3-4 nm sized platinum tetrahedron crystals with improved catalytic performance. The method is solution based and offers potential industrial scaling. This catalytic technology can impact the fields of automotive, oil refining, and organic synthesis.

UCLA Case No. 2011-825

Lead Inventor: Yu Huang

Patent Status: Pending

Rapid Bulk Synthesis of Carbon Nanotubes and Graphite Encapsulated Metal Nanoparticles

Scientists at UCLA have developed a rapid method for the bulk synthesis of carbon nanotubes and graphite encapsulated metal nanoparticles. The technology represents a highly efficient, inexpensive, and readily scalable route to multi- and single-walled nanotubes and graphite encapsulated metal nanoparticles. The reactions use cheap precursors and require less-expensive equipment, compared to existing methods.

UCLA Case No. 1999-245

Lead Inventor: Ric Kaner

Patent Status: Issued #6,479,028

Rapid Solid-State Metathesis Routes to Nanostructured Silicon-Germanium

Researchers at UCLA and JPL have identified a method for producing unfunctionalized nanostructured silicon and silicon-germanium through a solid state metathesis reaction that is very efficient and inexpensive. The method does not require any expensive equipment and instead relies on favorable thermodynamics to drive the formation of the nanostructured materials. Overcoming the previous limitations of the manufacturing methods could lead to cost-effective utilization of these materials device applications focusing on energy storage and energy conversion.

UCLA Case No. 2010-656

Lead Inventor: Ric Kaner

Patent Status: Notice of Allowance Received Published Application #20110318250

Mechanochemical Synthesis of Mg_2Si and Related Compounds and Alloys

Professor Kaner and colleagues have developed methods to synthesize substantially phase pure compounds of magnesium silicide and related alloys. The phase purity achieved by this method is unprecedented, and the yielded products are suitable to be used as thermoelectric materials in the mid- to high- temperature range (400 K to 800 K).

UCLA Case No. 2011-721

Lead Inventor: Ric Kaner

Patent Status: Issued #8,591,758

A Method for Preparing Organically Soluble Monodisperse, Metal Particles of Catalytically Active and Non-Catalytically Active Materials

Professor Leff and colleagues have developed a method of preparing monodispersely sized particles of uniform shape with well-defined surface compositions. Organically-functionalized nanometer-scale particles of catalytically-active metals have extremely high surface areas (a large number of catalytically active sites per particle) and unique size-dependent chemical behavior, enabling their application in a variety of homogenous and heterogeneous catalytic processes, from petroleum cracking to polymer synthesis.

UCLA Case No. 1995-560

Lead Inventor: Daniel Leff

Patent Status: Issued #6,103,868

Making Nanostructured Porous Hollow Spheres with Tunable Structures

Professor Lu and colleagues have devised a rapid, aerosol-based production method for metal-carbon composite spherical particles with porous hollow interiors. Inorganic hollow nanostructures previously required complicated and cumbersome practices to prepare. In this technology, materials such as organic ligands are used as permanent or removable structural templates for to produce well-ordered, porous hollow metal-carbon spheres. This approach can be applied to each elemental metal synthesize composite particles with tunable morphologies. The technology has wide applications in catalysis, sensing, energy conversion and storage, and drug delivery.

UCLA Case No. 2011-800
Lead Inventor: Yunfeng Lu

Patent Status: Pending - Published Applications #20120001354 & #20120001357

A Fabrication Method of Topological Features of Graphene

Professor Xie and colleagues have devised a method to fabricate graphene topological features via conventional photolithography and etching. This technology enables the fabrication of extreme lightweight and low density materials. The technique is simple, conventional, and mature.

UCLA Case No. 2012-217

Lead Inventor: Ya-Hong Xie

Patent Status: Pending

High-throughput Solution Processing of Large Scale Graphene for Device Applications

Professor Yang and colleagues have developed a novel solution process for the large-scale production of single layered graphene. The resulting graphene sheets have the largest area yet reported by an order of magnitude, resulting in significantly easier processing. Field effect devices were also fabricated by conventional photolithography that displayed currents that were 3 orders of magnitude higher than any every observed for chemically produced graphene. This versatile technique reproducibly produces large graphene sheets, enabling a vast array of applications in electronics.

UCLA Case No. 2008-422

Lead Inventor: Yang Yang

Patent Status: Pending - Published Application #20100273060

COMPOSITES & ALLOYS

Reactive Element Doped Bond Coat Alloys (Ti & Zr Doping)

UCLA researchers have developed a method to increase the adhesion of thermal barrier coatings (TBC) to substrates. One current limitation of TBCs is spallation, in which the TBC peels off of the underlying substrate. By doping the bond coat with zirconium or titanium, the oxide layer adheres more strongly to the bond coat. This technology has applications anywhere turbines need to operate at high temperatures, such as power plants and jet engines, making them more powerful, efficient, and durable.

UCLA Case No. 2002-002

Lead Inventor: Emily Carter

Patent Status: Issued #7,504,355

Palladium Alloy Hydride Nanomaterials

Professor Duan and colleagues have devised a method for the synthesis of intermetallic palladium hydride alloy nanocrystals using a low-cost solution process that avoids the use of surfactants and strong reducing agents. Nanocrystalline intermetallics and alloys are novel materials with high surface areas which are potential low-cost and high-performance catalysts. In this technology, UCLA researchers developed a systematic approach to synthesize various palladium hydride alloys with nickel, cobalt, chromium, manganese, vanadium, and platinum. The approach is relatively low temperature, and avoids the use of harsh reducing agents or surfactants that may lead to a decrease in performance. These high surface area materials can be utilized as catalysts in petrochemical refining, exhaust gas treatment, or for organic synthesis reactions.

UCLA Case No. 2014-904

Lead Inventor: Xiangfeng Duan

Patent Status: Pending

Interconnected Networks of Graphene and Nano-Scale Materials

Professor Grüner and colleagues have developed methods of producing novel, interconnected networks of nano-scale carbons and new forms of high surface area materials with significant electrochemical activity. These new composites can be used as electrodes for energy storage devices, taking advantage of the high conductivity of and the high specific capacitance of the component materials, leading to energy storage with both high energy and power density.

UCLA Case No. 2011-099

Lead Inventor: George Grüner

Patent Status: Pending - Published Application #2012112818

Multifunctional Polymer Nanocomposite Preparation Methodologies

Professor Hahn and colleagues have identified methods for manufacturing multifunctional polymer nanocomposites containing various fillers, including metal and ceramic nanoparticles. The fabrication methods are versatile enough to produce both flexible and robust final products and work with thermoplastic and thermosetting polymer matrix materials. The keys to the method are monomer stabilization and solvent extraction, producing a final process that is efficient and environmentally friendly.

UCLA Case No. 2008-452

Lead Inventor: Hong (Thomas) Hahn

Patent Status: Issued - #8,372,908

Gallium Alloy Nanoparticle Synthesis via Self-Assembled Monolayer Formation and Ultrasound

James Hohman and colleagues have devised a facile route to synthesize designer gallium-based alloy microscale and nanoscale materials with precise elemental ratios and excellent uniformity. Alloy nanoparticle synthesis is typically very challenging and traditional synthetic approaches suffer from elemental incompatibility, the need to use costly vacuum technologies, and limitations of composition range and product uniformity. In this technology, UCLA researchers demonstrate directed particle formation by molecular self-assembly assisted by sonication. The method is solution based and avoids the use of costly vacuum deposition technology while giving gallium-based nanoparticles with excellent uniformity. The technology has wide applications for catalysts, solar cells, and semiconductor components such as high brightness LEDs for displays.

UCLA Case No. 2011-627

Lead Inventor: James Nathan Hohman

Patent Status: Pending - Published Application # 20130244037

Pothole Repair for Asphalt and Concrete Base Aggregates

Professor Ju and colleagues have developed a strong bonding polymer that offers a long-term solution to asphalt and cement pothole repair patching material. Because the new polymer has high fracture toughness and impact absorbing ability, it serves as a continuous structural cage material for holding aggregates together even when heavy traffic stresses are applied. Furthermore, due to its adjustable viscosity, the material provides penetration depth control for various applications.

UCLA Case No. 2009-731

Lead Inventor: Jiann-Wen (Woody) Ju

Patent Status: Pending - Published Applications #20140056643 & #20110293954

Thermoelectric Materials Based on Tetrahedrite Structure for Thermoelectric Devices

Professor Vidvuds Ozolins and colleagues have devised a new class of lightweight and low-cost compounds for thermoelectric devices. Traditionally, thermoelectric materials are comprised of elements that are toxic, and of low abundance. This technology utilizes earth-abundant, light atomic mass compounds with tetrahedrite structures to produce high-efficiency thermoelectrics via basic, scalable processing techniques. The technology has potential applications in numerous energy-related industries, including automotive and solar cells.

UCLA Case No. 2013-066
Lead Inventor: Vidvuds Ozolins

Patent Status: Pending - Published Application #WO2014008414

Bulk Polymer Composites

Professor Pei and colleagues have developed a method of synthesizing novel composite polymers suitable for detection of radiation, including beta rays, positrons, gamma rays, X-rays, and neutron particles. The all-organic matrix exhibits as much as 45,000/MeV light yield- more than 2 times that of the current champion organic scintillators, and a gamma (662 keV) photoelectric peak with 10% resolution in the composite scintillator. Moreover, the synthetic chemistry for their production utilizes inexpensive materials.

