NDSU RESEARCH FOUNDATION

Technologies Available for Licensing

ARCHITECTURAL PAINTS & COATINGS 2011

1735, NDSU Research Park Drive, Suite 124
Dept No. 4400, PO Box 6050
Fargo, ND 58108
Ph: 701-231-8173
Fax: 701-231-6661

NDSU RESEARCH FOUNDATION

PATENTED TECHNOLOGIES AVAILABLE FOR LICENSING
(Architectural Paints and Coatings)

LIST OF TECHNOLOGIES

INVENTION TITLE	Tech No.	Application(s)
• Biobased Branched/hyperbranched Oligomers for Thermoset Polymer Materials	RFT-365	Architectural
• Soy Based, UV Curable Anti-corrosion Metal Coatings	RFT-349	Architectural
• Novel Grafted Coatings with Good Hardness Adhesion and Flexibility	RFT-335	Architectural
• Polymers Derived From Vegetable Oils Exhibiting Several Superior Mechanical Properties	RFT-318	Architectural
• Hard UV Curable Resins and Coatings Derived From Vegetable Oils	RFT-314	Architectural
• Novel Enamine Compounds and Coatings Resins: Miscible Blends of Sucrose Esters	RFT-310	Architectural
• A polymer for non-fouling or fouling release type coatings	RFT 283	Marine, Architectural
• UV-Curable Low Surface Energy Coatings	RFT 254	Marine, Architectural
• Siloxane-urethane coatings for anti-graffiti and marine antifouling applications	RFT 231	Marine, Architectural
• Modified Glycidyl Carbamate Resins Exhibiting Superior Mechanical Properties	RFT-226	Architectural
• Novel commercial grade hybrid coatings with enhanced hardness, thermal resistance and mechanical properties	RFT 225/240	Architectural
• Non-toxic and durable foul-release coatings	RFT 197	Marine, Architectural
• Unique coatings (with phase separation properties) for use as foul release and anti-graffiti paints	RFT 158	Marine, Architectural
• Hard, glossy water dispersible urethane epoxy coating	RFT 154	Architectural
• Novel coatings for outdoor bronzes: features superior protection and easy removal	RFT 141	Architectural
• Novel environment friendly (chromium-free) primer coating for corrosion protection	RFT 140	Anti-corrosion

• **Multi-use Aminofunctional Alkoxy Polysiloxanes**	RFT-71	**Architectural**
• **New family of organo-metallic single source precursors for inorganic films, coatings, and powders**	RFT 65	**Architectural**
• **Novel siloxane reactive diluents for cationic UV coatings**	RFT 27	**Architectural**
• **Vegetable seed-oil based coating for superior corrosion protection**	RFT 26	**Anti-corrosion**

Brief Descriptions

RFT 365

Biobased Branched/hyperbranched Oligomers for Thermoset Polymer Materials

This invention revolves around the synthesis of novel high bio-renewable content oligomers based on soybean oil and cashew nutshell oil. These oligomers can be either UV or thermally cured to produce thermoset polymer materials such as coatings. Because of the more rigid structure of these novel oligomers as imparted by the cashew nutshell oil, the cured materials containing these oligomers possess much improved material properties than current biobased materials and in some cases even their petro-based counterparts.

RFT 349

Soy Based, UV Curable Anti-corrosion Metal Coatings

The invention revolves around a UV curable coating that is based on acrylated soybean oil, hyperbranched acrylates, adhesion promoter, and a renewable reactive diluent that showed good coating properties, good anti-stain and anti-corrosion performance directly on aluminum after prolonged (nearly 2000 hours) salt spray test.

RFT 335

NOVEL GRAFTED COATINGS WITH GOOD HARDNESS ADHESION AND FLEXIBILITY

Scientists at NDSU have synthesized monomer-grafted sucrose ester resins by polymerizing styrene in the presence of the sucrose ester resins. At a composition of 50% styrene-50% sucrose ester, coatings had extremely fast track free drying times, similar to a commercial styrenated alkyd resin. However, the styrenated sucrose ester resin had a much lower viscosity than the commercial resin, meaning that higher solids coatings can be prepared. In addition, water dispersible resins were prepared by grafting a mixture of styrene and acrylic acid with the sucrose ester resin. These could be cross-linked with a melamine-formaldehyde resin to yield coatings that had good hardness, adhesion, and flexibility.

