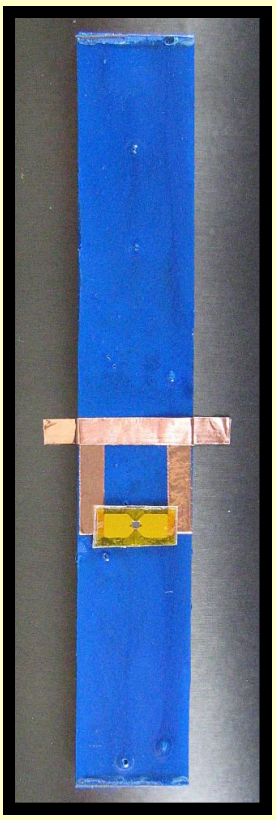
NDSU | RESEARCH FOUNDATION

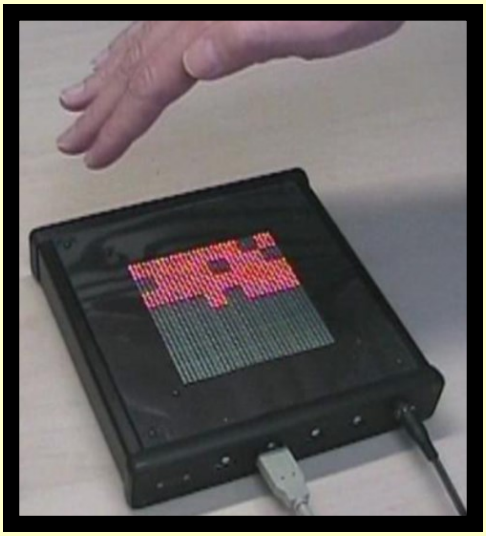
Electronics, Software and Devices Technologies Available for Licensing

In This Catalog:

Electronics

Software





Devices

Technologies by Application

Tech No.	Electronics and Sensors
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RFT-152/153	Novel Radiation-Curable Polymer Film and Radiation-Curable Sensitizers having Improved Laser Ablation Properties
RFT-65	A Method of Using Organometallic Single Source Precursors to Make Aluminum Oxide and Other Inorganic Coatings
RFT-44	On-The-Go Sensor Reads Sugar Content During Harvest
RFT-39	Advances in the Deposition of Amorphous Silicon Films and Printed, Flexible Electronic Circuits

Tech No.	Coatings for Electronics
RFT-530	Photoinitiators that Trigger Extremely Rapid and Efficient Polymer Synthesis Using UV or Visible Light
RFT-529	Renewable and Sustainable Biomass Derived Photodegradable Polymers
RFT-509	Smart Coating for Corrosion Mitigation in Metallic Structures
RFT-178	Novel “Carrier Gas” Sensitizers for Improved Laser Ablation Performance of Coating Films
RFT-152/153	Novel Radiation-Curable Polymer Film and Radiation-Curable Sensitizers having Improved Laser Ablation Properties

Tech No.	Mechanical Innovations
RFT-538	Low-Cost Disposable Device for Manufacture Car T-Cells for Cancer Therapy
RFT-532	Double Extra-Aortic Counterpropulsion Device
RFT-460	Reversible On-Off Adhesion of Rigid Items Achieved by Adjusting Backing Stiffness
RFT-370	Contactless Laser-Assisted Placement of Discrete Electronic Components
RFT-428	Biodegradable Soil Sensors that can be “Planted” with a Seed Mixture

Tech No.	Software and Algorithms
RFT-256	Asynchronous Cellular Automation Provides Benefits Over Field-programmable Gate Arrays

Tech No.	Green Technologies
RFT-161	Chromophore and Polymer Capable of Detecting the Presence of Various Neurotoxins
RFT-311/311A	Unique Electrospinning Process and Compositions for High Volume Silicon Nanowire Production