UCLA Case No. 2012-334

Lead Inventor: Qibing Pei

Patent Status: Pending

High Efficiency Organic Light Emitting Diodes

Professor Pei and colleagues have developed a novel approach to fabricating organic light emitting diodes (OLEDs) using transparent composite electrodes, that greatly increases their emission efficiency. The composite electrodes are thin, flexible, compatible with solution-based processing, and improve the light outcoupling efficiency. The new OLEDs are highly flexible and are at least twice as efficient as comparable OLEDs fabricated on ITO/glass. These new techniques can be used to more economically produce higher-efficiency OLEDs, which are becoming increasingly prevalent in solid state lighting, medical devices, smartphones, and other portable or wearable electronics.

UCLA Case No. 2013-001

Lead Inventor: Qibing Pei

Patent Status: Pending - Published Application #WO2014015284

Phase Change Materials in Concrete: Method for Enhancing the Thermal Damage Resistance of Structures

Professor Sant and colleagues have developed a method to enhance both the thermal damage resistance and energy efficiency of concrete structures by embedding phase change materials (PCM). By storing and releasing energy, PCMs limit thermal fluctuations, thereby reducing stress development and subsequent cracking. Moreover, minimizing thermal volatility can help promote energy conservation in building operations.

UCLA Case No. 2012-289

Lead Inventor: Gaurav Sant

Patent Status: Pending - Published Application #2013123428

Photoactivity and Ion-Exchange as New Routes to Corrosion Inhibition in Reinforced Concrete

Professor Sant and colleagues have developed a strategy to limit steel corrosion processes in concrete structures. This approach combines topical and integral methods of anatase deployment expected to be superior to current methods of steel corrosion inhibition, being both regenerative and tunable. By using an unprecedented combination of real and virtual experiments, this method represents a significant advance in the design and development of new infrastructure material systems.

UCLA Case No. 2012-702

Lead Inventor: Gaurav Sant

Patent Status: Pending - Published Application #2013169675

Methods to Control and Predict Cement Reaction Rates Using Tailored Limestone Powder Additions

Professor Sant and colleagues have developed an easy-to-use tool to predict and control the reaction rate of cement using tailored limestone replacements. By simply inputting desired material property parameters, the tool will perform calculations to provide appropriate mixture proportions needed to achieve said parameters. The tool can also recommend alternative mixtures of cement and limestone to yield the same material properties. By using this invention, concrete technologists can quickly assess process parameters needed to prepare a mixture that fits their desired material properties, without performing expensive and time-consuming experiments.

UCLA Case No. 2012-784

Lead Inventor: Gaurav Sant

Patent Status: Pending - Published Application #2013185019

Reactive Limestone as a Strategy Towards Sustainable, Low-Carbon Cements

Professor Gaurav Sant and colleagues have devised a low-carbon processing technique that uses limestone in the cement (binder) chemistry. As a precursor of concrete, cements are widely produced and used across the globe, with considerable energy consumption and environmental impact. This technology alters the sulfate/alumina balance in cement, incorporating limestone for a carboaluminate phase to provide strength and a structure in the overall cementitious system. The technology has potential applications in the sustainable concrete industry by substituting "pure-cement" concretes with high levels of ecologically benign, "natural-and-waste" construction materials.

UCLA Case No. 2013-080
Lead Inventor: Gaurav Sant

Patent Status: Pending Published Application #2014032018

Inorganic Admixtures for Preventing Conversion Phenomena in High-Alumina Cements

Professor Sant and colleagues have developed a method to prevent the strength loss caused by increased porosity seen in high alumina cement systems. The addition of inorganic admixtures serves to suppress hydrogarnet formation at the expense of more stable AFm phases. The result is high-alumina cement with increased volume stability and corrosion resistance.

UCLA Case No. 2013-634

Lead Inventor: Gaurav Sant

Patent Status: Pending

Multi-Dimensional Networks

Professor Yaghi and colleagues have designed and synthesized multi-dimensional networks, similar to porous networks materials of metal oxides or metal-organic frameworks (MOFs). Though several organometallic complexes have been proposed for the storage of gaseous carbon containing species, these complexes are unstable at moderate temperatures, difficult to synthesize, and have low storage capacity. In this technology, UCLA researchers have constructed networks with different properties that have wide applications in gas storage, chemical separation, and catalysis.

UCLA Case No. 2012-365

Lead Inventor: Omar Yaghi

Patent Status: Pending - Published Application #2011066648

Composite Films for Improved Stability in Electronics Devices

Professor Yang and colleagues have developed a composite of nanoparticles in a polymer matrix which serves as the transparent conductor and as a partial or complete encapsulation layer. This window is solution processable, which provides lower cost and decreased deposition-surface damage compared to vacuum deposition. The composite contains no pores or voids, which allows for use as an encapsulation layer to increase device stability. This technology can be applied to metal chalcogenide based and other thin film solar cells, transistors and storage.

UCLA Case No. 2012-481

Lead Inventor: Yang Yang

Patent Status: Pending

Robust and High Stability Solution Processed Silver Nanowire Composite as a Transparent Conductor

Professor Yang and colleagues have developed a silver nanowire composite coating as a transparent contact for thin film optoelectronics. The composite is fabricated using a sol-gel process, which is much less expensive than alternative vacuum deposition. Conductivity and optoelectrical properties of this composite are comparable to sputter-deposited ITO and ZnO, while maintaining high lifetimes. Applications include organic, quantum dot and thin film LEDs, phtovoltaics and transistors.

UCLA Case No. 2013-962

Lead Inventor: Yang Yang

Patent Status: Pending

FIBERS & CERAMICS

Enhanced Strength Carbon Nanotube Yarns

Professor Carlson and colleagues have developed a novel chemically functionalized carbon nanotube yarn. By infusing a resin having sub-nanometer rings, the inventors have created a new material capable of producing the world's strongest carbon fiber, well in excess of 7 GPa.

UCLA Case No. 2011-132

Lead Inventor: Larry Carlson

Patent Status: Issued - #8,470,946

Magneto-Optic Fiber Bragg Grating

The past decade has seen the development of optical fiber Bragg grating (FBG) sensors to measure physical quantities such as temperature, strain, and pressure. Current FBG-based methods detect external fields via strain, Faraday-effect materials, or ferrofluids. But, this additional step introduces extraneous thermal and mechanical influences. UCLA researchers have developed a method to couple multiferroic and optical behaviors in fiber Bragg gratings. By directly coupling the external field to the electromagnetic wave propagating in the FBG-containing fiber, the invention significantly improves on the current state of the art, offering greater sensitivity, compactness, and signal resolution. This technology has potential applications in a variety of industries, including homeland security, navigation, and mineral exploration.

UCLA Case No. 2012-060

Lead Inventor: Gregory Carman

Patent Status: Pending

Polyaniline Nanofibers

UCLA scientists have developed approaches to producing conductive polymer polyaniline nanofibers as well as chemical sensors made from such conductive polymer polyaniline nanofibers. This fundamental work has applications to electronic and optical applications, such as lightweight battery electrodes, electromagnetic shielding devices, anticorrosion coatings, and chemical sensors.

UCLA Case No. 2004-072

Lead Inventor: Ric Kaner

Patent Status: Issued #8,012,326

Polyaniline Nanofibers as Hydrogen Sensors

UCLA researchers have developed a method for sensing hydrogen using polyaniline nanofiber material. The approach utilizes detectable conductivity changes in the nanofiber material when exposed to hydrogen gas. This polyaniline sensor has advantages over traditional palladium-based sensors in that it its phase change for detection is reversible and its synthesis is inexpensive.

UCLA Case No. 2007-391

Lead Inventor: Ric Kaner

Patent Status: Pending - Published Application #20110300637

Polyaniline Nanofiber Composite Materials: New Chemical Sensors for Phosgene

UCLA scientists have developed a sensor with polyaniline polymers for the detection of phosgene ($COCl_2$), a colorless, highly toxic gas that has been used in chemical warfare as well as in industrial processes for polyurethanes. The approach provides a sensitive (ppb) method to detecting this highly poisonous gas.

UCLA Case No. 2008-717

Lead Inventor: Ric Kaner

Patent Status: Pending - Published Application #20100006334

Advanced Fiber-Metal Laminates with High Molecular Hybrid Prepregs for Aircraft Structures

Professor Yang and colleagues have developed a fiber-reinforced metal (FML) laminate using several optional fiber materials for different applications. The material's high tensile modulus and compressive strength compared to glass fiber FML, which prevents cracking of the aluminum sheet exhibited by the glass fiber FML. The high strength to weight ratio and good crack resistance allow for use in aircraft, automobiles and sports equipment.

