TEXAS STATE
COMMERCIALIZATION AND INDUSTRIAL RELATIONS

AVAILABLE TECHNOLOGIES

Title: Copolyester composition.

Background: This invention relates to polyester compositions. In one aspect, the invention relates to cyclobutanediol copolyesters having superior impact resistance and transparency.

Invention Description: According to the invention, an amorphous copolyester is prepared by contacting, under polymerization conditions an aromatic dicarboxylic acid or ester or anhydride thereof, a 2,2,4,4-tetraalkyl-1,3-cyclobutanediol and 1,3-propanediol or 1,4-butanediol. The resulting copolyester exhibits superior thermal and impact properties.

Benefits:

A benefit of the cyclobutanediol copolyesters containing 1,3-propanediol or 1,4-butanediol monomers is relatively low color, as compared with ethylene glycol-containing cyclobutanediol copolyesters, which tend to test high on the yellowness index (ASTM D-1925) as measured on 1/8" disks (see Table 2 of Example 3). The invention copolymers preferably exhibit yellowness indexes less than about 50, most preferably less than about 20. The preferred copolyesters have high molecular weights, most preferably reflected in an intrinsic viscosity (IV) (in hexafluoroisopropanol at room temperature) of at least about 0.5 preferably about 0.6 to about 1.0. Preferred copolyesters have notched izod impacts (1/8" thickness) of greater than about 2, most preferably greater than about 3 ft-lb/in, and glass transition temperatures greater than about 80.degree. C, most preferably greater than about 100.degree. C.

The copolyesters of the invention can be used in applications in which clarity, low shrinkage during molding, weatherability and toughness are desired in the preparation of molded articles such as lenses, glazing, packaging and compact disks. The invention copolyesters can also be blended with other polymers such as ABS, polycarbonates, poly(ethylene terephthalate) and poly(trimethylene terephthalate).

Market Potential/Applications: The copolyesters can be used in applications in which clarity, low shrinkage during molding, weatherability and toughness are desired in the preparation of molded articles such as lenses, glazing, packaging and compact disks. The copolyesters can also be blended with other polymers such as ABS, polycarbonates, poly(ethylene terephthalate) and poly(trimethylene terephthalate).

IP Status: US Patent donated to Texas State by Shell Oil Co. **5,705,575 (January 1998)**

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TEXAS STATE
Commercialization and Industrial Relations

AVAILABLE TECHNOLOGIES

Title: Remote temperature measuring system for hostile industrial environments using microwave radiometry.

Background: Numerous industrial processes presently operate with either no temperature monitoring or inadequate monitoring due to current technology limitations. Present technologies either require contact with the object or, if they are optical pyrometers or infrared sensors, are unable to operate in the presence of particulates that block light and infrared rays.

Invention Description: This technology is able to remotely sense temperature despite the presence of obstructing particulates in the air. This invention uses long-wavelength microwave radiation emitted from the object, which is not scattered by particulates as much as shorter infrared or light rays are. It is capable of measuring temperatures from below room temperature up to 3000oF or higher, depending on the material under examination and the operating

Benefits

- Relatively low cost in comparison to conventional systems
- Uses as few microwave components as possible (for size reduction, etc.)
- Works in situations where infrared or optical temperature measurements fail environment.

Market Potential/Applications: Any industrial process with temperature-critical steps that are presently not temperature-monitored remotely could benefit from this technology. Dusty cement kilns, certain applications in the foundry industry, paper mills, plastic manufacturing, chemical manufacturing, and food processing are some industries that may benefit from this technology.

IP Status: US Patent issued **7,052,176 (May 2006)**

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TEXAS STATE

COMMERCIALIZATION AND INDUSTRIAL RELATIONS

AVAILABLE TECHNOLOGIES

Title: Use of fiber film reactors to effect separation and reaction between two immiscible reaction components.

