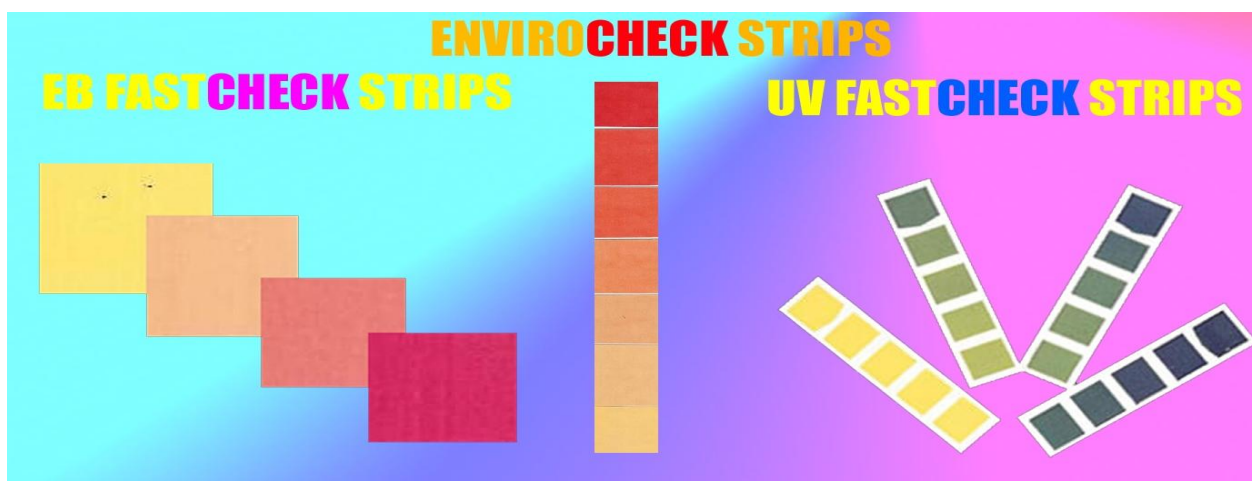
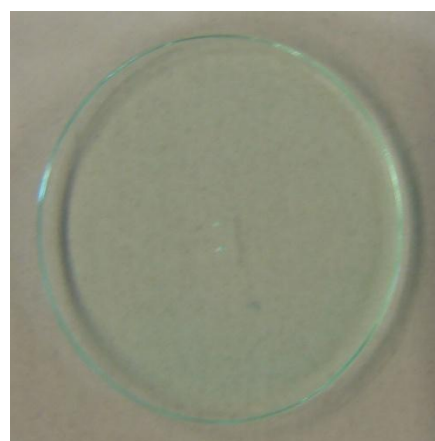
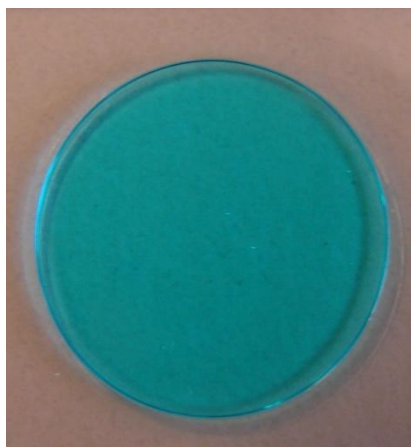


# Photoscience Solutions



## Color-On-Demand

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

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20 YRS OF PHOTOCHEMICAL SOLUTIONS

# SPECTRACOLOR

## Color-on-Demand Products

- Photoinduced COLOR CHANGE EFFECTS in coatings, inks, adhesives and plastics
- Differentiation by Type of the available product, Color Change Scheme or Matrix of Use choice
- Varying degree of color change PERMANENCY from completely IRREVERSIBLE to LONG PERIOD FADEOUT (weeks/days) to standard FAST-FORMING/FAST-REVERSING photochromics
- COLOR CHANGE response to various UV and visible light sources (including office and daylight fluorescent lamps), as well as sun exposure
- Product tailoring to the specific application
  - Some of the potential applications include:
    - Application verification
    - Exposure/Cure verification
    - Packaging effects, customization
    - Promotion and advertising
    - Security
    - Game pieces
    - Demonstrations, science kits
    - Screen printing
    - UV/Visible light/Electron Beam/ $\gamma$ -ray dose measurement

Joint Research & Development Projects to introduce Color-on-Demand capabilities are possible and encouraged. Confidentiality ensured.