UCLA Case No. 2008-209

Lead Inventor: Jenn-Ming Yang

Patent Status: Pending

CeramicAsh: Material and Method

Professor Yang and colleagues have developed a method to utilize the waste product fly ash to make CeramicAsh, a chemically bonded ceramic. Fabricated at room temperature, CeramicAsh exhibits high compression strength, fire resistance, and extremely low density. The inventors have demonstrated that the material's density, transparency, and pH can be tailored to produce specific solutions. Such versatility allows for myriad potential applications for this inexpensive yet robust new material.

UCLA Case No. 2012-114

Lead Inventor: Jenn-Ming Yang

Patent Status: Pending - Published Application #20130190165

New Lead- Boron-based Ceramics

Professor Yang and colleagues have developed a new fast-setting ceramic-cement material, fabricated with lead and boron compounds. In addition to shielding gamma rays and neutrons, these materials also effectively encapsulate radioactive nuclear and hazardous wastes. They also exhibit high temperature resistance and extraordinary compressive strength; one experimental composite recorded a mean value of 50 MPa, far exceeding the 3.45 MPa required for nuclear waste applications.

UCLA Case No. 2012-125

Lead Inventor: Jenn-Ming Yang

Patent Status: Pending - Published Application #WO2013130409

Calcium-Alumino Phosphate Cement Mechanically Stable for Temperatures up to 1000 °C

Professor Yang and colleagues have developed a chemically bonded ceramic with high thermal stability. The material does not show shrinkage or cracking after exposure to 1000 °C. Chemically bonded ceramics in general are useful for their sintered ceramic-like thermomechanical properties and cement-like ease of manufacture. However, many chemically bonded phosphate ceramics decompose at high temperatures. Applications include firewalls, furnaces, gaskets and tooling.

UCLA Case No. 2013-743

Lead Inventor: Jenn-Ming Yang

Patent Status: Pending

FILMS & ELECTRONICS

Electric Field Induced Tunable and Metastable Remanent Strain and Remanent Permittivity in Ferroelectrics

Current ferroelectric applications utilize linear ferroelectric properties from a polarized state, resulting in the piezoelectric strain and permittivity changing linearly with the applied electric field. However, when the electric field is removed the strains and permittivity values return to their initial state, causing issues in applications where long term changes are required or where power is a major issue. Researchers at UCLA have developed a novel method to control metastable remnant properties in ferroelectrics, specifically in (011) oriented relaxor ferroelectrics by applying a pulsed electric field in a specific regime resulting in permanent strain and permittivity changes (i.e. the strain and permittivity states remain after release of the electric field). Further, by applying pulsed electric fields of different amplitudes, the remenant properties can tuned within a wide range of values.

UCLA Case No. 2011-651

Lead Inventor: Gregory Carman

Patent Status: Pending - Published Application #20140042574

Electrically Reconfigurable Passive Magnetoelectric Microwave Devices

Professor Carman and colleagues have devised a novel kind of magnetoelectric microwave device that can be finely tuned without a continuous power-consuming electric field. The resulting microwave device is both reconfigurable and significantly more energy efficient than current magnetoelectric devices. Passive microwaves devices are integral components of circuits in radio frequency (RF) based wireless/mobile computing devices. This technology offers a novel low power permanent operation mode applicable to any generic RF device based on a ferroelectric/ferromagnetic construction. The technology has wide applications for portable devices, RF filters, spin wave switches, phase shifters, and inductors.

UCLA Case No. 2012-030

Lead Inventor: Gregory Carman

Patent Status: Pending

Controlled Nano-Doping of Copper Thin Films

As semiconductor feature sizes continue to shrink, interconnect current density increases leading to reduced reliability due to via void and hillock formation. The industry is currently ramping up its use of copper as an interconnect material due to its much greater electromigration resistance and conductivity relative to conventional aluminum. Professor Chang and colleagues have developed a method to grow a thin doped copper layer or alternating stacks of doped copper and undoped copper via atomic layer deposition (ALD) in high aspect ratio features and at low deposition temperatures. The copper dopant precursors can either be Ca, Mg or Zn halides or organometallics. ALD deposition is compatible with low-k dielectrics with typical processing temperatures of 350C or less.

UCLA Case No. 2003-317

Lead Inventor: Jane Chang

Patent Status: Issued #7,544,398

Atomic Layer Deposition of Alkali Metal Containing Solid Electrolyte for 3-D Micro-Batteries

Professor Chang and colleagues have utilized atomic layer deposition (ALD) to grow thin and uniform lithium ion conducting films for use in micro and nanoscale batteries. As the electronic industry shifts to micro and nano-scale devices, the need for miniaturized, on-device-operating batteries capable of delivering high energy and power density becomes crucial. Current miniaturized devices rely on two-dimensional batteries to meet the on-device-operation requirement, but these batteries inherently suffer from low energy density and life span because of non-uniform contact between electrodes and the liquid electrolyte used in this architecture. In this technology, UCLA researchers utilized a novel, thin and conformal solid state ionic conductor (SSIC) film to replace conventional liquid-based electrolytes in 3D microscale batteries thus achieving uniform coating between electrodes, higher conductivity, greater performance, and longer shelf life. The technology has wide applications for the automotive, consumer electronics, medical, and military industries.

UCLA Case No. 2011-706

Lead Inventor: Jane Chang

Patent Status: Pending Published Application #2014028853

Wafer-Scale Formation of Aligned Nanowires and Nanotubes

Professor Chui and colleagues have developed a method to form aligned nanowires (and/or nanotube arrays) through standard lithographic patterning techniques. The invention enables control over the nanowire (or nanotube) number, linewidth, and pitch, with no restriction on the substrate size and the material choice of nanowires (or nanotubes). Furthermore, since the technique requires a low-thermal budget, integration and fabrication of heterogeneous devices is feasible with minimal cross-contamination issues.

UCLA Case No. 2009-650

Lead Inventor: Chi On Chui

Patent Status: Pending

Physical Assembly Integration of Graphene and Dielectrics

Researchers at UCLA have developed a new graphene nanostructure via standard semiconductor processing methods. The new device, Graphene Nanomesh (GNM), is the first highly uniform, continuous graphene semiconducting thin film. When used as the semiconducting channel of FETs, the GNM based devices deliver large current, nearly 100 times greater than individual GNR devices. Additionally, the simple fabrication technique allows great versatility in controlling the electronic properties.

UCLA Case No. 2010-589

Lead Inventor: Xiangfeng Duan

Patent Status: Pending - Publication Application #20140077161

A Composite of Two Dimensional Material and One Dimensional Material as Transparent Conductor

Professor Duan and colleagues have synthesized a transparent conductor exhibiting low overall sheet resistance and uniform surface conductivity based on the combination of a network of 1D (such as silver nanowires) and 2D nanomaterials (such as graphene or indium tin oxide). Transparent conductors based on 1D networks of nanowires offer low sheet resistance but typically do not form continuous or uniformly conductive surfaces while 2D films based on graphene (both solution processed and chemical vapor deposition grown) offer uniform surfaces but unsatisfactory sheet resistance. In this technology, UCLA researchers developed a transparent conductor with excellent uniform surface conductivity, and low overall sheet resistance that can be readily coated onto a variety of rigid and flexible substrates such as glass and plastic. The technology has wide applications for touchscreens, thin film solar cells, and organic light emitting diodes (OLEDs).

UCLA Case No. 2012-213

Lead Inventor: Xiangfeng Duan

Patent Status: Pending

Conducting-Semiconducting Composite Films and Their Applications for High Performance Transistors

Professor Duan and colleagues have devised a conducting-semiconducting composite material for increasing the performance of nanofilm transistors without using sophisticated lithography. High performance electronic components such as transistors are crucial building blocks for many broad range consumer electronics such as integrated circuits. The speed of a transistor relies on both the mobility of a given material as well as the channel length--the distance between the source and drain electrode—of an integrated circuit. Recent developments in semi-conducting nanowire thin film transistors allows for the improvement of mobility, but reducing the channel length of these nanowire devices is costly and complicated. Researchers at UCLA decreased the effective channel length from microns to nanometers by utilizing a conducting-semiconducing ink to form thin film transistors. The conducting material acts as a short cut for the electrical current that flows between the source and drain electrodes. The method offers overall increased device performance, solution processing of a multitude of organic and inorganic semiconducting materials, and eliminates costly and complicated lithography steps to increase transistor performance. The technology has wide applications for consumer electronics and thin film displays.

UCLA Case No. 2012-298

Lead Inventor: Xiangfeng Duan

Patent Status: Pending

Chemical Vapor Deposition Growth of Large Single Crystalline Domains of Monolayer and Bilayer Graphene

Professor Duan and colleagues have devised a nucleation controlled chemical vapor deposition (CVD) process on copper foils to grow large and highly crystalline domains of single and bilayer graphene. Graphene is expected to make a large impact in the field of microelectronics owing to its remarkably high room temperature carrier mobility. However graphene transistors produced using CVD do not meet the predicted theoretical electronic properties due to the failure to grow single crystalline material. This method allows for the growth of monolayer crystals approaching millimeter lateral dimensions with highly uniform electronic properties closely approaching the theoretically predicted properties of graphene. The bilayer graphene grown via this method is also large, uniform and exhibits ordered AB-layered stacking. The technology has wide applications for consumer electronics and touch screen displays.

