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Center for Innovative Ventures of Emerging Technologies

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Low-Cost Solar Cell Devices

Aurelien Du Pasquier;
- Assistant research professor, Energy Storage Research Group
- Department of Materials Science and Engineering, Rutgers University
- Background: polymer science, electrochemistry.

A versatile and low-cost solar cell platform, based upon a Zinc Oxide nanostructure that offers an advantage over silicon-based solar cells due to material abundance, energy cost, bio-compatibility and other positive attributes. The structure can be used to grow varied solar cells (dye, organic, amorphous silicon, copper-indium-diselenide, etc.), and responds to a growing $50B market predicted for 2010.

Nanostructured Ceramics Processing and Applications

Bernard Kear;
- State of New Jersey Professor of Materials Science and Technology
- Director of the Center for Nanomaterials Research since 1986 after 20 years working in industry.
- Background: synthesis & processing of nanophase materials by solution, flame and plasma methods, surface treatments by thermal spraying of nanophase powders, and pressure-assisted sintering of nanophase oxide and non-oxide ceramics, diamond and fullerenes.

An integrated process for production and consolidation of metastable ceramic powders to produce products used for applications such as armor, tools, implants, IR-windows, high power lasers, etc. Ability to scale and producing near-net shapes. Support for technology is strong in government and commercial sectors. Manufacturability is proven and projected sales in $100M range.

Surface Imaging Camera

Kristin Dana;
- Associate Professor, Department of Electrical and Computer Engineering
- PhD from Columbia University in 1999
- Background: surface science for vision and graphics

A camera that captures multiple views of a surface to form a complete digital representation of the surface appearance. Yields a digital, quantitative, description of skin appearance where current standard is subjective and qualitative. Applicable in dermatology, retail e-Commerce, and other industries where realistic surface views with multiple lighting angles are required. Uses curved mirror for instantaneous capture of reflectance from multiple angles, has been prototyped with COTS components, and projects $1.5B market in 2005 for telemedicine and $100B forecasted for e-Commerce.

High Performance Ceramic Coating

Perusalam Balaguru;
- Rutgers Faculty member for 30 years
- Program Director at NSF for 4 years.
- Background: Structural engineering, new construction materials

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A high performance ceramic coating that offers many attractive attributes; it cannot be scratched with metals; graffiti resistant, mold resistant; self-cleaning; destroys indoor pollutants; temperature resistant; non-toxic; conventional application; compatible with concrete, steel, timber and clay bricks. Potential market application in transportation structures (bridges), buildings (fire-proof), pipelines (friction reduction), etc.

Prostate Cancer Grading

Anant Madabhushi;
- Assistant Professor, Dept. of Biomedical Engineering, Rutgers
- Background: expertise in machine learning, computer-aided diagnosis, medical image analysis

Computer-aided system to assist pathologist and radiologists in (detection and) grading of prostate cancer from high resolution in vivo MRI and biopsy specimens. Best hope for survival (1M biopsies; 20-30% are cancerous), is early detection. System helps distinguishing intermediate cancer grades (3, 4) both pre and post biopsy. System improvements continue (adding image retrieval functionality, expanding paradigm to include Gleason Grades 1, 2, 5, other) while potential industry partners discuss joint venture relationships.

Skin Matrix Regeneration Therapy

Prabhas Moghe;
- Professor of Biomedical and Chemical Engineering, Rutgers University
- Background: expertise in cellular Bioengineering and Nano-BioMaterials

A bio-nanotechnology formulation to trigger skin matrix assembly, thereby restoring skin's integrity and reversing the signs of aging where current options utilize passive fillers to replace only single components of the lost tissue leading to short-term and unsatisfactory treatment outcomes. The market profile shows estimated $500M for injectable facial aesthetics and expectations of growth at >20%/year for the next 5 years. The product is commercially viable due to demand; actives production has been optimized at the lab scale; and the process is reproducible and easily scaled. Additionally, protein-based nanoparticle fabrication and conjugation chemistry utilizes low-cost components and processes.

Nanolipoblockers

Prabhas Moghe;
- Professor of Biomedical and Chemical Engineering, Rutgers University
- Background: expertise in cellular Bioengineering and Nano-BioMaterials

Nanosized particles that bind scavenger receptors on inflammatory cells within blood vessels reducing cholesterol accumulation and resultant inflammation and reducing plaque rupture that can lead to heart attack and stroke. Nanolipoblocker is available via immediate (catheterization injection) or sustained (stent controlled release) delivery and leaves no waste products as nanolipoblockers are taken up by macrophage cells and broken down in the body. The materials are relatively inexpensive, competitive drug (Plavix) viewed as $8B drug franchise in heart disease market of $151.6B in 2007. Competitive stent was $2.9B market, diagnostic catheterizations numbered 1.3M in 2004.

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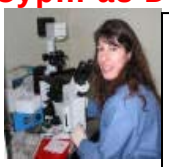
Hydroxyapatite Coatings for Biomedical and Value-Added Applications

Richard Riman;
- MIT, Ph.D., MSE, RU, BSE, Ceramic Engineering,
- Background: expert in ultra-low temperature crystal growth processes.

A ceramic coating that can be applied to a wide range of metals consisting of nano and micron-grained hydroxyapatite, grown on a metallic surface and crystallized from an aqueous solution. The coating is deposited on every surface that is in contact with the solution, allowing complex shapes to have uniform coatings. A wide range of attributes include corrosion inhibition and bioactivity. Market needs addressed include bone replacement, implantable electronic biomedical devices, etc. The product is commercially viable as reactants are easy to obtain, minimal surface preparation is required for metals, and ideas for continuous processing of parts has been conceived. Markets profiles show global protective coatings at $10.7 B/year, bioimplant materials at $24B/year, and proteomics at $2.7 MM/year.