RFT 318

POLYMERS DERIVED FROM VEGETABLE OILS EXHIBITING SEVERALSUPERIOUR MECHANICAL PROPERTIES

NDSU Scientists have invented a novel soybean based polymer polyVESFA (vinylether of soybean oil fatty acids) that has been shown to exhibit several superior properties from conversional soybean oil. polyVESFA has many more fatty ester branches per molecule than soybean oil that can be used to great advantage for many applications such as coatings and composites. PolyVESFA has been shown to exhibit superior mechanical properties, modulus, hardness, chemical resistance, corrosion resistance and stain resistance. Besides these characteristics, polyVESFA exhibits reduced shrinkage upon cure and enhanced adhesion capabilities due to its higher molecular weight and higher number of fatty ester branches. Additionally, polyVESFA offers tremendous potential for desirable tailoring of the polymer as it can be copolymerized with other vinyl ether monomers.

RFT 314

HARD UV CURABLE RESINS AND COATINGS DERIVED FROM VEGETABLE OILS

NDSU Scientists have synthesized a highly functional epoxy resins from the epoxidation of vegetable oil esters of polyols having 4 hydroxyl groups per molecule. These epoxy resins can be cured using UV photo-initiators into hard coatings. The novel epoxy resins can also be incorporated into formulations containing oxetanes, cycloaliphatic epoxies, and polyols. The photo-polymerization rate is significantly higher for these novel epoxy resins when compared to conventional epoxidized vegetable oil.

RFT 310

NOVEL ENAMINE COMPOUNDS AND COATING RESINS: MISCIBLE BLENDS OF SUCROSE ESTERS

Novel enamine compounds have been made from acetoacetylated polyols and monofunctional amines. In addition, novel compounds containing both esters of carboxylic acids and acetoaceate groups have also been synthesized. Coatings are also made which are cured by a combination of enamine formation through polyfunctional amines and through autoxidation of the vegetable oil moities.

RFT 283

A POLYMER FOR NON-FOULING OR FOULING-RELEASE TYPE COATINGS

The invention discusses the synthesis of a novel zwitterionic/amphiphilic pentablock copolymer for use in coatings formulations. This penta-block copolymer was synthesized with the necessary properties to qualify as a possible candidate for non-fouling or fouling-release type coatings. The invention combines the low surface energy of PDMS and the protein resistance properties of both zwitterionic and amphiphilic compounds into a single copolymer that makes it an excellent candidate for a non-fouling marine coating.

RFT 254

UV-CURABLE LOW SURFACE ENERGY COATINGS

Radiation-curable chemistry has been instrumental in achieving the industrial regulation goals of zero or low volatile organic content (VOC) coatings. UV-curable coatings have successfully replaced solvent-borne technologies for many applications. Since the coatings are cured by UV radiation, the crosslinking reactions take place at room temperature.
This invention involves the synthesis of novel siloxane-containing unsaturated polyester resins and their UV curing to form coatings having low surface energy. The coatings are useful in applications where low surface energy is desired such as for marine ship hull coatings, anti-graffiti coatings, release coatings, and biocompatible coatings.

The invention relates to the synthesis of siloxane-modified unsaturated polyester oligomers, blending the oligomers with vinyl ethers and a photoinitiator, and curing the formulation to form a coating that has low surface energy.

RFT 231

SILOXANE-URETHANE COATINGS FOR ANTI-GRAFFITI AND MARINE ANTIFOULING APPLICATIONS

This invention pertains to novel siloxane-urethane coatings that were developed from unique single-end-functional siloxane polymers. These coatings have novel properties with good adhesion, low surface energy and mechanical strength.

The invention could find its commercial viability in the paint industry in applications related to anti-graffiti and marine antifouling coatings.