UCLA Case No. 2013-457

Lead Inventor: Xiangfeng Duan

Patent Status: Pending

Novel Composite Semiconductor Substrate for Thin-Film Device Transfer

Professor Goorsky and colleagues have identified a high quality composite semiconductor substrate for epitaxial deposition of electronic device layers that is also capable of transferring device layers from the composite substrate to another substrate of choice. This technique reduces costs associated with having to replace starting materials, and can also be extended to a variety of semiconductor material combinations to create transfer-ready semiconductor substrates. This transfer substrate and process will be useful for any thin film semiconductor device manufacturer.

UCLA Case No. 2008-550

Lead Inventor: Mark Goorsky

Patent Status: Issued #8,624,357

Fabrication of Gallium Nitride Substrate

Professor Goorsky and colleagues have created a practical, repeatable and large-scale production method for fabricating a freestanding gallium nitride (GaN) substrate. Group III-nitrides (e.g. GaN) and their alloys are essential semiconductor components of full-color spectrum high brightness LEDs, high frequency and high power electronic devices, photovoltaics and lasers. Manufacturing and processing of GaN semiconductors is a costly process due to the expense of the growth substrate. In this technology, UCLA researchers developed a repeatable GaN growth method that will lower overall manufacturing costs. Central to the method is the ability to deposit a porous sacrificial layer on top of a GaN doped sapphire substrate. The deposition offers full control of the layer separation by controlling the porosity of the sacrificial layer. Full growth of a GaN crystal is continued and the underlying sacrificial layer can be later removed with application of force. The resulting GaN crystal is available for use in the manufacturing of semiconductor devices such as high brightness LEDs and the growth substrate is available for repeated growth of GaN. The technology has wide applications for high power semiconductor components in energy transmission, solar cells, and consumer electronics.

UCLA Case No. 2012-548

Lead Inventor: Mark Goorsky

Patent Status: Pending

Charge Storage Device Containing Carbon Nanotube Films

Some charge storage devices such as supercapacitors and batteries require high surface area materials that form a double layer with an electrolyte. These materials, which serve as the electrode, can be carbonaceous materials such as carbon black or carbon nanotubes, but must also be interfaced with metal charge collectors, resulting in a multi-layer structure. There is a need for a charge storage device that is cheap, has appropriate performance and can be disposed without creating environmental hazards. The invention describes a device that uses carbon nanotubes as both the electrode and the charge collector. Carbon nanotubes films are characterized by not only low resistance, but also a high surface area of the film to come in intimate contact with either organic or aqueous electrolyte solutions.

UCLA Case No. 2007-520

Lead Inventor: George Grüner

Patent Status: Pending - Published Application #20100178543

Nanostructured Polymer Electrodes

Scientists from UCLA and Caltech have developed novel electrode structures for use in the storage of ions made with novel nanostructured polymer films. This technology takes advantage of a new class of nanofiber conjugate polymer materials to form amphoteric electrodes that demonstrate improved cycling properties and remarkable application flexibility.

UCLA Case No. 2010-480

Lead Inventor: Ric Kaner

Patent Status: Pending - Published Application #20110229759

Methods of Restoring and Maintaining Gas Film on Superhydrophobic Surfaces while Underwater

Researchers at UCLA have identified methods to re-establish a gas film on a structured hydrophobic surface underwater when the gas film is disrupted or depleted. The new methods immediately restore the gas film when a breakdown begins, thereby ensuring that a gas film is sustained for a sufficiently long time under various harsh conditions. This technology has potential applications in watercraft manufacturing, water sports (e.g. surfing, windsailing, waterskiing), and any physical device that functions in water. It reduces frictional drag, lowers fuel costs, and prevents solid surface damage.

UCLA Case No. 2011-040

Lead Inventor: C.J. Kim

Patent Status: Pending - Published Application #20130122195

Post-Process Tuning of Quality Factor in Microelectromechanical Resonators

Jonathan Lake and colleagues have devised a tunable stress layer to be applied to the backside of silicon sensors to improve the MEMS resonator performance. Small scale resonators have a major source of energy dissipation in their anchor points, and the surface acoustic waves generated from them. This technology tunes the quality factor instead of the frequency through a backside stress layer, which in simulation and experimention has verified its efficacy in improving resonator performances. The technology can benefit resonators for wide MEMS applications, including gyroscopes and time/mass sensing.

UCLA Case No. 2014-559

Lead Inventor: Jonathan Lake

Patent Status: Pending

Carbon Nanotube/V_2O_5 Composites for Supercapacitors

Professor Lu and colleagues have created a nanocomposite material that vastly improves the charge storage capability of the EC supercapacitors. The unique composite consists of vanadium pentaoxide nanowires (VNW) with varying amounts of carbon nanotube (CNT)-supported vanadium pentaoxides. This unique CNT-VNW structure achieves higher specific energy, higher specific power, and enhanced electrochemical capacitance for supercapacitor applications. Furthermore, the CNT-VNW composite structure imparts higher capacitance than either CNT or VNW alone.

UCLA Case No. 2009-058

Lead Inventor: Yunfeng Lu

Patent Status: Issued #8,427,813

Asymmetric Hybrid Supercapacitor Based on V_2O_5/CNT Nanocomposite

Yunfeng Lu and colleagues have devised a high-performance energy storage device based on vanadium oxide (V_2O_5) /carbon nanotube (CNT) nanocomposites that provides an asymmetric supercapacitor with a high energy and power density. Current supercapacitor designs are comprised of organic electrolyte or titanium oxide-based nanowires coupled with CNTs as electrodes. This technology utilizes cost-effective V_2O_5/CNT nanocomposites of a hierarchical fibrous structure as cathodes for asymmetric supercapacitors, leading to increased capacitance and conductivity of electrodes for high-performance devices. The technology has wide applications in heavy-duty facilities, electric vehicles, mobile electrical tools, and consumer electronics.

UCLA Case No. 2010-298
Lead Inventor: Yunfeng Lu

Patent Status: Pending - Published Application #20130170098

Hierarchically Porous Carbon Particles for Electrochemical Applications

Professor Yunfeng Lu and colleagues have developed a new electrode architecture which enables much higher energy densities. By creating a network of many different sizes of pores, the surface area is ~2500 m^2/g, compared to activated carbon's ~2000 m^2/g. Moreover, this arrangement increases the ion transport rate, allowing for high power density, and the graphitized carbon allows for excellent electrical conduction, further allowing for rapid discharging. Relevant electrochemical applications suited to this technology include supercapacitors, advanced water-splitting devices, and advanced battery electrodes.

UCLA Case No. 2012-419
Lead Inventor: Yunfeng Lu

Patent Status: Pending - Published Application #20120300364

Phase Transition in Ferroelectric Piezocrystals for Energy Harvesting

Professor Christopher Lynch and colleagues have developed an efficient energy harvesting apparatus based on a single crystal ferroelectric material to convert external changes in force and temperature to electrical energy. This technology utilizes the phase transitioning behavior of ferroelectric piezocrystals to achieve high energy density. The technology has various applications in sensing and transduction.

UCLA Case No. 2014-519
Lead Inventor: Christopher S. Lynch

Patent Status: Pending

Direct Conversion of Nanoscale Thermal Radiation to Electrical Energy Using Pyroelectric Materials

Professor Pilon and colleagues have developed a novel way to harvest waste heat by combining thermal radiation at the nanoscale with pyroelectric energy conversion. This could be used to recover energy from mobile electronic devices, increase efficiencies in power plants, or provide power to remote sensors, among many other applications.

UCLA Case No. 2010-532

Lead Inventor: Laurent Pilon

Patent Status: Pending - Published Application #20110298333

Methods of Generating High-Electron Beams in a Hybrid Laser-Plasma Accelerator

Professor James Rosenzweig and colleagues have devised a cost-effective method for generating high-quality electron beam in a compact plasma-based setup. Electron beams are a high resolution and efficient way to illuminate molecular structures and processes, but require expensive and large machines to produce. This technology enables the generation of high-quality electron beams with a ultrashort pulse length, width, divergence and emittance, using a hybrid laser-plasma accelerator. The technology has potential applications related to biology, medicine, and material sciences.

UCLA Case No. 2012-804
Lead Inventor: James Rosenzweig

Patent Status: Pending - Published Application #20140131594

Space Confined Polymer-Based Field Effect Transistors

Professor Tolbert and colleagues have developed a polymer field effect transistor (FET) which employs a silica space-confinement structure to allow high carrier mobility. Prototype devices have demonstrated carrier mobilities of 10 cm2/Vs due to the device's conduction along a polymer chain, rather than through an inter-chain network. Fabrication method can potentially be used to create transistors as narrow as 5 nm. This technology is well suited for applications in thin, flexible or low-cost devices, including displays, sensors, RFID and smart textiles.

UCLA Case No. 2012-027

Lead Inventor: Sarah Tolbert

Patent Status: Issued #7,888,170

VSAT Structure for Nonvolatile Memory Device

Provided are a semiconductor device and a method of fabricating the same. At least one mold structure defining at least one first opening is formed on a substrate, wherein the mold structure comprises first mold patterns and second mold patterns that are sequentially and alternatingly stacked. Thereafter, side surfaces of the first mold patterns are selectively etched to form undercut regions between the second mold patterns. Then, a semiconductor layer is formed to cover a surface of the mold structure where the undercut regions are formed, and gate patterns are formed, which fill respective undercut regions where the semiconductor layer is formed.