Tech. No.	Technology Title	Category(ies)
RFT-538	**Low-Cost Disposable Device for Manufacture Car T-Cells for Cancer Therapy** Scientists at NDSU have developed a new device for a scalable, biomanufacturing platform for the production of CAR-modified T-cells while eliminating on-target/off-tumor toxicity and decreasing the current production cost by 500 times (per treatment). The technology relates to a device to produce modified T-cells comprising a first chamber for proliferating a population of T-cells and a second chamber for modifying the T-cells to express a desired T-cell receptor antigen. The modified CAR T-cells can be used to treat cancer.	Mechanical Innovation
RFT-535	**Identification of Weeds, Herbicide Resistance and Herbicide Injury with UAS-Based Remote Sensing** Scientists at NDSU have developed a method for determining the glyphosate sensitivity of plants in a plot comprising obtaining a thermal image of the plot to determine the amount of heat emission at a time after application of glyphosate and correlating the heat emission to the level of glyphosate sensitivity. Combined with visible imaging, the species identification of the weeds as well as their response to glyphosate treatment can be determined. The method allows determination of glyphosate susceptibility much earlier than visual determination of actual glyphosate injury to the weeds. Imaging can be completed using unmanned aerial systems (UAS) for rapid and frequent determination of the glyphosate effect, diagnosis and retreatment.	Electronics/ Sensors
RFT-532	**Double Extra-Aortic Counterpropulsion Device** Scientists at NDSU have developed a double extra-aortic cuff to treat heart failure. Counterpulsation devices (CPDs) have been the most widely used mechanical circulatory support (MCS) devices for treating heart failure (HF) patients. However, these CPDs provide insufficient cardiac output (CO) to meet the needs of New York Health Association (NYHA) ambulatory class IV HF patients. During extra-aortic CPD deflation, retrograde flow may result that reduces the forward kinetic energy (KE) of the aortic flow (AOF) which reduces the potential improvement in CO. To enhance the physiological benefits extra-aortic CPDs we have designed a non-blood contacting extra-aortic two-segmented CPD that can optimize the KE of the AOF and provide additional increase CO to patients' lives.	Mechanical Innovation
RFT-530	**Photoinitiators that Trigger Extremely Rapid and Efficient Polymer Synthesis Using UV or Visible Light** NDSU researchers have developed a range of Type I, Type II, and acidic photoinitiators, which provide polymerization of polyacrylate with good efficiency at low concentrations. The synthesis of photoinitiators is efficient using routine chemistry, and their structures are easily manipulated to tune for low energy (including visible) light wavelengths. These photoinitiators are each triggered by a very narrow and easily defined wavelength, making timing of polymerization easy to control (and avoiding inadvertent triggering of the reaction). The photoinitiators may be produced from either bio-based or petroleum-based starting materials, including such readily available materials as vanillin.	Coatings for Electronics
RFT-529	**Renewable and Sustainable Biomass Derived Photodegradable Polymers** Worldwide efforts have been devoted to converting biomass into chemicals due to the high abundance, low cost, and renewability. Carbohydrates are of particular interest as one of its derivatives, FDCA, is one of the top 14 bio-based chemicals that can be used as a replacement in the synthesis of polyethylene terephthalate (PET). Though made from renewable resources, recyclability of the polymers has remained an issue. Sivaguru et al addressed this through the use of a nitrobenzyl phototrigger unit backbone which allows for controlled photodegradation, via UV irradiation, of biomass-derived polymers.	Coatings for Electronics

