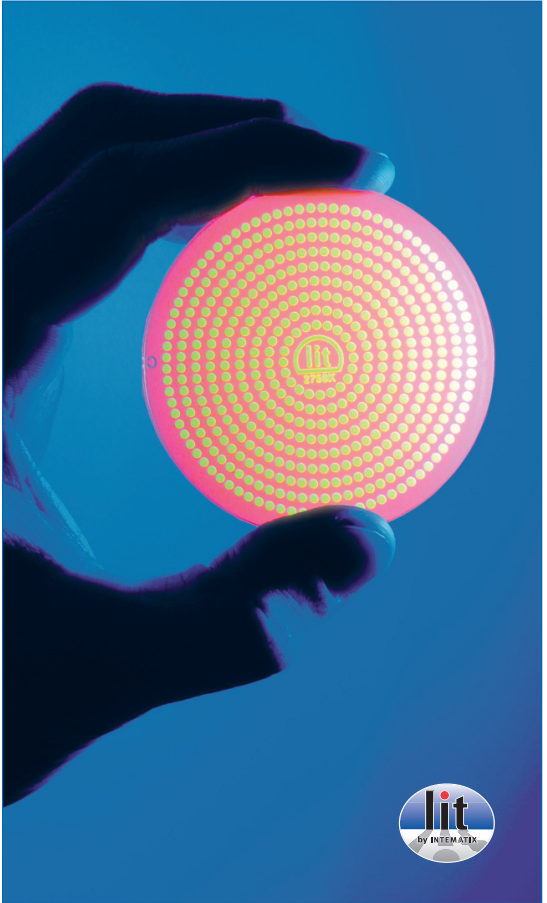


ChromaLit™

Remote Phosphor

*Intematix Intellectual Property Leadership*



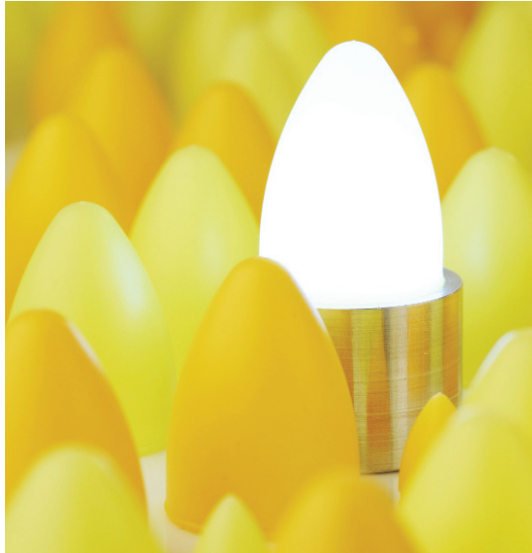
INTEMATIX

## Inspiration

From the black light posters of the 1960s to the fluorescent lights in your office, light-emitting phosphor has infiltrated our lives over the past century.

While remote phosphor is a novel approach to LED lighting, the fundamental architecture has a long history. In 1896 and 1901, Thomas Edison filed the first patents for lamps powered by a phosphor-coated substrate excited by X-Ray and UV light. By the 1930s, the Switzer brothers, Robert and Joseph, had created phosphor ink and called it Day-Glo.

DayGlo paint, invented by the Switzer Brothers in 1934, has infiltrated everything from art to fashion with phosphor-powered color.



Intematix patented ChromaLit remote phosphor light sources are moving LED lighting forward.

## Innovation

Shortly after commercializing LED phosphors in the early 2000s, Intematix began efforts for commercializing technology for applying phosphor remotely. Like the fluorescent lights ubiquitous in offices, LEDs would power a phosphor coating.

Unlike fluorescent, however, LEDs flexibility and use of environmental material means the phosphor can be made in any shape. With the first Intematix remote phosphor patent being issued in 2006, Intematix currently has 56 patents issued or filed around remote phosphor technology.