STATUS:
Optioned in "Marine Applications" Field of Use
Available in All Other Fields

RFT 226

MODIFIED GLYCIDYL CARBAMATE RESINS

This invention pertains to novel glycidyl carbamate resins that have been modified with alkyl or ether alkyl groups. These resins have improved properties such as lower viscosity, which makes them good candidates for commercialization in the paint industry. In particular, it has potential for application as a coating on aircrafts.

RFT 225/240

NOVEL COMMERCIAL GRADE HYBRID COATINGS WITH ENHANCED HARDNESS, THERMAL RESISTANCE AND MECHANICAL PROPERTIES

This invention pertains to the preparation of polyurethane-silane hybrid coating systems from glycidyl carbamate resins.

APPLICATIONS: In the paint industry as a commercial grade coating and paint product with improved properties.

PROPERTIES: This organic-inorganic hybrid coating material shows improved characteristics such as good hardness, better solvency, better abrasion resistance and improved thermal and mechanical properties.

PREMISE: Preparation of polyurethane-silane hybrid coating systems from glycidyl carbamate (GC) resin. The invention was conceived with an aim to develop novel hybrid coatings that could possess the reactive properties of epoxy and also have the advantages of carbamate chemistry. Different organic-inorganic hybrid coating materials, using a glycidyl carbamate functional oligomer and amine terminated trimethoxysilane, were prepared by a systematic three-step reaction process. Formation of the Si-O-Si network was performed by moisture curing reactions.

RFT 197

NON-TOXIC AND DURABLE FOUL RELEASE COATINGS

The adherence of organisms to surfaces exposed to aquatic environments (fouling) is a major economic concern, particularly in the maritime shipping industry. Fouling on ships can increase fuel consumption by up to 40%. Coatings that prevent fouling currently exist but are an environmental concern due to their release of toxic levels of tin and copper.

Scientists at NDSU have invented a novel non-toxic, cross-linked thermoset polysiloxane-polyurethane coating that exhibits properties as foul release (FR) coating and allows organisms to be sloughed off by shear forces obtained at a ship's cruising speed. In addition to exhibiting its fouling release behavior, these coatings have been demonstrated to provide improved durability to its coating surface.

RFT 158

UNIQUE COATINGS (WITH PHASE SEPARATION PROPERTIES) FOR USE AS FOUL RELEASE AND ANTI-GRAFFITI PAINTS

This invention pertains to novel coating compositions that spontaneously phase separate to form uniform micro-domains on the coating surface, providing a multiphase topographical surface structure.

APPLICATIONS: These coatings may have use as foul release coatings in aquatic environments, anti-graffiti coatings, or as release paper for adhesive labels.

PROPERTIES: The micro-domain projections have low adhesion properties which are further augmented by the surface texture that limits the effective surface area for adhesion.

PREMISE: Micro-domain projections extrude approximately five microns from the surface with a separation distance of five microns between projections.

RFT 154

HARD, GLOSSY WATER DISPERSIBLE URETHANE EPOXY COATING

This invention pertains to novel water dispersible compositions that have epoxy urethane functional groups. These compounds can be dispersed in water with an added surfactant to form a dispersion containing no volatile organic solvent. The dispersed polymer can self-crosslink and can also crosslink with multifunctional amine compounds into a hard, glossy, solvent resistant coating.

STATUS:
Optioned in "Biomedical Coating Application on Medical Devices" Field of Use
Available in All Other Fields

RFT 141

NOVEL COATINGS FOR OUTDOOR BRONZES: FEATURES SUPERIOR PROTECTION AND EASY REMOVAL

This invention provides a solution for coating outdoor bronzes that affords both superior protection and easy removal.

APPLICATIONS: Outdoor bronze structures: provides protection from salt, UV radiation and moisture (the greatest hazards for outdoor bronzes). It also has potential applications on indoor bronze products.

PROPERTIES: Easy application (just spray or brush on the) coating, durability, without yellowing or oxidizing the bronze beneath, Uncomplicated and safe removal and elimination of damage caused by traditional mechanical removal methods.

PREMISE: This unique polymer technology has been used (in conjunction with combinatorial chemical methods) to make this coating formulation.