UCLA Case Nos. 2009-453, 2010-381

Lead Inventor: Kang Wang

Patent Statuses – Issued #8,664,707 and #8,164,134

Epitaxial Growth of Single Crystalline MgO on Germanium

Professor Wang and colleagues have demonstrated epitaxial growth of magnesium oxide on Germanium (Ge) with single crystalline order and atomically smooth morphology. One application of the MgO/Ge interface is use in a Ge-based Metal-oxide-semiconductor field-effect transistor (MOSFET) to amplify or switch electronic signals. Another application of this technology would utilize the ferromagnetic metal/MgO/Ge tunnel junction to realize efficient spin injection from ferromagnetic metals into Ge.

UCLA Case No. 2010-244

Lead Inventor: Kang Wang

Patent Statuses – Issued #8,766,341

Ordered and Self-Assembled MnXGe1-X Nanostructures by MBE

Researchers at UCLA have developed a novel growth method for secondary-phase free MnGe thin films. Molecular beam epitaxy (MBE) is used to alter the growth of MnGe and GE thin layers, resulting in a "superlattice" structure that successfully avoids the formation of secondary phases. In particular, the method enables the formation of ordered and self-assembled MnGe nanostructures, such as MnGe nanodots, nanocolumns, and wells. Furthermore, the proposed growth method can be applied to other ferromagnetic material to achieve similar magnetic nanostructures, leading to new spintronic devices.

UCLA Case No. 2009-721

Lead Inventor: Kang Wang

Patent Status: Pending

Spin Injector

Professor Xie and colleagues have conceived a fundamentally new approach for efficient spin injection that can inject charge carriers such that near 100% of the charge carriers are spin polarized. The approach is based on quantum mechanical effects and avoids the drawbacks and shortcomings associated with the low spin polaroization efficiency associated with diffusion-based current injection and the high series resistance associated with tunnel injection. The spin injector can enable viable spin FETs, which may potentially provide an alternative to Si CMOS electronics. This technology has broad applications across electronics development, including computer memory, data storage devices, spin FETs, and spintronics.

UCLA Case Nos. 2006-689, 2006-725

Lead Inventor: Ya-Hong Xie

Patent Statuses: Issued #8,233,315, #8,101,984, & #8,098,515

A Low Stress Group III-Nitride Composite Substrate Platform

Professor Xie and colleagues have developed a solution to severe wafer warpage and cracking of group III-nitride composite substrates in volume production. Many applications of group III-nitrides could benefit from low dislocation density. One of the approaches of achieving low dislocation density is to grow a thick (from 10-100 mm) group III-nitride buffer layer in which interactions between dislocations could result in orders of magnitude lower dislocation density. The downside of thick buffer layers is wafer warpage due mainly to thermal expansion coefficient mismatch between the epitaxial layer and the substrate. In this technology, UCLA researchers have developed an approach to circumvent the fundamental roadblock of wafer warpage and epilayer cracking and create low defect density alloys. This technology has wide applications for high power electronic devices, such as electric and hybrid powered vehicles, microwave power transistors, and lasers.

UCLA Case No. 2014-294

Lead Inventor: Ya-Hong Xie

Patent Status: Pending

Dislocation-Free GaN on Silicon-On-Insulator Platform

Professor Xie and colleagues have conceived a low cost, single-step, large-scale production platform for fabrication of dislocation-free group III-nitride on silicon. The platform is based on silicon-on-insulator (SOI) technology and only requires one epitaxial step with one level of lithography. This will lead to significant cost saving and yield improvement during high volume production. This technology has wide applications for power systems of electric and hybrid powered vehicles, microwave power transistors, and lasers.

UCLA Case No. 2014-702

Lead Inventor: Ya-Hong Xie

Patent Status: Pending

An Apparatus for Hydride Vapor Phase Epitaxy of III-Nitride

Professor Xie and colleagues have conceived an apparatus that allows the hydride vapor phase epitaxy growths of III-nitride films on multiple wafers of over 100 mm thickness without warpage. Applications of this technology include power systems of electric and hybrid powered vehicles, microwave power transistors, lasers, and solid state lighting.

UCLA Case No. 2014-703

Lead Inventor: Ya-Hong Xie

Patent Status: Pending

A Method for Large Scale Epitaxial Growths of Single Crystal III-Nitride on Si

Professor Xie and colleagues have developed a method for the growth of high quality III-nitride on Si. High intensity light emitting diodes (LEDs) have numerous applications as a general light source as well as for solid state lighting, and are made from group III-nitrides and their alloys. Thus, it is extremely important to develop an economic method to produce high quality III-nitride.

UCLA Case No. 2014-733
Lead Inventor: Ya-Hong Xie
Patent Status: Pending

Au Nanoparticle Doped Polyaniline Nanofiber Non-volatile Memory Device

Professor Yang and colleagues have developed a solution-processable, polymer non-volatile memory storage device. The conductivity of the polymer material can be increased or decreased by applying a positive or negative voltage pulse, respectively, with an on/off conductivity ratio of 10^3. On/off ratios are expected to be maintained at 10^{2-3} after 10^6 switching cycles, which is comparable to Si-based solid-state storage. The flexibility and low-cost manufacturing of the device allow for use in smart textiles, ID cards, RFID devices, and disposable electronics.

UCLA Case No. 2004-561
Lead Inventor: Yang Yang, Richard Kaner
Patent Status: Issued #7,554,111

Aqueous Precursor Synthesis and Deposition of Semiconducting Metal Chalcogenide Films

Professor Yang and colleagues have developed a method of depositing thin films of metal chalcogenides using an aqueous solution process. The method is inexpensive and the solution is environmentally friendly, due to lack of the toxic standard solvent hydrazine. The method uses only elemental metal and chalcogenide powder and does not require synthesis of metal chalcogenide. This technology can be applied for deposition of metal chalcogenide-based thin film solar cells, transistors and storage.

UCLA Case No. 2012-128
Lead Inventor: Yang Yang
Patent Status: Pending

Annealing Methods to Fabricate Copper Zinc Tin Chalcogenide (CZTS) Thin Films and Photovoltaic Devices

Professor Yang and colleagues have developed a method of incorporating Se vapor into the CZTS thin film through series of annealing steps. The method forms large, stable kesterite CZTS grains which prevent phase decomposition while improving power conversion efficiency in a CZTS PV device. This technology increases CZTS viability for long-lifetime, large-scale manufacturing. This technology can be applied to metal chalcogenide based thin film solar cells, transistors and storage.

UCLA Case No. 2012-818
Lead Inventor: Yang Yang
Patent Status: Pending

Low Temperature Processed High Performance Metal Oxide Transistors Based on Earth Abundant Elements

Professor Yang and colleagues have developed a metal oxide transistor which replaces the rare earth elements with more abundant materials. The transistors exhibit high optical transparency and can be manufactured at low temperatures. These properties allow the technology to be fabricated on plastic substrates and used in optoelectronic applications, including displays, LEDs and photovoltaics.

UCLA Case No. 2014-131
Lead Inventor: Yang Yang
Patent Status: Pending

Formation Method of Metal Oxide Semiconductor Films and Transistors Using the Solution Process

Professor Yang and colleagues have developed solution processed methal oxide films and a transistor consisting of them. These thin films have mobilities and other electrical properties similar to metal oxide thin films produced through a vacuum deposition process. Thin film transistors using this technology have high on/off ratios, while maintaining the low cost and lower environmental impact of solution processed devices. Applications include MOS thin film transistors for LCD and OLED displays, in which this technology has many advantages over traditional amorphous silicon.

UCLA Case No. 2014-298
Lead Inventor: Yang Yang
Patent Status: Pending

Spin-Coupling Semiconductor Materials and their Applications

Professor Yang and colleagues have developed a new class of materials for high performance electronics which take advantage of a spin-orbital coupling effect. In these materials, the singlet and triplet states are within a few meV, allowing the singlet electrons to thermally transition to the longer lifetime triplet state. These materials include organic-inorganic perovskites, heavy metal atom complexes, and polymers. Applications include thin film solar cells, LEDs, and transistors.

UCLA Case No. 2014-412
Lead Inventor: Yang Yang
Patent Status: Pending

Method of Direct Patterning on Sol-Gel Inorganic Films and Film Formation at Low Temperature

Professor Yang and colleagues have developed a method of fabricating patterns of high performance amorphous oxide semiconductor (AOS) films through a solution process. AOS materials have received recent attention due to their high electron mobility, flexibility, optical transparency and high stability. This method allows for low-temperature printing of AOS materials which provides the benefits of solution processing with the high performance of traditional vacuum deposition. Applications include thin film transistors for display applications, particularly suitable combined with OLEDs for displays due to its ease of manufacture and low cost.