## Intematix and ChromaLit

### *Remote phosphor commercialization*

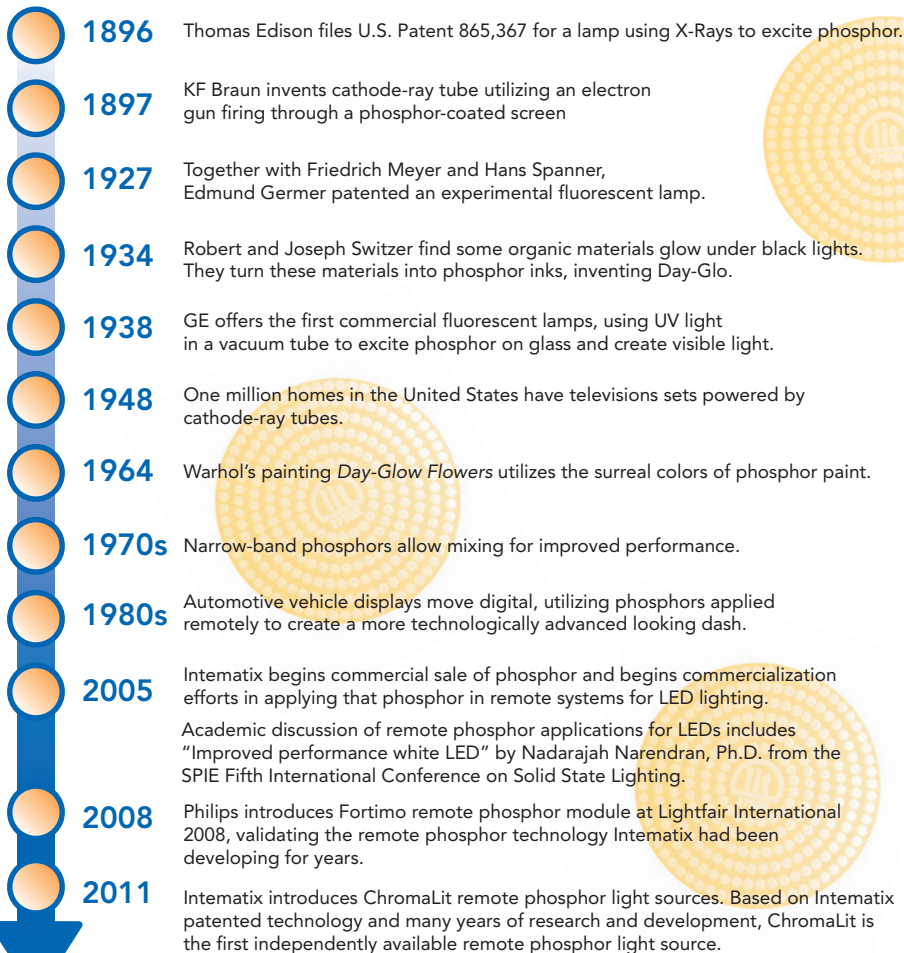
After years of research and intellectual property development on remote phosphor technology in tandem with phosphor development, Intematix launched ChromaLit remote phosphor light sources.

While the ChromaLit remote phosphor product line's patented layering process and standard shapes have improved continuously, the inventive origins can be found in past innovation and Intematix's rich intellectual property.

*When automotive dashboard displays moved digital, phosphors were used for digital lighting (1980s).*



# Remote Phosphor Timeline

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- 1896** Thomas Edison files U.S. Patent 865,367 for a lamp using X-Rays to excite phosphor.
- 1897** KF Braun invents cathode-ray tube utilizing an electron gun firing through a phosphor-coated screen
- 1927** Together with Friedrich Meyer and Hans Spinner, Edmund Germer patented an experimental fluorescent lamp.
- 1934** Robert and Joseph Switzer find some organic materials glow under black lights. They turn these materials into phosphor inks, inventing Day-Glo.
- 1938** GE offers the first commercial fluorescent lamps, using UV light in a vacuum tube to excite phosphor on glass and create visible light.
- 1948** One million homes in the United States have television sets powered by cathode-ray tubes.
- 1964** Warhol's painting *Day-Glow Flowers* utilizes the surreal colors of phosphor paint.
- 1970s** Narrow-band phosphors allow mixing for improved performance.
- 1980s** Automotive vehicle displays move digital, utilizing phosphors applied remotely to create a more technologically advanced looking dash.
- 2005** Intematix begins commercial sale of phosphor and begins commercialization efforts in applying that phosphor in remote systems for LED lighting. Academic discussion of remote phosphor applications for LEDs includes "Improved performance white LED" by Nadarajah Narendran, Ph.D. from the SPIE Fifth International Conference on Solid State Lighting.
- 2008** Philips introduces Fortimo remote phosphor module at Lightfair International 2008, validating the remote phosphor technology Intematix had been developing for years.
- 2011** Intematix introduces ChromaLit remote phosphor light sources. Based on Intematix patented technology and many years of research and development, ChromaLit is the first independently available remote phosphor light source.