Background: Chemical reactions between two fluids are conducted in reactors that mix droplets of one phase in the other. Dispersed small droplets provide the surface area that allows chemical reaction between the fluids to occur. The smaller the droplets the greater the reaction. Unfortunately, it can be difficult to coalesce the droplets back into one phase for further processing. The specialty chemical industry, the pharmaceutical industry, and the biodiesel industry all rely heavily on dispersion reactors. Large biodiesel plants rely on centrifuges to coalesce and separate the phases rapidly.

Invention Description: A continuous static non-dispersive fiber reaction process in which reactive components contained in immiscible streams are intimately contacted to effect chemical reactions and separations. The tubular reactor contains wettable fibers onto which one stream is substantially constrained and the second stream flows between the wetted fibers to continuously create a new interface to efficiently bring about contact of the reactive species and thus promote reactions or extractions. Co-solvents and phase transfer catalysts may be employed to facilitate the process.

Benefits: The new reactor is 60X more efficient at achieving mass transfer between the phases than conventional reactors. That means it is 60X faster and 60 smaller for the same volume processed. In addition, the phases come out of the static reactor separated without centrifuges. Fiber Reactor™ chemical processes can be built with less capital and will operate with less operation costs. Engineering calculations indicate that world scale biodiesel reaction trains can be built for less than half the capital of conventional plants and use less than half the energy to operate.

Market Potential/Applications: The immediate potential application is for biodiesel manufacturing. Currently the US has capacity to make 2.5 billion gallons of biodiesel. Consumption of petroleum diesel is 60 billion gallons per year and gasoline consumption is 120 billion gallons per year. Biodiesel could replace a substantial portion of 180 billion gallons per year in the next 10-15 years. The Fiber Reactor will substantially reduce the costs of capital and production of biodiesel.

IP Status: U.S. patent application allowed and assigned to John L. Massingill, Jr. US **20060157411 (July 2006).**

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TEXAS STATE
COMMERCIALIZATION AND INDUSTRIAL RELATIONS

AVAILABLE TECHNOLOGIES

Title: Treatment Method for Imparting Self-healing and Shape Memory Properties to Certain CBDO Copyesters.

Background: This invention relates to amorphous copolyester copolymer compositions, as disclosed in U.S. Pat. No. 5,705,575, which inherently have a superior impact resistance. There is a need for such materials having an even greater impact resistance, and this invention is a treatment method for imparting superior impact resistance to said amorphous copolyester copolymers (hereinafter referred to as CBDO copolymers).

Invention Description: Discovered that the compositions made according to U.S. Pat. No. 5,705,575 will display self healing and shape memory properties when undergoing treatment which involves heating the CBDO polymer to a temperature above its glass transition temperature. This discovery is unexpected since the CBDO polymer is an amorphous linear polymer with no crosslinks. The article by Behl et al. that reviews the current knowledge about shape memory polymers points out two main mechanisms that lead to shape memory. These include crosslinking and crystalline domains that act like crosslinks, neither of which exist in the CBDO polymer.

Benefits: A benefit of the cyclobutanediol copolyesters containing 1,3-propanediol or 1,4-butanediol monomers is relatively low color, as compared with ethylene glycol-containing cyclobutanediol copolyesters, which tend to test high on the yellowness index (ASTM D-1925) as measured on 1/8" disks. The copolymers preferably exhibit yellowness indexes less than about 50 or less than about 20. The copolyesters may have high molecular weights, typically reflected in an intrinsic viscosity of at least about 0.5 or about 0.6 to about 1.0. Copolyesters may have notched izod impacts of greater than about 2 or greater than about 3 ft-lb/in, and glass transition temperatures are 80 to 100.degreeC.

Market Potential/Applications: In addition to market potential of the original patent (U.S Pat No. 5,705,575), automotive parts, military applications, house hold goods, etc.