UCLA Case No. 2014-641
Lead Inventor: Yang Yang
Patent Status: Pending

PHOTOVOLTAICS & PHOTOELECTRICS

Plasmonically Enhanced Nanopillar Separate Absorption Multiplication Diodes (PEN-SAMD)

Professor Huffaker and colleagues have developed novel group III-V plasmonically enhanced nanopillar separate absorption multiplication diodes (PEN-SAMD) photodetectors suitable for high speed and high sensitivity applications. Group III-V compound semiconductors have intrinsically higher mobilities and other properties that are superior to silicon for particular functions, particularly optoelectronic functions. PEN-SAMD offer superior signal-to-noise ratios and efficiency compared to traditional photodetectors based on linear and Gieger mode photodiodes. In this technology, UCLA researchers developed a nanopillar array useful as a plasmonically enhanced antenna for the absorption of a signal (e.g. incoming wavelength of light) and as an electric current multiplier for signal enhancement which offers greatly augments photodetection. The technology has wide applications in telecommunications and advanced next generation communications.

UCLA Case No. 2012-531
Lead Inventor: Diana Huffaker
Patent Status: Pending

Subwavelength Nanolens Arrays as Optical Concentrators in Nanowire Photovoltaics

UCLA researchers in the Department of Electrical Engineering have developed a processing technique for fabricating convex domes on top of individual nanopillar structures. This innovation enhances the optoelectric efficiency of these arrayed structures used in such devices as solar cells and light-emitting diodes. A reliable fabrication process has been developed, and working prototypes produced, showing the optoelectronic enhancement that results from the dome-shaped optical concentrators.

UCLA Case No. 2013-421
Lead Inventor: Diana Huffaker
Patent Status: Pending

Plasmonic Light Trapping with Active Layer Incorporated Gold/Silica Core/Shell Nanorods

Dr. Janković and colleagues have engineered a novel way to increase the efficiency of an organic photovoltaic (OPV) device by incorporating gold/silica core/shell nanorods into the device active layer. The increase in efficiency results from near field optical field concentration at the surface plasmon resonance frequency of the gold/silica core/shell nanorods analogous to the way a car radio antenna works except for light. The thin silica shell and the organic ligand are key enabling innovations that allow incorporation of the nano-antennas directly into the active region without affecting electrical transport and device morphology. Using nanorods compared to more commonly employed nanospheres is another advantage since different aspect ratios of nanorods will have different resonance frequencies, thus enabling broadband light trapping. Finally, the approach is completely solution-based and doesn't require any modifications to traditional OPV device processing techniques.

UCLA Case No. 2013-603
Lead Inventor: Vladan Janković
Patent Status: Pending

New Materials for the Formation of Polymer Junction Diodes

Professor Pei and colleagues have developed innovative polymer p-i-n junction diodes formed by simple solution processing at ambient conditions. The diodes are particularly useful for organic light emitting diodes with high quantum or power efficiency and low-cost fabrication, high-sensitivity photodetectors, high efficiency polymer solar cells, and large area thin film transistors capable of carrying high current densities.

UCLA Case No. 2005-239
Lead Inventor: Qibing Pei
Patent Status: Issued #7,939,900

Regioregular Copolymers of 3-alkoxythiophene and their Photovoltaic Application

UCLA researchers in the Department of Materials Science and Engineering have invented low bandgap conjugated copolymers based on alkyloxythiophene monomers. Performance of bulk hetero-junction solar cells fabricated using blends of these polymers with PCBM was measured under white light illumination (AM 1.5 G, 100 mW/cm2), the obtained short circuit current density (Jsc) was 6.3 mA/cm2, open circuit voltage (Voc) was 0.76V, fill factor (FF) was 50.5%, and PCE was 2.4 %. These copolymers exhibit superior electrical characteristics appropriate for polymeric solar cells, LEDs, and thin-film transistors.

UCLA Case No. 2006-494
Lead Inventor: Qibing Pei
Patent Status: Issued #8,530,594

Improved Photovoltaic Efficiency in Semiconducting Polymer/Fullerene Solar Cells through Control of Fullerene Self-Assembly and Stacking

Professor Tolbert and colleagues have identified a self-assembly method for arranging fullerene molecules that results in a 4X increase in solar cell energy conversion efficiency (current density; on average). This technique allows more control over the packing of individual molecules to provide for higher material densities that result in improved efficiency.

UCLA Case No. 2008-662

Lead Inventor: Sarah Tolbert

Patent Status: Pending – Published Application #20090266416

Solution Synthesis and Deposition of Kesterite Copper Zinc Tin Chalcogenide Films

Professor Yang and colleagues have developed a solution based method for Cu2ZnSnS4 (CZTS) precursor synthesis that uses earth abundant and environmental friendly materials as a viable alternative to Cu(In,Ga) Se2 (CIGS) for use in solar cells. This method provides a powerful tool for depositing uniform films in chemical compositions for large scale device fabrication. Devices have been fabricated with the structure of ITO-glass/CZTS/CdS/Ag and the method was tested and validated in the lab. Photovoltaic effect has been demonstrated from the initial solution processed CZTS device and current-voltage characterization shows an excellent rectifying effect of the p-n junction between CZTS/CdS with an ideality factor of 1.3.

UCLA Case No. 2011-410

Lead Inventor: Yang Yang

Patent Status: Pending - Published Application #20140116512

Titanium Oxide as the Window Layer for Metal Chalcogenide Photovoltaic Devices

Professor Yang and colleagues have developed a transparent charge collection layer for solar cells. The technology's solution processable window results in significantly lower manufacturing costs compared to vacuum-deposited materials, such as standard zinc oxide. Solution coating can cause less damage to lower layers than magnetron sputtering, and may allow for use of a simpler, cheaper device structure that omits the cadmium selenide layer. The technology can be used in CuInSe2 solar cell devices, with potential use in other types of solar cells. Other applications include UV absorbing coatings for windows.

UCLA Case No. 2011-853

Lead Inventor: Yang Yang

Patent Status: Pending - Published Application #2013021452

Conjugated Polymers with Selenium Substituted Diketopyrrolopyrrole Unit for Electronics Devices

Organic photovoltaic devices provide an opportunity to utilize solar energy efficiently and at low cost. To harvest a greater spectrum of light, scientists have sought to reduce the energy bandgap of the active material. Professor Yang and colleagues have developed a novel low-bandgap polymer that provides excellent photovoltaic performance in single junction devices (PCE >7%). This technology has application to organic solar cells, tandem solar cells, transparent solar cells, field-effect transistors, near infrared (NIR) organic photo-detectors, and NIR organic light emitting diodes, among others.

UCLA Case No. 2013-071

Lead Inventor: Yang Yang

Patent Status: Pending

Metal Nanowire Contacts for Thin Film Silicon Photovoltaics

Professor Yang and colleagues have developed a solution processable metal nanowire network with a polymer or nanoparticle matrix. This technology provides a low resistance transparent contact and appropriate surface roughness to enhance light trapping for high photovoltaic performance. Solution processability allows for low cost manufacturing. This technology is particularly applicable for amorphous or nanocrystalline Si thin film PV, but can be used as the transparent contact for many thin film optoelectronic devices.

UCLA Case No. 2013-800

Lead Inventor: Yang Yang

Patent Status: Pending

Multi-Functional Anti-Reflection Coating for Photovoltaic Devices

Professor Yang and colleagues have developed a multi-junction photovoltaic structure which utilizes low-refractive index organic materials to decrease the reflective loss. Thin film PV devices must optimize light absorption in order to have high efficiency with a thin film. This technology increases light absorption by decreasing optical reflectance loss from ~40% to <10%. This anti-reflective structure is well applied to increase the efficiency of thin film inorganic solar cells. Future applications may include multi-functional, energy harvesting anti-reflective coatings for windows or electronics displays.

UCLA Case No. 2013-851

Lead Inventor: Yang Yang

Patent Status: Pending

Selenophene Modified PTB Polymer for Additive-Free Organic Electronic Devices

Professor Yang and colleagues have developed a conjugated polymer for high performing organic electronic devices without the need of problematic additives. Previous high performance bulk heterojunction devices required additives to improve phase dispersion, which lowered the stability and increased manufacturing complexity. This technology can be used to fabricate devices with similar performance to additive-necessary materials. A single-junction PV prototype device using this material has produced a power conversion efficiency of 8.8%. Other applications include mutli-junction solar cells, OLEDs, transistors and smart textiles.

UCLA Case No. 2014-835

Lead Inventor: Yang Yang

Patent Status: Pending

Vertical Heterostructures for Transistors, Photodetectors, and Photovoltaic Devices

Professor Duan and colleagues have developed a vertical field-effect transistor (VEFT) that enables high current density through the overall semiconductor area with a high on-off current ratio. Current densities reach 2-5 orders of magnitude greater than those recently reported for vertical tunneling transistors or barristors. Integrating graphene with solution-processible semiconductor materials to form vertically-stacked devices can lead to new types of low-cost, high-performance transistors, photodetectors, and solar cells.

