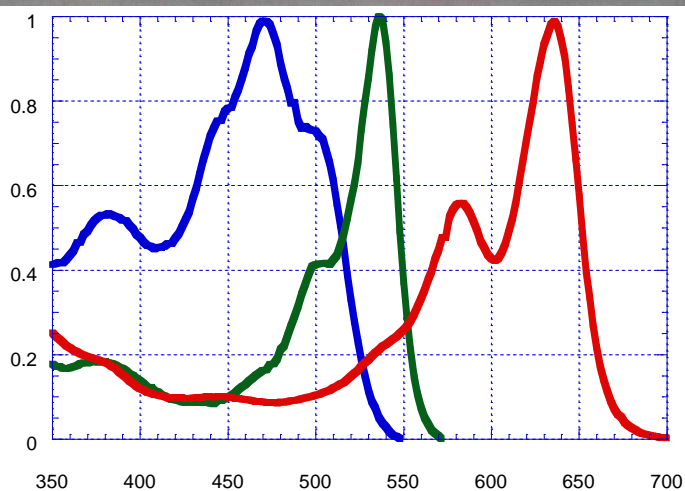


Photoscience Solutions

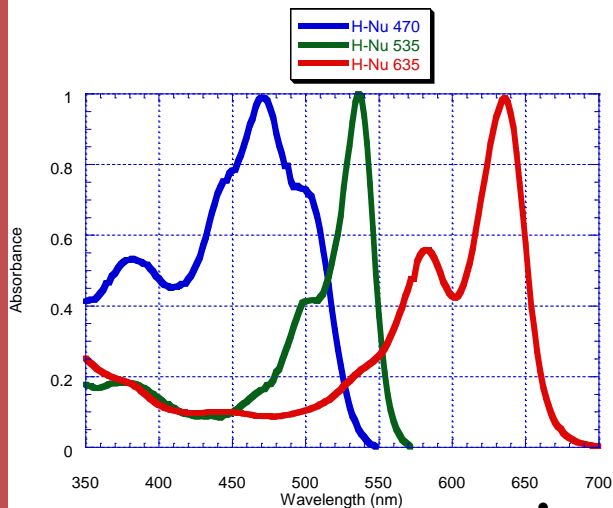


Photoinitiators

Enabling Technology in Photochemistry
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spectra
group limited, inc
20 YRS OF PHOTOCHEMICAL SOLUTIONS



H-Nu 470, 535, 635 Visible Light Photoinitiators

- Panchromatic absorbance, 350-670 nm among all three initiators
- Capable of curing a wide range of resins via two mechanisms:
 - Free-radical Acrylates or
 - Cationic Epoxides (including SU-8 photoresists^a)
- Capable of significant depth of cure, > 1 in.
- Enhanced adhesion/depth of cure of pigmented formulations
- Cure through UV opaque, pigmented, colored substrates (i.e. red plastic)
- Initiators bleach as they cure to pale or no residual color and indicate exposure to UV/Visible light

Initiator	Cure Mechanism	Abs Peak	ϵ at peak	Abs Range
H-Nu 470 ^{b,c}	Free Radical/Cationic	470	30,000	350-530 nm
H-Nu 535 ^c	FreeRadical/Cationic	535	90,000	450-550 nm
H-Nu 635	Free Radical	635	90,000	500-660 nm

^a **SU-8 References:** Y. Lin, P.R. Hermann and K.Darmawikarta, *Appl. Phys. Lett.* **86**, 7, 071117 (2005)
 J.H. Moon, S.-M. Yang, D.J. Pine, W.-S. Chang, *Appl. Phys. Lett.* **85**, 18, 4184 (2004)
 D. Rodriguez Ponce, K Lozano, et al. *J. Polym. Sci.: Part B: Polym. Phys.* **48**, 1, 47 (2010)

^b **H-Nu 470** is commercially available (LVE) and is non-toxic (LD50>5000 mg/kg)