IP Status: US patent issued. **7,772,362 (August 2010)**

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TEXAS STATE
COMMERCIALIZATION AND INDUSTRIAL RELATIONS

AVAILABLE TECHNOLOGIES

Title: Thermal Barrier Coatings.

Invention Description: Texas State San Marcos researchers have developed a novel combination of additives to be used in intumescent coatings to enhance thermal barrier properties and in some embodiments will increase char during a fire, which is a poor conductor of heat and a barrier to gas release from the substrate, thus retarding heat transfer and flammability.

Background: Flame retardant coatings are important for the reduction or elimination of damage to structures caused by fires. Many coatings are used for protection of wooden and steel structures. In general, these coatings retard fires either by chemical reactions to eliminate the fire or by shielding the substrate during a fire. Substrates that shield a substrate may include hydrates. During a fire as the hydrates are consumed, water vapor is released, which cools the fire. The compounds may also produce char, retarding heat transfer and flammability.

Many compounds that include hydrates are susceptible to environmental influences such as humidity. Humidity may reduce or negate the compounds ability to swell. Other compounds may be added to a flame retardant coating to improve fire retardant properties. The compounds, however, may affect moldability, tensile characteristic or other physical properties of the final product. Many flame retardant coatings include halogens, which may be harmful to the environment.Although, there has been a significant amount of effort to develop methods and systems to produce thermal barrier coatings there is still need to produce thermal barrier coatings that retard fires and are environmentally safe.

Commercial Applications & Advantages: The TBC's developed in this invention can be formulated using polyurethane binders, which are well understood in the coatings industry, in combination with state of the art nanotechnology to act in several synergistic mechanisms:

- Reflecting up to 94% of the heat from the fire;
- Reducing conduction of heat into the interior coating;
- Growing an insulating intumescent (char) layer;
- Cooling the coating and diluting pyrolysis gases (15%) by releasing water of hydration from halloysite nanotubes; and,
- Reinforcing the coating at several scales.

Other potential advantages are:

- Reduction of potentially hazardous gaseous combustion products from certain materials, and
- Thermal insulation to prevent heat loss, e.g. in attics or rooms

IP Status: Filled Provisional Patent (**April 2012**)

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TEXAS STATE
COMMERCIALIZATION AND INDUSTRIAL RELATIONS

AVAILABLE TECHNOLOGIES

Title: Novel Approach to Immobilizing Ionic Liquids in Layered Compounds and Creating New Catalysts

Invention Description: Without using any solvent, and requiring only a few minutes of a single-step reaction, researchers have shown that their mechanochemical reaction serves as a "green" approach to immobilize Ionic Liquids (ILs) into layered compounds and thus may expand the applications of ionic liquids and improve catalyst separation and recycling.

Background: ILs have attracted significant attention because of their unique chemical and physical properties that allow them to be used both as alternatives to classical molecular solvents in a wide range of applications, and also for many new applications such as catalysis, electrolytes, lubricants, biomass processing, and energetic materials. However, the use of ILs has two major issues: cost and viscosity. One of the most promising approaches to solve these two problems is to immobilize ILs on solid supports. In fact, immobilization of ILs can also increase efficiency, facilitate recycling, and bring about new applications. For example, for IL-catalyzed reactions, supported ILs can bring a number of advantages, including facilitating catalyst separation, increasing catalysis efficiency, minimizing product contamination, and opening the possibility to use fixedbed reactor systems. In addition, immobilization of ILs can minimize the potential toxicity of ILs, which has been largely ignored but has recently begun to draw attention.
Furthermore, layered materials are a group of ideal candidates for the immobilization of ILs within their galleries. In layers, the immobilized ILs can be better protected, and the release of ILs from the interlayer space might also be controlled, which would be very beneficial for certain applications. In addition, such a layered structure might be ideal for some specific applications, such as electrolytes. However, the intercalation of bulky ILs into layered compounds in solution systems is often unsuccessful mainly owing to the dimensional mismatch.