UCLA Case No. 2013-363

Lead Inventor: Xiangfeng Duan

Patent Status: Pending

POLYMERS & MEMBRANES

3D Printable Magnetic Thermoplastic Polymer

Professor Candler and colleagues have invented a thermoplastic polymer that incorporates uniformly mixed magnetic powders. This new polymer can be extruded into spools for use with any fused deposition modeling 3D printer, and allows for the tailoring of the polymer's magnetic properties, by adjusting the volume of integrated magnetic materials. Additive manufacturing or 3D printing has the potential to revolutionize manufacturing by creating sophisticated products without the need for labor-intensive factories. This singly integrated approach eliminates the need to separately print materials and post combine them into useful composites, which offers advantages for mass production. This technology broadly impacts the fields of architecture, engineering and construction (AEC), automotive, aerospace, education, and dental and medical industries.

UCLA Case No. 2014-560

Lead Inventor: Robert Candler

Patent Status: Pending

Spontaneous Droplet-Into-Droplet Insertion for Formation of Polymer Particles

Professor Garrell and colleagues have developed a new microfluidic device to generate spontaneous droplet-to-droplet insertion for formation of polymer particles. This invention utilizes digital microfluidic devices to spontaneously insert one droplet into second droplet in various ambient mediums such as air or an immiscible liquid. This novel microfluidic device can precisely control predetermined, diverse dimensions and shapes of polymer particles or can be used to prepare solid shells containing various materials.

UCLA Case No. 2009-768

Lead Inventor: Robin Garrell

Patent Status: Pending - Publication Application #20120000777

Nano-Structured Membranes for Engineered Osmosis Applications

Professor Hoek and colleagues have developed novel nano-structured membrane materials to be used in osmosis-driven separations. Compared to the only commercially-available osmotic membrane, a first-generation form of the current technology exhibited ~3-5 times greater water permeability with similar separation performance; a remarkable early performance benchmark. This membrane has potential applications in forward osmosis water purification, osmotic water samplers, food and beverage dehydration, and salinity gradient energy production.

UCLA Case No. 2010-004

Lead Inventor: Eric Hoek

Patent Status: Pending - Published Application # 20130105395

Exploring New Chlorine-Tolerant Polyamide Derivatives for Preparing Biofouling-Resistant RO Membrane

Professor Hoek and colleagues have developed a novel reverse osmosis (RO) membrane formulation that is chlorine tolerant, extremely hydrophilic and molecularly smooth, which imparts significantly better biofouling resistance in application like desalination and water reuse. These new RO membranes could be packaged for use in new and existing RO water treatment plants, where they could reduce the need for pre-treatment as well as the overall energy demand and cost of operation.

UCLA Case No. 2013-455

Lead Inventor: Eric Hoek

Patent Status: Pending

Membranes Formed by Phase Inversion for Forward Osmosis Applications

Professor Hoek and colleagues have devised a hydrophilic, chemically and thermally robust polymeric membrane with tunable morphology and high salt rejection for use in forward osmosis desalination. Low energy desalination by forward osmosis (FO) exploits the natural process of osmosis to draw fresh water from seawater into a very concentrated solution when separated by a semi-permeable membrane. The solute in the concentrated solution is recovered by various means such as low grade heat, and a shift in solution temperature and acidity. The major hindrance in the development of this technology is a lack of suitable membranes. In this technology, the Hoek group developed a more hydrophilic FO membrane that allows for high water permeability while maintaining high salt selectivity. The approach is scalable and offers widespread applications in water treatment, including concentration of nutrients in treated sewage, concentration of RO brine, and treatment of landfill leachate.

UCLA Case No. 2013-507

Lead Inventor: Eric Hoek

Patent Status: Pending

Nanocomposite Membranes from Conducting Polymer Nanospheres and Conventional Polymers

Professor Hoek and colleagues have utilized encapsulated polypyrrole nanospheres within traditional membranes to enhance the water permeability, selectivity, and antifouling properties of the membranes for use in water treatment. Traditional water treatment membranes suffer from gradual attachment of rejected materials on their surfaces that lead to reduced performance, clogging, and ultimately, failure. The technology has wide applications for water treatment, bioseparations, protein purification, and oil-water separation.

UCLA Case No. 2013-850

Lead Inventor: Eric Hoek

Patent Status: Pending

Bistable Electroactive Polymers

Professor Pei and colleagues have developed a bistable electroactive polymer transducer for electrically actuated deformation of rigid electroactive polymer members. They can be electrically deformed to various rigid shapes with maximum strain greater than 100% and as high as 400%. The polymer transducers' advantages include high energy and power densities, quietness, mechanical compliancy (for shock resistance and impedance matching), high efficiency, lightweight, and low cost. Applications include tactile displays, Braille electronic readers, and adaptive structures.

UCLA Case No. 2009-356

Lead Inventor: Qibing Pei

Patent Status: Issued #8,237,324

Hydrogel-Supported Membranes

Researchers at UCLA have developed a method for the *in situ* formation of a mechanically supportive hydrogel around a bilayer membrane that increases the lifetime of the membrane while still allowing the measurement of the transport of ions and proteins to and from the membrane. The hydrogen-supported membranes are useful in the single-molecule analysis of membrane-embedded proteins, as well as in diagnostic devices, drug discovery, and rapid DNA sequencing.

UCLA Case No. 2006-077

Lead Inventor: Jacob J. Schmidt

Patent Statuses: Issued #8,038,885, Pending - Published Application #20120025414

Automatable Continuous Flow System for Lipid Bilayer Membrane Production

Professor Jacob Schmidt and colleagues have developed an automated procedure to produce lipid bilayers using computer-controlled continuous flow. Traditionally, lipid bilayers are formed by trained professionals at the time of use and are inherently difficult to work with. This technology incorporates computer-controlled flows and fluid dispensing into the inter-layer contacts of self-assembled lipid monolayers. The technology has potential applications in the biotechnology industry, including biosensing and drug screening.

UCLA Case No. 2009-003
Lead Inventor: Jacob J. Schmidt

Patent Status: Pending

Droplet Membrane Formation with Integrated Electrode

Researchers at UCLA have identified a method for automating a membrane self-assembly process for creating and measuring lipid bilayers. The invention employs a modified pipette which is responsible for dispensing the second phase required for membrane fabrication and also allows for an electrical pathway to be established, which is necessary for measuring ionic currents associated with the membrane and the ion channel. The unique design of this membrane assembly technique combined with the modified pipette allows for simultaneous fabrication and characterization which drastically cuts down on labor.

UCLA Case No. 2009-004

Lead Inventor: Jacob J. Schmidt

Patent Status: Pending

Thermally Re-mendable Cross-Linked Polymers

Professor Wudl and colleagues have developed a method of making thermally re-mendable polymers. These transparent and colorless polymeric solids can be fabricated without the use of solvent and cured at temperatures ranging from 80° C to 120° C. Once a crack is propagated in this cured material, the crack can readily be thermally repaired. Upon heating the polymeric body to 120° C, many bonds within the material break. Upon slow cooling back to room temperature, these bonds reform in a way that allows for the repair of the fracture. This procedure can successfully be repeated multiple times on the same sample.

UCLA Case No. 2002-343

Lead Inventor: Fred Wudl

Patent Status: Issued #6,933,361

SURFACE FUNCTIONALIZATION & MODIFICATION

Synthesis of Thioether Containing Trialkoxysilanes

Professor Garrell and colleagues have developed a simple method of producing a wide variety of functionalized trialkoxysilanes using low power UV light. The pendant group, linked to the trialkoxysilane by a thioether bond, may be a small molecule, synthetic macromolecule, biomolecule or biopolymer. The method generally results in the formation of product trialkoxysilanes in high yield and purity, enabling product use without further purification. Furthermore, the invention is a low-cost method; synthesis does not require the use of noble metal catalysts, reactants and reagents are inexpensive, and only simple equipment is required.

UCLA Case No. 2011-600

Lead Inventor: Robin Garrell

Patent Status: Pending - Published Application #20130345412

Micro-Tentacle Nanofilaments for Functionalization of Nano Delivery Drugs and Biological Assays

Professor Gimzewski and colleagues have devised a new nano-therapy drug inspired by naturally occurring nanoparticles in the body such as viruses, vaults, and exosomes. Exosomes are next-generation nanocarriers for drug delivery due to their small size (<100 nm), lack of toxicity, and target specificity. In this technology, UCLA researchers propose a novel tentacle delivery system based on a lipid or molecular coating functionalized by synthetic or naturally occurring filamentary particles 10-15 nm in diameter with lengths sub to several microns long. Nanofilaments may serve as long tethers for anchorage, increasing the probability of exosome binding to target cells. Applications include drug development for cancer, influenza, and autoimmune therapy.

UCLA Case No. 2014-389

Lead Inventor: James Gimzewski

Patent Status: Pending

Liquid-Repellent Surfaces Made of Any Materials

Professor C.J. Kim has devised a surface structure that repels all liquids, including aqueous solutions, organic and fluorinated solvents, that does not require the material to be hydrophobic or for a hydrophobic coating to be applied. This pattern functions regardless of what the solid surfaces are made from. This includes ceramics, metals and polymers. These surfaces are suited for a myriad of applications as a non-degradable or heat-resistant nonwetting surface. For electronic thermal management systems that use refrigerants, they can provide nucleation spots for phase-change heat transfer. The surface can also be made with a gradient pattern for droplet collection, separation, and transportation.