Tech. No.	Technology Title	Category(ies)
RFT-509	**Smart Coating for Corrosion Mitigation in Metallic Structures** Though corrosion is well understood in terms of mechanisms and methods of control, it still accounts for a notable number of failures in pipelines buried or on the ground. This is due to a large number of potential complications such as varying soil properties along the pipeline and over time, local cracks on the soft coating surface, separation of coating from the pipeline surface, and corrosive environments. To address this, Azarmi et al developed smart coatings which can both prevent and monitor corrosion of steel through the use of a hard coating deposited by thermal spraying with embedded Fiber Bragg Grating (FBG) sensors.	Coatings for Electronics
RFT-460	**Reversible On-Off Adhesion of Rigid Items Achieved by Adjusting Backing Stiffness** Scientists at North Dakota State University are developing a technology that brings the repeatable adhesion of sticky notes to rigid items such as plastics, glass, metal, wood, particle board, composites, and even highly pliable materials that you don't want to bend, such as paper or woven materials. This reversible adhesion is accomplished simply by adjusting the degree of rigidity – adding stiffness leads to adhesion, while reduced stiffness leads to release. This technology improves upon reversible adhesive systems, where items can be adhered to surfaces and easily removed. Two methods are widely used (illustrating the high value of reversible adhesion), but each has significant limitations. The first example is the bendable 'sticky note,' which attaches to many surfaces, can be peeled to remove, and can reattached many times over. A major limitation is that this only works with a foldable backing (e.g. paper), where 'fold' formed by peeling creates an angle that triggers adhesive release. A second example is that rigid items can be removed using a stretchable adhesive backing, where the adhesive releases as the backing stretches (e.g. 3M's Command® products). A major limitation of these products is that they are single use, the stretchable backing being destroyed by the process of release. This system is not an adhesive, but rather the process of using existing adhesives in new ways. Therefore, the system can be used synergistically with existing reversible adhesives that would be selected to match the specific properties of a backing material and the needs of a given application.	Mechanical Innovation
RFT-454	**Continuous Synthesis of Si Nano-Crystals Using Liquid Silanes** Tunable band-gap of silicon nano-crystals (Si-NCs) presents applications such as light emitting diodes, broad-band absorber in solar cells and many more. By engineering the size, crystallinity, surface state (functionalized group) the properties of Si-NCs can be designed to offer variety of opto-electronic properties. Syntheses of freestanding Si-NCs adopt either a low-pressure plasma process with monosilane or cumbersome chemical reduction processes; these have limited throughput and require additional processing to make them stable. Injection of liquid hydrosilane composition and subsequent pyrolysis allows continuous synthesis of few nm to sub-micron sized particles, with the ability to design the morphology (amorphous, intermediate to crystalline) and surface chemistry (passivation). In addition, by sequential injection of the liquid hydrosilane composition synthesis of core-shell nanoparticles of Si is possible. Synthesis of organic-inorganic photoluminescent hybrid nanomaterials with tunable emission is feasible with this technology. **Status:** **Licensed Exclusively in all Fields of Use and in all Territories**	Electronics/ Sensors Nanotechnology
RFT-449	**Silicon Thin films with Embedded Heteroatoms** Scientists at NDSU have discovered methods for forming silicon thin films and structures with incorporated metals, non-metals, and combinations thereof. The precursor compositions useful in such methods are generally liquid at ambient temperature and are comprised of liquid silane(s) and metal and/or non-metal source(s). The compositions may be processed by printing, coating, or spraying onto a substrate and subjected to UV, thermal, IR, and/or laser treatment to form silicon films or structures with embedded heteroatom(s). These compositions allow for the control of dopant level prior to film processing allowing for very high doping levels with minimal out-diffusion. The available dopants are not highly toxic (as is the case for phosphine and diborane) and provide a means for film deposition without the use of expensive vacuum chambers. **Status:** **Licensed Exclusively in all Fields of Use and in all Territories**	Electronics/ Sensors Nanotechnology