# Product Type

Fully Formulated  
Inks and Products

Additives  
and Concentrates

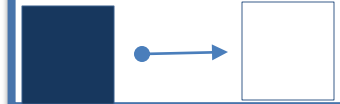
Printed Products

# Color Change Scheme

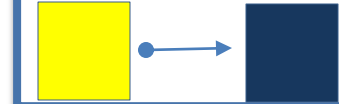
FORMING Color



REMOVING Color



CHANGING Color



# Matrix of Use

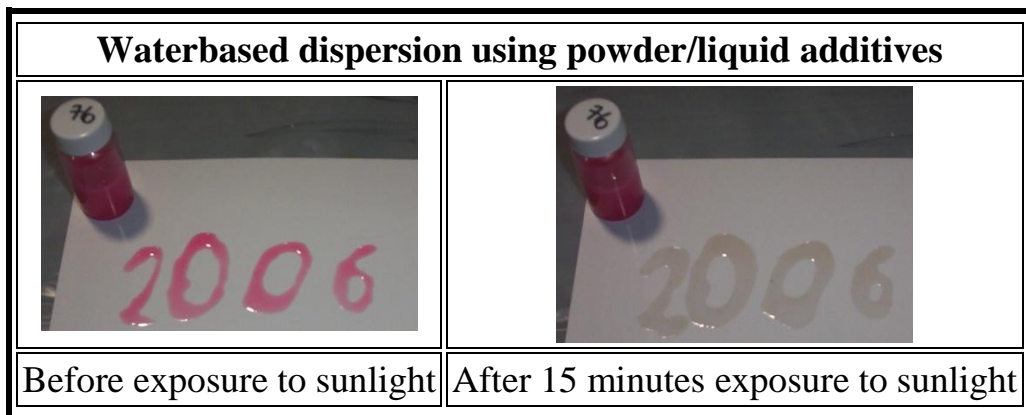
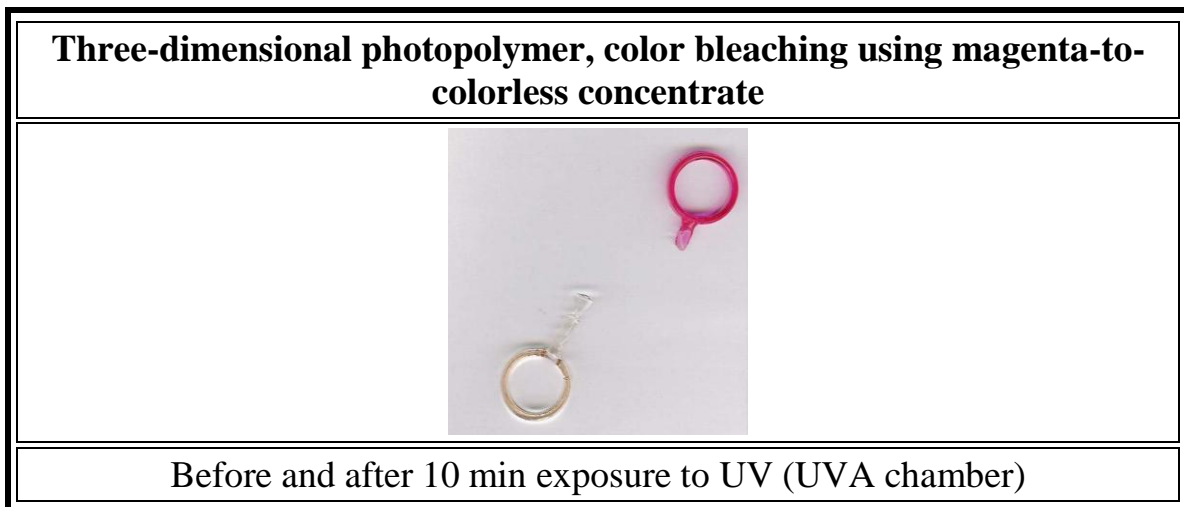
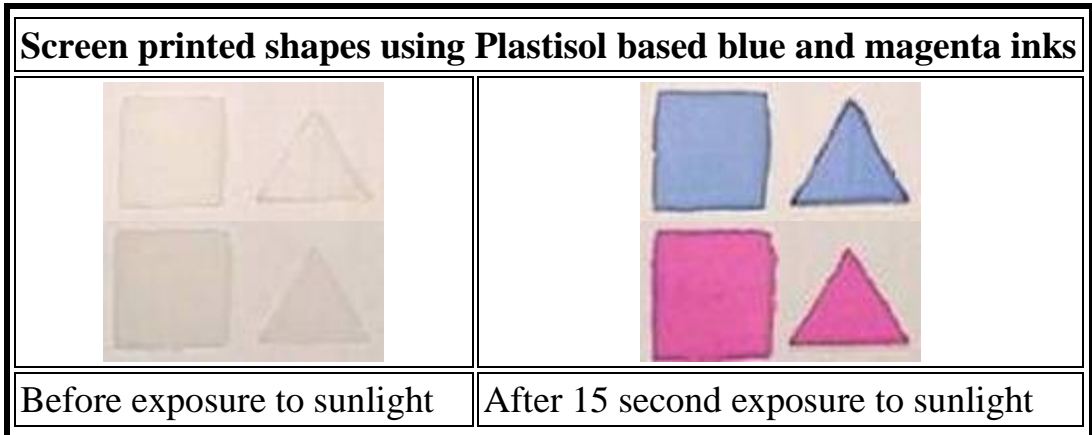
Solvent Based