Market Applications: This "green" approach to immobilize Ionic Liquids (ILs) into layered compounds may expand the applications of ionic liquids and improve catalyst separation and recycling. These benefits will enhance: catalysis, electrolytes, lubricants, biomass processing and energetic materials.

Benefits and Advantages:

- Process is a low cost single-step reaction
- Process is a "green" technology because it is done without using any solvent
- Process allows intercalation of ILs that are larger than the interlayer gap of layered compounds
- ILs Immobilized in layers eliminates the problems associated with their viscosity

IP Status: Filed PCT application (**December 2011**).
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TEXAS STATE
COMMERCIALIZATION AND INDUSTRIAL RELATIONS

AVAILABLE TECHNOLOGIES

Title: Durable Ceramic Liner (Platform Technology/Multiple Applications)

Invention Description: A ceramic coating for metal and refractories is derived from a polysilazane resin and inorganic hollow nanotubes (HNT) that significantly decrease thermal conductivity, increase toughness, increase corrosion resistance, and abrasion resistance of the coated part. The coating composition can easily be applied to a metal or refractory material substrate. Heating the coated part forms the ceramic coating on the substrate.

Background: Refractory materials are used in applications that involve high temperatures, pressures, and stress. The eventual failure of materials that are exposed to high temperatures, high pressure, and corrosive environments is typically due to a combination of heat weakening of the material, wearing during operation, and corrosion. Metals used in applications such as gun barrels, internal combustion engines, deep sea drilling rigs, turbochargers, superchargers, high pressure pumps, etc. are subjected to varying stresses that eventually lead to decreased strength or failure.

Market Applications:

This novel ceramic nanocomposite coating improves wear and corrosion resistance, provide thermal barrier performance, and replaces chrome as a protective coating on steel.

The benefits of the ceramic coating will enhance the performance and value of:

- Pistons and cylinders
- Guns
- Internal combustion engines
- Drilling rigs
- Structural metal
- Cast iron
- Silicon bronze
- Turbochargers
- Superchargers
- High Pressure pumps
- Automotive manifolds
- Ceramic liners for engine blocks and cylinder walls
- Corrosion prevention in petrochemical and ethanol pipelines
- Shake-out process for castings
- Foundry binders
- Reinforced concrete containing steel reinforcement and infrastructure
- Cold rolled steel (protects the steel with a thin coating that is suitable for fabrication)

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AVAILABLE TECHNOLOGIES

Benefits and Advantages:
Some of the key benefits and advantages of this technology include:

- Improve performance and reduce environmental impact though the elimination of chrome
- A ceramic liner that enables quick implementation with a highly practical production method
- Low cost, tough, robust, corrosion coating
- It is desirable alternate coating for metals and refractory materials that is not as toxic as existing coatings and is simpler to produce.
- Improvement of wear resistance, corrosion resistance, and heat resistance of ceramic coatings for metals and refractories.
- Applications such as ceramic coating for gun barrels illustrate specific product benefits such as but not limited to; improvement of service life, reduce parts consumption & failure rates, reduce field pack weight, reduce corrosion, reduction in barrel heat load, and replace chrome coating
- Environmentally friendly (especially as a chrome replacement)

Intellectual Property Status: Filed PCT application (**August 2011**).

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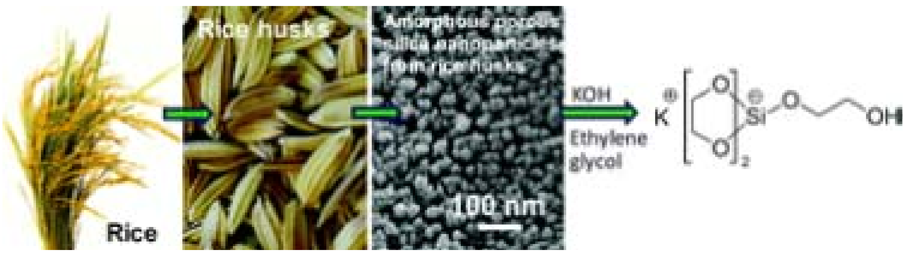
AVAILABLE TECHNOLOGIES

Title: Novel Approach to Producing Organosilicon Compounds and Polymers from Rice Husk Biomass

Invention Description: Developed a novel synthesis process of producing amorphous silica nanoparticles from rice husk biomass which shows high reactivity and thus high yield. These compounds can be further polymerized to synthesize high quality organosilicon polymers.



