Photoscience Solutions

spectra

group limited, inc

Custom Formulations

Enabling Technology in Photochemistry
Photochemical Products and Services
Contract Research and Development

27800 Lemoyne Road Suite J Millbury, OH 43447
Phone 419-837-9783 Fax 419-837-6816

Specialists in Creative Photosciences Solutions

- Founded in 1991; dedicated and highly skilled staff
- Coverage of various fields including photochemistry; polymer chemistry; organic synthesis; troubleshooting; failure mechanism determination; performance testing
- Specialty resin formulations for various light cure applications
- World renowned photoscientist Dr. Douglas C. Neckers (Bowling Green State University, retired) is a permanent consultant to the staff

A. CONTRACT RESEARCH AND DEVELOPMENT SERVICES

- World-class expertise and well-equipped facilities in the basic and applied photochemical sciences, radiation cure and allied industries
- Proprietary or patent position for clients: introducing new products; assessing feasibility; finding solutions to existing problems
- Novel, difficult or "next generation" applications
- UV/visible light cure resin formulation development; photoinitiator optimization; testing and analysis; system approach
- Benefits for companies who are not skilled in photochemistry/radiation cure, who are exploring the use of radiation cure for the first time, or who want to employ supplemental expertise
- Areas of development: coatings for metal (including corrosion resistant coatings, automotive primer), wood and plastic; inks; adhesives for plastics, glass and metal; thick composition cure; filled potting materials
- Custom and toll formulation for customers' existing or newly developed products
- Custom and toll small molecule organic synthesis

B. SPECTRA GROUP PRODUCTS

UV/VISIBLE, PANCHROMATIC VISIBLE AND IR PHOTOINITIATORS

COLOR-ON-DEMAND LINE, including fully formulated products, additives and printed materials

SPECIALTY FORMULATIONS

ORGANIC SYNTHETIC SPECIALTIES

Custom Formulation/Product Development Services

Spectra Group offers a number of existing specialty light curable formulated products and can engage in custom formulation development.

Spectra Group offers its expertise in formulation/product development as a part of its customer service. The work is performed on a completely confidential and contractual basis. The following procedure is often implemented:

- Confidentiality/non-disclosure agreement is executed
- Formulation/product targets and specifications are discussed
- Properties needed and tests/measurements necessary to achieve them are highlighted
- Upon customer's request Spectra Group may submit a proposal; intellectual property disclosed in the proposal belongs to Spectra Group until the proposal is accepted
- If the proposal requests the prospective customer to finance the development, intellectual property developed during the work in the client's field will belong to the client
- If the proposal does not require the prospective customer to finance the development, the customer may still have an option to execute a technology transfer agreement to acquire the intellectual property that was developed in the course of work from Spectra Group
- Future relationships can be based either around a potential royalty stream or exclusive formulation/product supply for a number of years
- Existing formulation products can be purchased on a vendor/purchaser basis with no contractual obligation (minimum order sizes will apply in certain cases)

LIST of FORMULATED PRODUCTS

Formula #	Intended Use	Base chemistry	Viscosity @ 22C, cps	Substrate	Cure conditions	Main attributes
SPC-1121	UV Primer/Tiecoat for Plastics	Free radical, acrylate	5200	Polyester, Mylar	UVA, < 300 mJ/cm^2	To promote attachment of photopolymer plate to plastic substrate
Spectratite HP208 HP211	Structural adhesive for elevated temperature	2-part epoxy-amine	A: > 10,000 B: >35	Properly prepared aluminum	82^{o}C for 1 hr or 7 days at room T	Adhesives maintain significant lap shear and peel strength at temperatures > 82^{o}C
Spectratite HP121 HP183	Structural shim	2-part epoxy-amine	A: 20,000 B: 45	Properly prepared aluminum	82^{o}C for 1 hr or 7 days at room T	Solidified adhesive shim possess high compressive strength and superb solvent resistance
SPC-1135	UV decorative black ink	Free radical, acrylate, contains VOC for printability	2000	Metal	395 nm LED, 3 sec @ 1.5”	Pad printable, other colors may be developed
SPC-459, SPC-459Y1	Corrosion protective paint	Free radical, acrylate	4,500	Properly prepared steel	40 sec, visible Xe pulsed light @ 1.5”	Excellent adhesion and corrosion protection in continuous salt water immersion and salt fog exposure
SPC-1177	Low viscosity low gloss OPV	Free radical, acrylate	50	Paper, plastic	UVA, ~ 800 mJ/cm^2	Low gloss (10) does not come with the viscosity penalty
SPC-G5	Metallography embedment resin	Free radical, acrylate	400	Specialty use	UVA, visible light	Excellent hardness, solvent resistance, no shrinkage
SPC-1191 SPC-1192 SPC-1193	Protective OPV for wood with variable gloss	Free radical, acrylate	50	Wood veneer, paper	UVA, ~150 mJ/cm^2	Sprayable wood protective coatings with variable gloss; excellent adhesion, solvent and abrasion resistance
AP18-54	Automotive Primer	Free radical, acrylate	200	Metal	UVA, sunlight	Sprayable sandable primer for automotive body repair and topcoat application; excellent adhesion to metal, corrosion resistance