Water Based





Solvent Free  
(Radiation  
Curable)




Plastisol  
Inks

# FULLY FORMULATED PRODUCTS and PRODUCTS BASED on SPECTRACOLOR ADDITIVES/CONCENTRATES



# PRINTED PRODUCTS/THIN PROFILE RADIACHROMIC FILMS

<p><b>UV FastCheck Strips</b></p>	<p>--- UV exposure dose monitoring (narrow web, difficult to access, partially covered and 3-D applications)                  --- Good linearity color change vs accumulated exposure dose, large dynamic range of exposure doses – <u>five</u> sensitivity zones, broad spectral responsivity (suitable for undoped and various doped mercury sources)                  --- Comparison of multiple sources, quality control</p>  <p><i>Unexposed 100 200 400 550 800 1700 3400</i></p> <p><i>** Fusion single 300W/lin inch H-bulb, actual dose (mJ/cm<sup>2</sup>) measured with ILT-393 radiometer, (UVA/UVB range)</i></p>
<p><b>UV Intensity Labels<sup>a</sup></b></p>	<p>--- UV exposure dose monitoring (narrow web, difficult to access, partially covered and 3-D applications)                  --- Good linearity color change vs accumulated exposure dose, large dynamic range of exposure doses – <u>single</u> sensitivity zones, broad spectral responsivity (suitable for undoped and various doped mercury sources)                  --- Comparison of multiple sources, quality control</p>  <p><i>Unexposed 100 200 400 550 800 1700 3400</i></p> <p><i>** Fusion single 300W/lin inch H-bulb, actual dose (mJ/cm<sup>2</sup>) measured with ILT-393 radiometer, (UVA/UVB range)</i></p>
<p><b>EB FastCheck Strips<sup>b</sup></b></p>	<p>--- Electron beam (EB)/γ-ray exposure dose monitoring for varying accelerated voltage                  --- Depth of penetration profiling                  --- Comparison of multiple sources, quality control                  --- Radiation sterilization indicator</p>  <p><i>Unexposed 5 10 20 30 40 70 100</i></p> <p><i>** Dose in kGy, EB pilot curing line, 150 kV accelerating voltage, 50 fpm, 1.5" air gap</i></p>
<p><b>EnviroCheck Strips</b></p>	<p>--- Measure accumulated sun dose exposure over a period of a <u>day</u> in distinct increments                  --- Longer sun exposure products (measurement over a period of a <u>month</u>) are possible</p>  <p><i>Unexposed 0.5 1 2 3 4 6</i></p> <p><i>** Q-Sun Xenon test chamber (1.3 W/m<sup>2</sup> @ 420 nm, 50 °C): varying residence time in hrs</i></p>