Background: Organosilicon compounds are a group of important materials and used in a wide variety of fields. However, their synthesis relies virtually exclusively on the carbothermal reduction of silica to silicon and subsequent reaction between silicon and aryl chloride. This multi-step approach involves high temperature and pressure, which is energy-intensive and eco-hazardous. To address this issue, several groups explored alternative approaches, which bypass the carbothermal process, to synthesize organosilicon compounds from silica. Such approaches typically require a much lower reaction temperature and energy consumption than the carbothermal process. The ultimate goal is to produce organosilicon compounds directly from low cost silica resources, such as sand. However, when sand is used as the starting material, it requires much longer reaction time (100 times longer) due to its low reactivity, which sets a huge obstacle for commercial production. Therefore, it is highly desirable to seek an alternative silica resource which is of low cost and possesses sufficiently high chemical reactivity, so that it can be converted to organosilicon compounds via one of the developed low temperature approaches at high rate and yield. Rice husk (RH), the byproduct of rice milling, is a major agricultural waste. Dry RH contains ca. 80 wt% of organic components (lignin, cellulose, hemicellulose, etc.) and up to 20 wt% of hydrated silica, depending on the variety, climate, and geographic location. While a good source material, previous methods to extract silica required a long reaction time of 96 hours, which did not show obvious advantage over beach sand. Amorphous silica with porous structure possesses a very high reactivity due to its high surface area. The researchers at TSU have developed effective, fast, and low reaction temperature approaches to derive amorphous silica with tunable porous structure and different levels of crystallinity from RHs using KOH and Ethylene glycol. Because these silica nanoparticles show high reactivity and thus high yield, they are excellent candidates for direct conversion to form organosilicon compounds as well.

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COMMERCIALIZATION AND INDUSTRIAL RELATIONS

AVAILABLE TECHNOLOGIES

Market Applications:

- Such silica nanoparticles and porous frameworks can find widespread applications in
- chemical and food industry, especially for coating and adhesive applications
- Synthesized silica nanoparticles and porous frameworks can be further converted to
- organosilicon compounds via a low temperature process

Benefits and Advantages:

- Process is a low cost, low temperature reaction
- This process offers an opportunity to introduce a wide range of functional groups
- Process can be used to synthesize high quality organosilicon polymers
- Rick Husk starting material is a major agricultural waste, and using it may contribute to a
- company’s sustainability goals

IP Status: Filed PCT application (**February 2012**).

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TEXAS STATE

COMMERCIALIZATION AND INDUSTRIAL RELATIONS

AVAILABLE TECHNOLOGIES

Title: Varistor-Transistor Hybrid Devices (Platform Technology/Multiple Applications)

Invention Description: This invention from researchers at Texas State University deals with unique properties and applications of their “Varistor-Transistor Hybrid Devices”. They Identify a number of applications based on: (a) tuned varistors and (b) tuned transistors. In both these devices the output signal can be modified resulting in three types of hybrid devices: (1) voltage biased induced varistor-transistor hybrid device (Vb-VTH), (2) electric field induced varistor-transistor hybrid device (E-VTH), and (3) magnetic field induced varistor-transistor hybrid device (H-VTH). In certain modes they can be used as: (i) low pass filters covering a wide range of bandwidth including the human auditory range, (ii) bipolar signal amplifiers, (iii) varistors to protect the electronic circuit and ICs from abrupt input surges, (iv) transistors to meet the needs of large number of applications in microelectronics, space electronics, radhard electronics and possibly in automobile and bio-electronics. They can be used either as current amplifiers or voltage amplifiers, and (v) sensors.