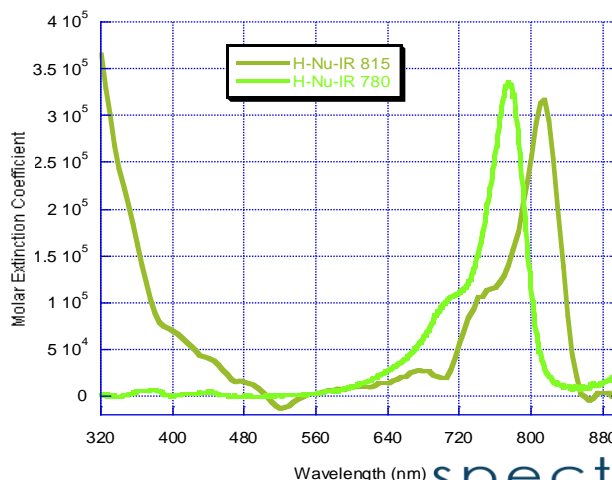
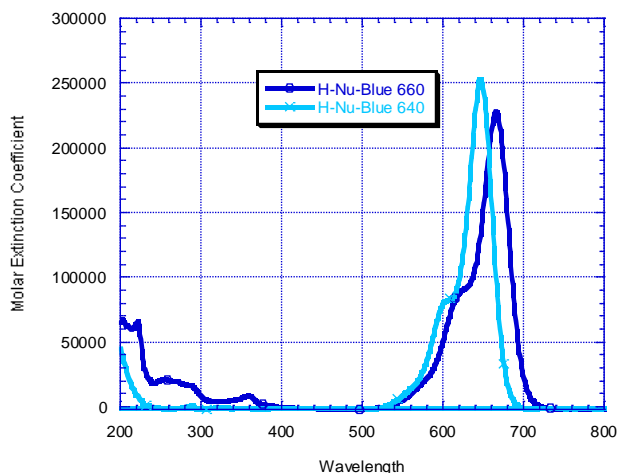
^c **AN-910-E** coinitiator can be used to accelerate the cationic cure of **H-Nu 470** and **535**

H-Nu-Blue 640 & 660 (Visible) and H-Nu IR 780 & 815 (Infrared) Photoinitiators

- Absorbance in the 575-700 nm range for curing with red colored light sources and through colored substrates (i.e. red plastic)
- Absorbance in the 700-850 nm range for curing with infrared sources (e.g. laser diodes)
- Capable of curing a wide range of acrylates via a free-radical mechanism
- Initiators bleach as they cure to pale or no residual color and indicate exposure to Visible/IR light

Initiator ^d	Abs Peak	ϵ at peak	Abs Range
H-Nu-Blue 660	665	230,000	580-690 nm
H-Nu-Blue 640	645	255,000	570-670 nm
H-Nu-IR 780	780	>250,000	650-810 nm
H-Nu-IR 815	815	>250,000	690-850 nm

^d Use of **Borate V** coinitiator enhances cure and bleaching



Blends of H-Nu PIs for Efficient Visible Light Cure

- Novel products
- H-Nu 470X provides improved surface cure in acrylate systems
- Liquid blends make photoinitiators easy to incorporate
- Capable of curing wide range of acrylates via a free-radical mechanism in visible and UV/visible range
- Initiator bleaching for selected blends: pale or no residual color

Blend	Range, nm	Co-Initiator	Comments	Blend
<u>470X</u> powder	300-550 Peaks 380 & 470	Amine or Borate	Improved surface cure, sulfonium salt sensitization	<u>470X</u> powder
<u>470IL</u> liquid	300-550 Peaks 380 & 470	Not required	Improved UVA performance, contains N,N- DMAA, version in cyclohexanone available	<u>470IL</u> liquid
<u>470LT</u> liquid	300-550 Peaks 380 & 470	Not required	Improved surface cure, tested with 365 and 395 nm LED	<u>470LT</u> liquid
<u>605IL</u> liquid	300-420, 590- 620 Peaks 380 & 605	Not required	UV/Visible light cure for waterbased acrylated dispersions	<u>605IL</u> liquid

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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