STATUS:
Licensed Exclusively in "Protective Coatings for Bronze and Other Metals" Field of Use in the US Territory
Currently Available in All Other Countries and Other Fields of Use

RFT 140

NOVEL ENVIRONMENT FRIENDLY (CHROMIUM-FREE) PRIMER COATING FOR CORROSION PROTECTION

Since the early 1980's, the use of chromates and other chromium-containing compounds have been subject to stringent regulations due to their recognized carcinogenic properties. This invention is a substitute for widely used chromium-based primer coating products, and is a novel, long lasting, chrome–free primer coating with proven anti-corrosive properties on metals.

This technology has been exclusively licensed in the Aerospace field of use. Licensing opportunities are however available in the other fields of use.

APPLICATIONS: This invention has been proven to be the only technology that protects high strength alloys from corrosion, without the need of any chromate pretreatment or pigmentation. Applications of this technology are broad and include aerospace, automobile, air conditioning and medical device manufacturing sectors.

PROPERTIES: This technology protects aluminum from corrosion while eliminating toxic and carcinogenic materials, such as chromium, that are currently being predominantly used for corrosion protection.

PREMISE: Immersion of elements in an inorganic matrix coating sacrificially corrodes and provides extended corrosion protection to the underlying metal substrate. It alleviates waste disposal hazards. Presence of Mg granulates in the coating provide sacrificial protection to the underlying metal substrate. It alleviates hazardous waste disposal.

RFT 71

MULTI-USE AMINOFUNCTIONAL ALKOXY POLYSILOXANES

This invention involves the method of preparing aminofunctional polysiloxanes. The method includes reacting a polyhydrosiloxane with an alcohol reactant including an aminoalcohol to form the aminofunctional alkoxy polysiloxane. The reaction is typically carried out in the presence of a catalyst which includes a rhodium compound. The invention also describes a coating composition which inludes an aminofunctional alkoxy polysiloxane. The coating composition is particularly suitable as an adhesive or primer for coupling a topcoat to a substrate.

RFT 65

NEW FAMILY OF ORGANOMETALLIC SINGLE SOURCE PRECURSORS FOR INORGANIC FILMS, COATINGS, AND POWDERS

A new family of organometallic compounds was developed. 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.

The advantages of the invention include the relatively innocuous nature of the precursor compound and the effluent organic compounds generated during decomposition and the low temperature of decomposition (less than 100^{o}C).

RFT 27

NOVEL SILOXANE REACTIVE DILUENTS FOR CATIONIC UV COATINGS

This invention revolves around the synthesis of novel siloxane reactive diluents that are compositions of epoxy resins and (cyclo) alkoxy-substituted organosilane.

APPLICATIONS: Provides improved properties to coatings that can be used on wood, plastic, paper, or metal. Potential uses include coil coating metal for beer, soda, and other cans, fiber optic protective coatings and microchip coatings or sealants (capsulation).

PROPERTIES: The reactive diluent increases the hydrolytic stability of the resultant cured films, and reduces the surface tension of the coatings.

PREMISE: This technology has functionalized the polyols with a siloxane group that participates in the film forming reaction via a photolytically initiated cross linking process.

RFT 26

VEGETABLE SEED-OIL BASED COATING FOR SUPERIOUR CORROSION PROTECTION

This vegetable (seed) oil-based (drying oil) coating utilizes mixed metal-oxo clusters to improve the properties of the ceramer films.

APPLICATIONS: Has potential uses with roofing materials, corrosion-resistant primers, heavy duty industrial coatings, new generation appliance (alkyd) coatings, and other alkyds or solvent based coatings.

PROPERTIES: Environmentally safe technology. The coatings exhibit enhanced hardness without sacrificing toughness, impact resistance, or adhesion. In addition, the mixed metal concept has resulted in films which exhibit superior corrosion protection for metal substrates.

PREMISE: Sol-gel methodology is implemented in this invention. The use of two sol-gel precursors has resulted in superior film properties over the use of a single sol-gel precursor.

FOR FURTHER INFORMATION

Please Contact:

Jonathan Tolstedt
NDSU Research Foundation
Fargo, ND 58105
Phone: 701-231-8173
Fax: 701-231-6661
Web: www.ndsuresearchfoundation.org

NDSU RESEARCH FOUNDATION