Background: The invention utilizes the unique physical properties of a class of wide bandgap oxide semiconductors in the family of iron titanates; specifically, the pseudobrookite (PsB) with the chemical composition Fe_2TiO_5 , and a solid solution comprised of ilmenite ($FeTiO_3$) and hematite (Fe_2O_3) commonly abbreviated as IH and with the general formula: (1-x)$FeTiO_3$.xFe_2O_3. In this invention x=0.45, so the ilmenite-hematite ceramic (IHC) of this invention (known as IHC45) has the following composition: 0.55 $FeTiO_3$.0.45 Fe_2O_3. IHC45 is an n-type semiconductor and also ferromagnetic and remains so until a temperature of 610 F is attained. PsB is also an n-type semiconductor but nonmagnetic. Both IHC45 and PsB are well established radhard materials also.

The configurations for the development of the hybrid devices are simple and straight forward . They can be produced in large volumes rather inexpensively. Ceramic substrates can be used for the production of these hybrid devices giving this technology an advantage over the currently used technology in electronics.

For the development of the three types of devices the ceramic form of IHC45 and PsB were processed. Also single crystals of PsB were grown in lab and they too were evaluated for the fabrications of these devices and their applications. They details are covered in the patent application as well as in 4 recent papers (1 published, 1 in press, 1 in review and the other is in the process of being submitted to a journal).

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AVAILABLE TECHNOLOGIES

Market Applications:

This platform technology can address multiple applications including but not limited to:

- Bioelectronics (such as hearing aids)
- Cell phones, MP3's, Radio's, Space electronics
- High altitude electronics
- Microelectronics

- Bipolar signal amplifiers
- Electronic and audio amplifiers
- Electronic switches
- Tunable devices for low frequencies
- Non-conservative low pass filters
- Tunable transistors
- Magento-electronics
- Magnetically controlled voltage and current amplifiers,
- High temperature electronics

Benefits and Advantages:

Some of the key benefits and advantages of this technology include:

- Platform technology with multiple applications
- High-radiation resistant (radhard)
- Anticipated lower manufacturing costs
- Materials used are biocompatible
- Abundant low cost raw materials

IP Status: Filed PCT application (**September 2012**).

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TEXAS STATE
COMMERCIALIZATION AND INDUSTRIAL RELATIONS

AVAILABLE TECHNOLOGIES

Title: New High Strength and High Impact Polymers from Isomers of Cyclic Diols

Background: Researchers at Texas State University have succeeded in forming polymers with similar properties to Kevlar, but which can be processed by melt spinning and then woven. These polymers are formed from the reaction of cyclic diols with terephthalic acid and their properties can be tuned by adjusting the stereochemistry of the monomers used. High impact polymers are used in numerous applications ranging from reinforcement of marine ropes, industrial belts to structural reinforcement in the aerospace and automotive industry.

Benefits: In this work, the physical and mechanical properties of the polymer can be tuned by altering the composition of the monomers used. When only the trans form of the diol is used in the synthesis, an all trans, linear, high density polymer forms, which can be spun into highly aligned fibers, with tensile properties similar to Kevlar. When only the cis form is used, the resulting polymer is amorphous with a higher modulus and impact resistance than both the all trans and an amorphous polymer prepared from a mixture of isomers. In addition, the polymers have self-healing and shape memory properties, and high solvent and UV resistance. The polymers prepared do have exceptionally high impact resistance values. In addition the trans polymer can be melt spun, providing a much easier method of processing than for Kevlar which is made by a condensation reaction followed by hot drawing, washing, neutralizing, drying and finally spinning and fabrication into a fabric.