<p><b>UVC Labels</b></p>	<p>--- UV exposure dose monitoring, specifically targeted for short wavelength, 254 nm, germicidal bulbs</p>  <p>Unexposed 0.5 1 2 5 10 20</p> <p>** 2 germicidal USHIO 9Wbulbs, 3inch distance, varying residence time in min</p>
<p><b>RoomLight</b></p>	<p>--- Measure accumulated room light dose exposure over a period of <b>days</b> in distinct increments</p>  <p>Unexposed 7 17 30 43 56</p> <p>** Indoor room with no windows, lit by a set of daylight fluorescent bulbs, stickers attached on the vertical wall not facing the lamp directly, lights on b/t the hours of 8 am and 5 pm, lights off during non-working hours and on weekends, varying residence time in days</p>
<p><b>SunGuard Strips<sup>c</sup></b></p>	<p>--- Simple personal guide against UV overexposure from the sun          --- Calibrated to measure Minimal Erythral Dose (MED)</p>  <p>** Before sun exposure      1/2 MED      1 MED</p>

<sup>a</sup> R. W. Stowe, Fusion UV Systems, Inc. Advanced Methods of Radiachromic Radiometry for UV Curing, *RadTech 2008*

<sup>b</sup> I. Rangwalla, Energy Sciences, Inc. Quick and Easy Way to Characterize Low Voltage (80 – 125 kV) EB Accelerators Using FastCheck Strips, *RadTech 2010*

<sup>c</sup> The medical community states that exposure to 1 MED results in a reddening of the skin. After 1 MED is reached people with fair and medium complexion are advised to seek protection from the sun.  
<http://www.fda.gov/cdrh/consumer/tanning.html> <http://www.epa.gov/sunwise>

## COLOR-ON-DEMAND IRREVERSIBLE FORMULATED PRODUCTS

Product Type	Recommended Usage	Product Description <sup>b</sup>	Color Change Scheme <sup>a</sup>
Formulated Inks and Coatings	Screen Printing Solvent Casting Various In-Line Coaters (i.e. slot-die) Pad Printing	Solvent Based Screen Printing Ink <i>S LOVIS Series</i>	Forming, Bleaching, Changing Reversible Photochromics
		Solvent Based Inks for In-Line Coating	Forming, Bleaching, Changing Reversible Photochromics
		Plastisol (thermal fusion) Screen Printing Inks <i>IPL Series</i>	Forming Reversible Photochromics
Liquid Additives/Concentrates	Addition to solventbased systems	Base - acetone, MEK, propylene carbonate, diacetonealcohol, diglyme, N, N-dimethyl acrylamide (N,N-DMAA)	Forming, Bleaching Reversible Photochromics
	Addition to waterbased systems	Base - diacetonealcohol, triethanolamine, water	Forming, Bleaching
	Radiation Curable VOC-free systems (cationic and free radical)	Base - cycloaliphatic epoxy, various acrylate monomers, diacetone alcohol, propylene carbonate, N, N-dimethyl acrylamide (N,N-DMAA)	Forming, Bleaching Reversible Photochromics

<sup>a</sup>Exact color change schemes depend on application and may be limited

<sup>b</sup>Custom product development is possible. Solvent content minimization or solvent substitution can be attempted upon request.

# About Spectra Group

## We Are Specialists in Creative Photosciences Solutions

The company was founded in 1991 and has a dedicated and highly skilled staff covering various fields including photochemistry, polymer chemistry, and organic synthesis.

Some of our main specialties include **resin formulation** for various light cure applications, **photoinitiator optimization, formulation testing and analysis**, including novel, difficult and “next generation” varieties.

Spectra Group offers both **CONTRACT RESEARCH/DEVELOPMENT SERVICES** and a **UNIQUE COLLECTION of PRODUCTS**

For Contract R&D Spectra Group uses its world-class expertise and well-equipped facilities to obtain proprietary or patent position for its clients, introduce new products, assess feasibility, or find solutions to existing problems.

Spectra Group Contract R&D work can be beneficial 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 in the field.

The areas of formulation development for existing and new products include coatings for metal (corrosion resistant coatings, automotive primer), wood and plastic; inks; adhesives for plastics, glass and metal; thick composition cure; filled potting materials.

Spectra Group also performs custom and toll small molecule organic synthesis.

**SPECTRA GROUP PRODUCTS** include:

- UV/VISIBLE, PANCHROMATIC VISIBLE AND IR PHOTOINITIATORS
- COLOR-ON-DEMAND LINE, including fully formulated products, additives and printed materials
- SPECIALTY CUSTOM FORMULATIONS
- ORGANIC SYNTHETIC SPECIALTIES

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