Custom Formulation/Product Development Services

Selected Examples

Corrosion Resistant Coatings SPC 459, SPC 459-Y1

- ***Target***

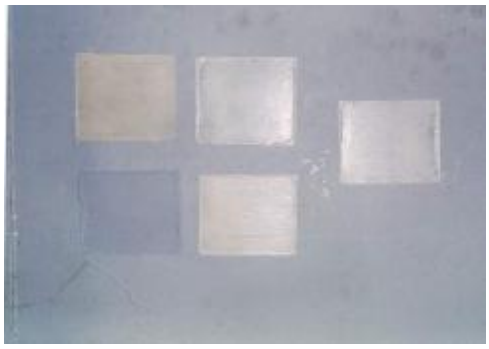
Development of radiation curable corrosion resistant coatings under a contract from the Navy to investigate protective repair paints for submarine ballast tanks

- ***Principle***

The technology (US Patent #6,211,262) is based on acrylate resins which incorporate corrosion protective fillers and other materials.

- ***Results***

1. Energy curable, essentially zero or very low VOCs paints have been developed
2. Very fast cure times are achieved with UVA, UV LED or visible light (pulsed Xenon) cure. For UV LED and pulsed Xe ~ 4 mil highly filled coating is cured under 1 min
3. No mixing – one part system
4. Cure is not sensitive to temperature or humidity conditions
5. Double coating is generally required for repair
6. Adhesion is optimized using silane adhesion promoters
7. Field trials have been conducted; paints have been applied to the inside of active duty submarine ballast tanks; 33 months of regular use showed no loss in adhesion or rust formation (see picture below)



Epoxy-Amine 2-part Adhesive System for Bonded Repair HP 208, HP 211

- ***Target***

Adhesive system compatible with safe, efficient aluminum surface preparation (sol-gel) that can be cured below 180 °F in a time that allows completion of the total repair cycle in 24 hrs or less. The final adhesive assembly must perform satisfactorily when subjected to an array of mechanical and adhesive strength tests across a service temperature range of -67 °F to 180 °F.

- ***Principle***

Formulation includes the use of novel materials which allow for both a high degree of flexibility and increased mechanical strength at elevated temperatures

- ***Results***

1. Adhesive developed is cured in 1 hr at 82 ^{o}C under 15” mercury vacuum
2. Excellent compatibility with the US Air Force accepted sol-gel aluminum surface pretreatment
3. Excellent mechanical strength at 180 ^{o}F (lap shear ASTM-D-1002)
4. Outstanding T-peel strength (ASTM-D-1876)
5. Reliable performance in wedge test (ASTM-D-3762) at 120 +/- 5 °F and 95 – 100% relative humidity: no crack propagation, no adhesive failure

Light Castable Mounting Resin G5

- ***Target***

Fast setting, one component material for clear encapsulation of brittle and heat sensitive specimens for microtoning

- ***Principle***

UV/visible light curing formulation is created using careful material selection to minimize shrinkage and provide low cure exotherm

- ***Results***

1. Sets in less than 5 min, 20 min for complete cure in 2" thick plugs
2. Peak exotherm does not exceed 110 ^{o}C
3. Excellent clarity
4. Low viscosity (400 cps @ room T) allows for easy air entrapment release
5. High hardness, Shore D 90
6. Excellent solvent resistance
7. Excellent adhesion to embedded metal parts

UV/sunlight activated primer-filler AP18-54

- ***Target***

One component, UV/sunlight curable, high build primer filler for automotive body repair and topcoat application

- ***Principle***

Solvent-based formula allows for easy spraying using conventional spraying equipment

- ***Results***

1. UVA lamp cure in 3 min or less, sunlight cure in 5 min in full sun
2. Up to 5-8 mil thickness per coat after solvent evaporation
3. Excellent adhesion to metal (5B ASTM 3369)
4. Corrosion resistance
5. Wet and dry sandability

Low viscosity low gloss overprint varnish (OPV) SPC-1177

- ***Target***

UV curable OPV for paper or plastic substrate with low gloss and low viscosity

- ***Principle***

UV formulations naturally have high gloss and incur viscosity penalty when the gloss is lowered, which makes them difficult to coat

- ***Results***

1. Specialty filler is used to achieve low gloss
2. Viscosity ~ 50 cps @ 22^{o}C makes this coating suitable for spraying or roll coater
3. Gloss of 10 at 60^{o} gives the coating an ultramatte appearence
4. High solvent and abrasion resistance