Market Potential/Applications: In 2002, global production of Kevlar-type polymers was estimated at about 41,000 MT/year with annual increases of 5–10%. More recently, the global body armor and personal protection equipment market alone was predicted to be valued at $19.4B over the next 10 years. This gives an indication of the sheer size of the global market for this kind of polymer

IP Status: Filled Provisional Patent (**October 2012**).

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TEXAS STATE
COMMERCIALIZATION AND INDUSTRIAL RELATIONS

AVAILABLE TECHNOLOGIES

Title: Nanocomposite Coatings from a Facile Exfoliation-Reassembly Process

Background; Facile exfoliation is defined as the dispersing of layered-sheets of material on the nano-scale and re-assembly involves the ordered assembly of dispersed sheets with a matrix-polymer in-between the sheets forming a nano-composite material with advantageous new properties such as enhanced thermal, mechanical and flame retardancy capabilities.

Nano-coating processes such as the 'layer-by-layer' (LBL) but exhibit some limitations. For example, LBL assembly process involves a lot of repeated steps to build a film thickness on a substrate. In one referenced paper, a thin film of thickness 5 nm (10-9m) took more than 2 days to form. LBL and other nano-composite methods tend to be highly labor intensive, time-consuming processes that lead to high cost. This is not the preferred method for a commercial application.

Benefits: This exfoliation-reassembly process involves the dispersion of a layered compound, introduction of a polymer matrix in an aqueous solution (water as a solvent in some cases) and finally co-assembly of the exfoliated individual single layer nano-sheets with the polymer matrix onto the substrate. As the single layer nano-sheets re-assemble, alignment can be guided by either gravity or a mechanical/shear force exerted by common industrial processing rolls. If needed, the aligned nano-sheets can be cross-linked with the polymer matrix, to solidify the nano-coating. The final nano-coating will possess significantly improved mechanical and barrier properties as well as flame retardancy.

Market Potential/Applications: Nano-composite materials possess valuable properties such as excellent barriers to moisture and gases, superior mechanical properties, thermal stability and improved flame retardancy. The packaging and motor-vehicle industries are two major markets for nano-composites, accounting for almost 50% of the market demand. Key packaging applications include soft-drinks, beer, food and pharmaceuticals due to the improved barrier properties and strength. Construction will also begin to utilize nano-composite materials by replacing fiber-reinforced plastics in a number of applications.
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IP Status: Filled Provisional Patent (**October 2012**).

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TEXAS STATE
COMMERCIALIZATION AND INDUSTRIAL RELATIONS

AVAILABLE TECHNOLOGIES

Title: Method for Forming a Vertically Movable Gate Field Effect Transistor (VMGFET) on a Silicon-on-Insulator (SOI) Wafer

Background: The vertically moveable gate field effect transistor (VMGFET) is a component that would be part of an integrated circuit (IC), a key component used in the semiconductor market. FET's are transistors that use electric current to control conductivity along a channel of a semi-conducting material or terminal. Other vertically moveable gate FETs exist, but the innovation of this invention is that the field effect transistor utilizes a highly doped, single, crystalline silicone as a gate structure as opposed to metal and poly-silicon deposits. The advantage of using one silicone crystal instead of metal include: 1) limited internal stresses; 2) allowance for longer gate length; 3) and, increased sensitivity of transistor.

Benefits: The novelty of this technology is the highly doped silicon device layer of the SOI wafer as a gate material and a mildly doped handle layer. Within the semiconductor production industry, 'doping' is defined as the process by which impurities are intentionally introduced into an extremely pure semiconductor. This method will reduce the deposition and etching processing steps, insure the alignment of the gate and channel structure while allowing the source/drain regions to be doped at the same time as the gate. In effect, it reduces the number of processing steps by using the single silicon wafer, decreasing overall fabrication time while generating cost savings in the fabrication process.

Market Potential/Applications: VMGFETs are described as the brains of most electronics that possess IC's such as computers, cell phones and TV's. In addition, due to the high sensitivity of the transistor, other potential applications include using the transistor as an accelerometer module in cell phones.