Cypin as Drug Target for Learning and Memory Disorders



Bonnie Firestein;
- Associate Professor of Cell Biology and Neuroscience, Rutgers University
- Postdoctoral Fellow, Department of Physiology, University of California, San Francisco
- Background: cell biology and neuroscience

Identification of Cypin as a mediator of branching in dendrites, hence improvement of learning and memory and an associated method for stimulating Cypin for treatment of related disorders, specifically Alzheimer's, mental retardation, and autism. Approximately 1 in 68 or 4.5M people in the US are diagnosed with Alzheimer's disease; there is no cure, current treatments only slow progression. Stimulating Cypin will produce better results with decreased side effects. Drugs that stimulate Cypin are known, so testing for suitable drug targets is relatively inexpensive, screening is computer-based with no formulation or development required. 2005 market projections show that Alzheimer's medications generated revenues of over $2.6 billion.

Dynamic Measurement of Powder Density and Flow

Fernando Muzzio;
- Professor at Rutgers since 1991
- Consultant to at least 30 Fortune 500 companies
- Background: Ph.D. Chemical Engineering

A new method for accurately measuring the density and cohesion (i.e. flow index) of powders as they flow. This dynamic measurement enables accurate determination of powder density, for design of tableting and capsule filling processes, convenient methodology for assessing flow properties of powders and effective method for quality control and process trouble shooting. Powder flow control is important to ensure correct blending, filling, and packaging and for overall quality control where no existing method accounts for density and cohesion. There are multiple points of industry entry (product, process, quality), and already have progress with research center established with 29 industrial partners immersed in this research with FDA promoting same for manufacturing quality control. Market to exceed $20M/year.

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Novel ZnO Nanostructures for Energy Efficiency

Yicheng Lu;

- Professor and Chair of the Department of Electrical and Computer Engineering, and a Graduate Faculty member in both Electrical and Computer Engineering and Materials Science programs at Rutgers.
- Background: Primary research in ZnO, their nanostructures and multifunctional devices.

Nanostructured Zinc Oxide (ZnO) based materials used for various applications such as solid state light sources, full color spectrum light emitting diodes (LEDs), UV photodetectors and Thin Film Transistors (TFT) for large flat panel displays. Nanostructured ZnO-based applications offer various benefits; Gallium Nitride LEDs offer higher brightness, lower cost, and large scale fabrication; Nanostructured ZnO offers enhanced light extraction (200%) and compact and flexible full-color LED design; ZnO nanotip UV photodetectors offer high performance and low cost UV detection and ZnO based TFT offers improved aspect ratio, simplified architecture, reduced degradation and faster operating speeds. Generally, ZnO-based applications improved emission efficiency, higher yield and lower cost. They offer capacity for growth at low temperatures on various substrates, lowering manufacturing cost, are environmentally friendly and significantly reduce CO2 production. Generally, the domestic market for new solid state light sources exceeds > $50B/year; and other markets are limitless. The technology to grow the nanostructures on the various substrates has been developed and several prototypes built.

Multi-Functional Wireless Sensors

Yicheng Lu;

- Professor and Chair of Department of Electrical and Computer Engineering, and a Graduate Faculty member in both Electrical and Computer Engineering and Materials Science programs at Rutgers.
- Background: Primary research in ZnO, their nanostructures and multifunctional devices.

ZnO-based, multi-functional sensors provide a template to enhance the bio-sensing performance of existing sensor technology and provide biomedical and biochemical compatibility, ability for adaptive secure communications, and a platform for remote monitoring with wireless system integration. The nanotip-based devices can be used for gas and liquid phase sensing, have high manufacturability and low cost. Industry applications include health care for medical and genetic diagnostics with application of chemical and biochemical sensors, zero-power remote wireless sensors, detection of biological warfare agents with use of secure wireless communication, and adaptive communications with frequency hopping using a Voltage-Controlled Oscillator (VCO). Fifth most abundant material on the earth, so very low manufacturing cost. Ernst & Young estimated >1 trillion sensors by 2010, with a $3-5B market in 2005. Wireless sensor market is similarly on the upswing. Processing technology established for material growth and nano-fabrication and device processing with several device prototypes demonstrated.

Active Multi-Layer Interface (AMI) for Tissue Engineering

Bill Craelius;

- Professor of Biomedical Engineering
- Founded Nian-Crae, Inc. in 1989
- Background: experienced with neural tissue engineering and cell biomechanics

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AMI (is a cellular bioreactor that) optimizes the structural and biophysical environment for growing thick tissue grafts and will efficiently produce grafts from any cell type. The grafts can then be implanted and integrated into organs. As there is a significant need for repair of damaged myocardium, blood vessels, bone and skin and an increasing trend toward use of individual's own cells for tissue repair, AMI is designed to optimize the growth rate and differentiation of progenitor cells. Currently, there are limited tools to produce significant amounts of repair tissue. The product is commercially viable as it is an established market, manufacturing costs are low due to design with disposable materials, product is software controlled for easy update, etc. The cardiovascular market alone is quoted as a $400B market and this innovation has many market applications.

Solid State Portable Oxygen Generation

Lisa Klein;
- Professor, Materials Science and Engineering
- Background: experience in sol-gel processing of oxide materials

A solid state portable oxygen generator comprised of multi-layered material contained in a closed end tube; when a voltage is applied to the device at a temperature of approximately 750ºC, pure oxygen is collected inside the tube and can be delivered for medical or other purposes. Applications include hospitals, replacing compressed gas cylinders and cryogenic units, home healthcare for portable oxygen and other uses such as aircraft environments, fuel cell operation and metal refining. The device boasts lower temperature operation, no moving parts/noise, portability, and flexible capacity. The medical oxygen market alone is estimated at $1B and others will follow suit.