UCLA Case No. 2014-186

Lead Inventor: C.J. Kim

Patent Status: Pending

Reducing Particle Conglomeration in a Tribo-System

Professor Yunfeng Lu and colleagues have devised a tribo-system to reduce friction between two surfaces. The system includes a surfactant layer, a lubricant and nanoparticles dispersed in the lubricant. Nanoparticle-based lubricants require high durability to ensure their effectiveness in lubrication. This technology results in durable nanoparticles with a predetermined size, shape and shell to preferentially interact with surfaces instead of with each other. The technology has potential applications in several industries, including automotive, aerospace, regenerative medicine, and military systems.

UCLA Case No. 2012-805
Lead Inventor: Yunfeng Lu

Patent Status: Pending - Published Application #20130323595

Self-Latching Piezocomposite Actuator

Professor Christopher Lynch and colleagues have devised a piezocomposite control surface that does not require electrical power to maintain the deflection of materials. Conventional passive metallic and composite structures typically do not possess the advantages of solid-state, shape-changing control surfaces that are especially useful in aerodynamic applications. This technology utilizes the potential for ferroelectric/ ferroelastic "shape memory" behavior in piezoelectric materials to create an actuator system that can change and hold shapes with no applied control signals. The technology has potential in the navy and space applications.

UCLA Case No. 2014-518
Lead Inventor: Christopher S. Lynch

Patent Status: Pending

Safer-by-Design Rare Earth and Upconversion Nanoparticles

UCLA researchers have developed a method for safer design of rare earth nanoparticles or RE-enabled nanomaterials through surface passivation that uses a series of phosphonate chemicals that provide high-affinity and stable phosphate binding to particle surfaces. Compared to non-passivated nanoparticles, the safer design approach can specifically and effectively prevent the toxicological injury response to RE nanomaterials in biological environments. The research team demonstrated that this injury results from the complexation of cellular phosphate groups on the particle surface during incidental exposures or diagnostic use applications. The stable passivation of the particle surfaces prevents the sequence of hazardous effects that results in organ and systemic fibrosis as a result of the pro-inflammatory effects that are triggered by disruption of cellular phosphate metabolism by non-passivated particles.. Not only does the surface passivation of RE oxide nanoparticles, RE hydroxide nanoparticles, or RE-doped up conversion nanoparticles provide a safer by design feature, but also prevents the imaging quenching that occurs as a result of surface phosphate complexation.

UCLA Case No. 2014-938
Lead Inventor: Andre E. Nel
Patent Status: Pending

Ligand Management in Metal Nanowire Inks

Professor Yang and colleagues have developed a nanowire ink consisting of nanowires modified with a strongly bound species to increase ease of dispersion. The modified nanowires have good dispersive properties for coating or printing. The species does not negatively impact the conductivity of the nanowires- the ink is conductive immediately after deposition and can deposited using inexpensive blade coating or roll-to-roll coating. Applications include thin film optoelectronic devices.

UCLA Case No. 2013-963
Lead Inventor: Yang Yang
Patent Status: Pending

Hypersonic Laminar Flow Control Using Surface Roughness

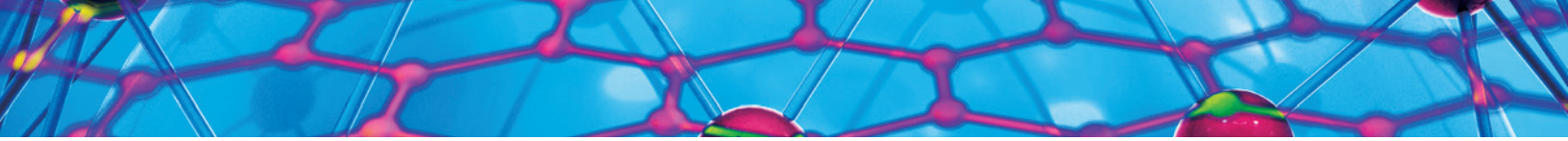
Researchers in UCLA's Department of Mechanical and Aerospace Engineering have developed a novel passive control strategy to maintain laminar flows over air transportation vehicles and space reentry vehicles at high supersonic and hypersonic speeds. The strategy focuses on delaying the laminar-turbulent flow transition. By applying an array of surface roughness in the appropriate region determined by detailed flow field calculations, one can delay the transition and maintain controlled laminar flow. The result is a substantial reduction in drag force, surface heating, and increased fuel efficiency of hypersonic vehicles. The technology may be applied to produce various surface roughness elements, which can be easily attached or removed from the vehicle surface.

UCLA Case No. 2013-207
Lead Inventor: Xiaolin Zhong
Patent Status: Pending

Solution-Processible Inorganic Ordered Vertically-Oriented Porous Films

Professor Tolbert and colleagues have created a technique for producing vertically oriented inorganic pore systems via solution processing. Using this novel procedure, a hexagonal honeycomb structured surfactant or polymer templated inorganic-organic composite is grown on a cubic self-assembled patterned surface to form the vertically aligned pores. Unlike many traditional methods, this innovative procedure can utilize a variety of materials to form the film structure, which enhances substrate versatility. Additionally, the use of a cubic self-assembled liquid crystal system for a substrate to align a hexagonal self-assembled liquid crystal system allows the realization of superior feature size and material control.

UCLA Case No. 2005-728
Lead Inventor: Sarah Tolbert
Patent Status: Issued #8,399,057



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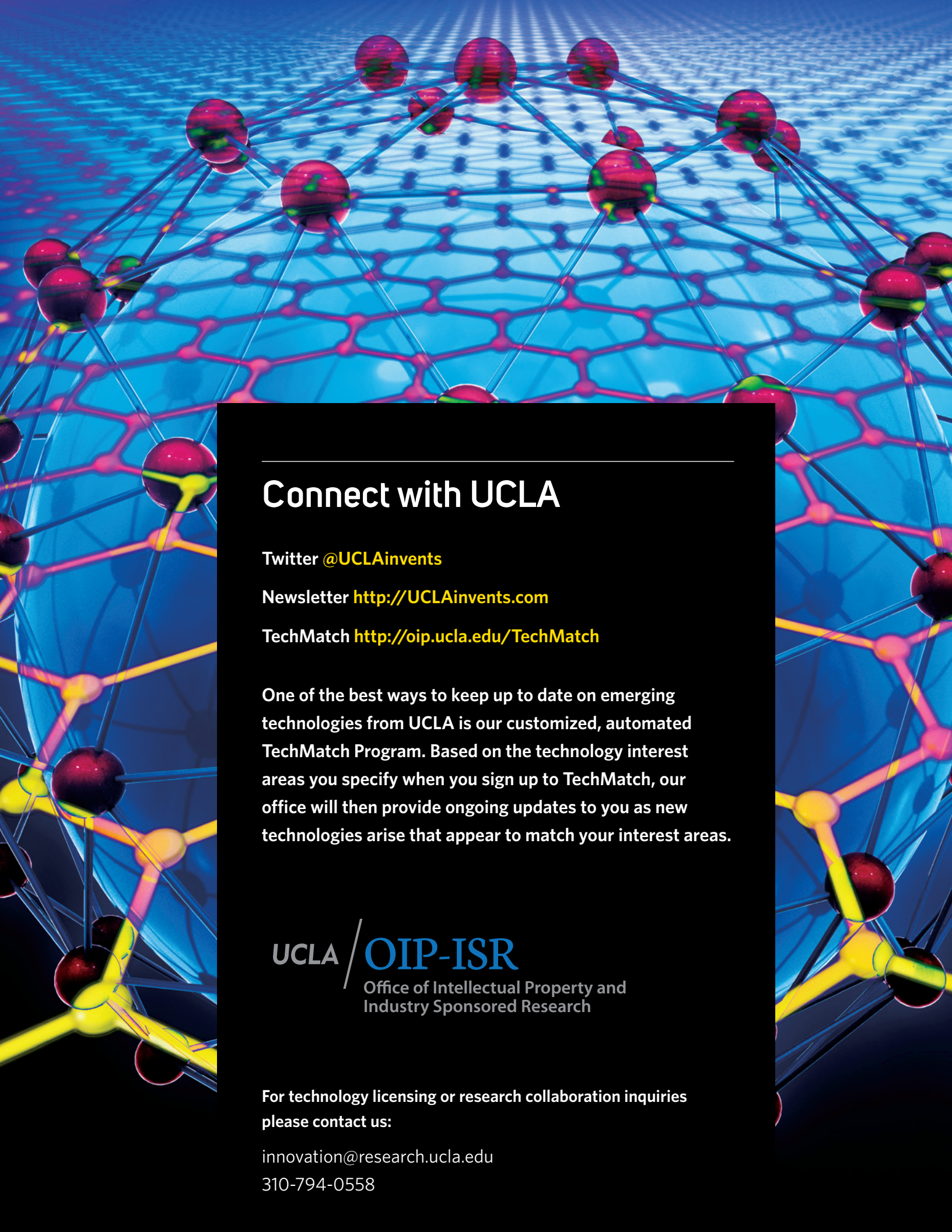

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