IP Status: Filled Provisional Patent (**October 2012**).

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TEXAS STATE
COMMERCIALIZATION AND INDUSTRIAL RELATIONS

AVAILABLE TECHNOLOGIES

Title: Multimodal Ocular Biometrics for Enhanced Identification and Security

Invention Description: A researcher at Texas State University-San Marcos has developed an ocular biometric method for identification of an individual based on a multimodal approach utilizing a single image sensor device. The novel method utilizes unique behavioral and physiological characteristics of the eye to provide enhanced identification of individuals for high security applications.

Technology: The global market for biometric systems is estimated to be over $5B, with anticipated growth of over 20% annually. Iris recognition systems account for an increasing proportion of the biometrics industry. Standard iris recognition technology provides accurate identification, but is vulnerable to counterfeit techniques that can compromise security. Additionally, standard iris recognition technology cannot accurately assure resistance to a variety of spoofing attacks. The Texas State technology incorporates two innovative techniques that, combined with standard iris recognition technology, offer enhanced identification accuracy and security. A single sensor device captures Oculomotor Plant Characteristics (OPC), which represent the unique, internal anatomical structure characteristics of the individual eye globe and muscles, and Complex Eye Movement (CEM), which represent the strategies employed by the brain and the unique patterns of eye movement to guide visual attention in response to a stimulus. The novel multimodal approach combines OPC and CEM with iris recognition technology to achieve high identification accuracy and enhanced security.

Benefits:

- Enhanced identification accuracy
- High resistance to spoofing and shoulder-surfing compared to other authentication systems
- High counterfeit resistance based on behavioral and physiological human attributes
- Assurance that live tissues belonging to the authentic user are being identified

IP Status: Filled PCT application (**March 2012**).

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TEXAS STATE
COMMERCIALIZATION AND INDUSTRIAL RELATIONS

AVAILABLE TECHNOLOGIES

Title: Direct Synthesis of Layered Double Hydroxide Single-Layer Nanosheets

Technology: Layered Double Hydroxide (LDH) nanosheets have demonstrated value across a wide range of electronic, magnetic, optical, and chemical applications. Current bench top production methods use a two-step approach that can take up to several hours to complete. Scaling for mass production of LDH nanosheets requires a simplified production method to reduce initial capital investment and on-going operating costs.

Two step-approaches to producing LDH nanosheets split a pre-existing lamellar LDH compound into component LDH nanosheets. Such processes force delamination of the LDH compound by using a time consuming method that first modifies the inter-layer environment and then uses highly polar solvents to force delamination. In the proposed single step approach, an oil bath and a combination of surfactants and co-surfactants creates droplets within which single-layer LDH nanosheets are created directly from a solution of metallic salts.

Competitive Advantage: The one-step approach to the production of LDH nanosheets reduces the time, energy, and capital required for scale production of LDH nanosheets. Laboratory experiments using this technique have produced nanosheets in fewer than 10 minutes compared to up to several hours for two-step approaches. A simpler process should accelerate scaling for mass production with fewer production steps allowing less equipment and lower costs both to build and operate. Low production costs could support rapid and widespread adoption of LDH nanosheets as the nanotechnology of choice for a broad range of market applications.

Opportunity: Uses for LDH nanosheets include such applications as catalytics, photovoltaics, drug delivery, environmental remediation, microwave absorption, and gene delivery. These markets are global and multi-billion in scope. Many already show high growth rates. For example, the dyesensitized photovoltaics market brought in $8.5 billion in 2010 with an estimated CAGR of over 70% through 2017. Nanotechnologies enable new capabilities (such as targeted drug delivery) and higher efficiency (such as in catalytics or photovoltaics). This novel method for producing LDH nanosheets could provide a simple, low cost process for producing the nanostructures that support applications across many rapidly expanding markets.

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