Tech. No.	Technology Title	Category(ies)
RFT-447	**Roll-to-Roll Synthesis of Silicon Thin Films from Liquid Silanes** Silicon thin films are fundamental in solar and microelectronic industries, and are presently obtained using expensive low-pressure plasma enhanced chemical vapor deposition (PECVD) using gaseous silanes despite of its low precursor utilization efficiency. Instability and low vapor-pressure of liquid hydrosilanes have limited their use in the semiconductor industries for longtime. Researchers at NDSU have developed a process to synthesis silicon thin films from liquid hydrosilane (Si_6H_{12}) at ambient pressure in a roll-to-roll method using atmospheric pressure aerosol assisted chemical vapor deposition (AA-APCVD) that has higher deposition rates compared to the state-of-the-art PECVD. Solubility of solid dopants in the liquid hydrosilane facilitate the deposition of degenerately doped (n & p –type) Si thin films opposed to compressed toxic phosphine and borane gases used in other techniques. Low decomposition temperature (higher activation energy) of cyclohexasilane (Si_6H_{12}), a liquid hydrosilane, benefits for a new plasma-free process for the synthesis of silicon nitride films and Si nanowires (with suitable catalyst) at temperatures as low as 350 oC using the AA-APCVD, readily adoptable for large-scale roll-to-roll continuous manufacturing. Liquid hydrosilane compositions consisting of nanomaterials enable hybrid Si films with embedded nanomaterials that have applications in energy harvesting and light emitting devices. **Status: Licensed Exclusively in all Fields of Use and in all Territories**	**Electronics/ Sensors** **Nanotechnology**
RFT-428	**Biodegradable Soil Sensors that can be "Planted" with a Seed Mixture** Scientists working at NDSU are developing biodegradable sensors capable of directly monitoring and reporting the soil environment in which they are placed. The sensors are constructed by using NDSU's patent-pending "direct write" electronic printing techniques to print circuit and antenna patterns directly onto renewable, bio-based materials. The circuit patterns are printed with trace amounts of metallic materials such as aluminum that are safe for the soil when the sensors naturally biodegrade over time. **Status: Licensed Exclusively in all Fields of Use and in all Territories**	**Electronics/ Sensors** **Mechanical Innovation**
RFT-370	**Contactless Laser-Assisted Placement of Discrete Electronic Components** This is a method for the contactless laser-assisted assembly of discrete components such as ultra-thin, ultra-small semiconductor dies and MEMS components onto rigid and flexible substrates. Laser-direct write techniques are an enabling technology for the ever-decreasing scale of microelectronic devices. Specifically, Laser Induced Forward Transfer (LIFT) techniques show promise as a disruptive technology which will enable the placement of components smaller than what conventional pick-and-place techniques are capable of today. NDSU's Thermo-Mechanical Selective Laser Assisted Die Transfer (tmSLADT) process is an application of the unique blistering behavior of polyimide film when irradiated by low energy focused ultraviolet laser pulses. The tmSLADT process has the potential to take its place as the next generation LIFT technique, with distinct advantages over previously studied ablative and thermal releasing techniques. Experimental results studying transfer precision indicate this non-optimized die transfer process compares with, and may exceed, the placement precision of current assembly techniques. **Status: Licensed Exclusively in all Fields of Use and in all Territories**	**Electronics/ Sensors** **Mechanical Innovation**
RFT-336	**Micro Cold Spray Enables Fine Features without the Heat** NDSU's use of cold spray as a direct write technology (called "micro cold spray") has several advantages over existing direct write technologies. The metal powders can be deposited on rigid as well as flexible substrates without the need for post-processing, making it suitable for use on low temperature substrates. Alternatives to expensive metal powders like gold and silver can be used, including copper, aluminum, and tin. There is no shrinkage of the deposited features, since no solvents are used during the deposition process. The same deposition process can be used for printing interconnects as well as via hole filling.	**Electronics/ Sensors** **Green**

Tech. No.	Technology Title	Category(ies)
RFT-311/ 311A	**Unique Electrospinning Process and Compositions for High Volume Silicon Nanowire Production** This is a unique synthetic routes to a novel liquid silicon precursor, cyclohexasilane (Si6H12), which is converted to silicon nanowires by electrospinning. Readily purified by distillation, the liquid nature of Si6H12 allows the development of a high-volume electrospinning route for silicon nanowire production. Because the spun wires convert to amorphous silicon at relatively low temperatures, formation of excessive surface oxide and carbide phases can be avoided which would otherwise negatively affect capacity and rate capabilities. The technology can be used in the development of anodes for use in next-generation lithium ion batteries, in which the traditional carbon-based anode is replaced with a silicon-based anode for a dramatic increase in capacity (theoretically over 1100% increase in capacity). **Status: Licensed Exclusively in all Fields of Use and in all Territories**	**Electronics/ Sensors** **Green**
RFT-256	**Asynchronous Cellular Automation Provides Benefits Over Field-programmable Gate Arrays** North Dakota State University scientists have created a unique asynchronous cellular automaton which is believed to have several distinct advantages over currently available field-programmable gate arrays (FPGAs). These cellular automata are easily scaled from small circuits to large computing arrays.	**Electronic/ Sensors** **Software/ Algorithms**
RFT-178	**Novel "Carrier Gas" Sensitizers for Improved Laser Ablation Performance of Coating Films** Laser ablation of polymeric materials results in more precise patterning and improved performance when the polymeric material decomposes into a gas capable of carrying ablation material away (carrier gas). NDSU inventors have developed polymer films and additives that can be used in polymer films such as polyol photosensitizers, carrier gas UV laser ablation sensitizers and other additives that can be used in preparation of such carrier films.	**Electronics/ Sensors** **Coatings** **Green**
RFT-161	**Chromophore and Polymer Capable of Detecting the Presence of Various Neurotoxins** This NDSU-developed invention is a dual-use technology that was initially reported under the spin electronics program funded by Department of Defense. The "spintronics" polymer is being tested for use in applications such as increased electronic or computer memory. However, this same material was also used by NDSU in sensor tests. The material provides an optical alert when it comes in contact with metallic poison such as insecticides that are in the same family as nerve gas and neurotoxins.	**Electronics/ Sensors** **Green**
RFT-152/153	**Novel Radiation-Curable Polymer Film and Radiation-Curable Sensitizers having Improved Laser Ablation Properties** These inventions pertain to unsaturated polyester polymer compositions containing monomer molecules that sensitize the resulting polymer coating/film to ablation (i.e., removal of film material) by exposure to laser radiation (and method for making same). This technology is of potential value to parties in the semi-conductor and electronic manufacturing industries.	**Electronics/ Sensors** **Coatings**

Tech. No.	Technology Title	Category(ies)
RFT-65	**A Method of Using Organometallic Single Source Precursors to Make Aluminum Oxide or Other Inorganic Coatings** A new family of organometallic compounds has been developed by NDSU Scientists. These compounds contain a metal such as aluminum and a group 16 element such as oxygen in a stoichiometric ratio of 2:3 and can be decomposed to produce an inorganic compound such as A1203 (aluminum oxide), eliminating the organic portion of the original compound. Aluminum oxide is the only material developed to date under this program, although it may be expanded to other very useful compounds. This technology has completed initial laboratory testing. Scale-up is required, but no difficulties are foreseen.	Electronics/ Sensors
RFT-44	**On-the-Go Sensor Reads Sugar Content During Harvest** This invention provides a fast, reliable and nondestructive method of determining sugar content during the harvest of sugar beets. This on-the-go sugar content sensor, developed at North Dakota State University, uses optical technology in combination with intelligent information processing techniques to provide sugar content information in real time as the sugar beets are being harvested. By combining the sugar data with the yield information, the producer has unprecedented, site-specific accuracy.	Electronics/ Sensors
RFT-39	**Advances in the Deposition of Amorphous Silicon Films and Printed, Flexible Electronic Circuits** This patented technology provides a compound and process useful in the production of amorphous silicon films, such as those used in photovoltaic applications, as well as in the creation of printed, flexible electronic circuits. The technology involves a process of producing compounds containing a tetradecachlorocyclohexasilane dianion. These compounds are prepared by contacting trichlorosilane with a reagent composition comprising a tertiary polyamine. The resulting dianion can be chemically reduced to liquid cyclohexasilane (CHS), a stable compound useful in the silicon-based industries described herein. **Status: Licensed Exclusively in all Fields of Use and in all Territories**	Electronics/ Sensors

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For Further Information visit our website:

www.ndsuresearchfoundation.org

or Contact:

Henry Nowak, Technology Manager

Phone: 701-231-8173

Fax: 701-231-6661

Email: hnowak@ndsurf.org

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