OmniCure®
UV Curing • In Control

Hydrogel UV Curing

The Challenge

Obtaining high doses of UV energy from a UV curing light source while maintaining controlled temperature levels required for in vitro and in situ photopolymerization for hydrogel curing applications.

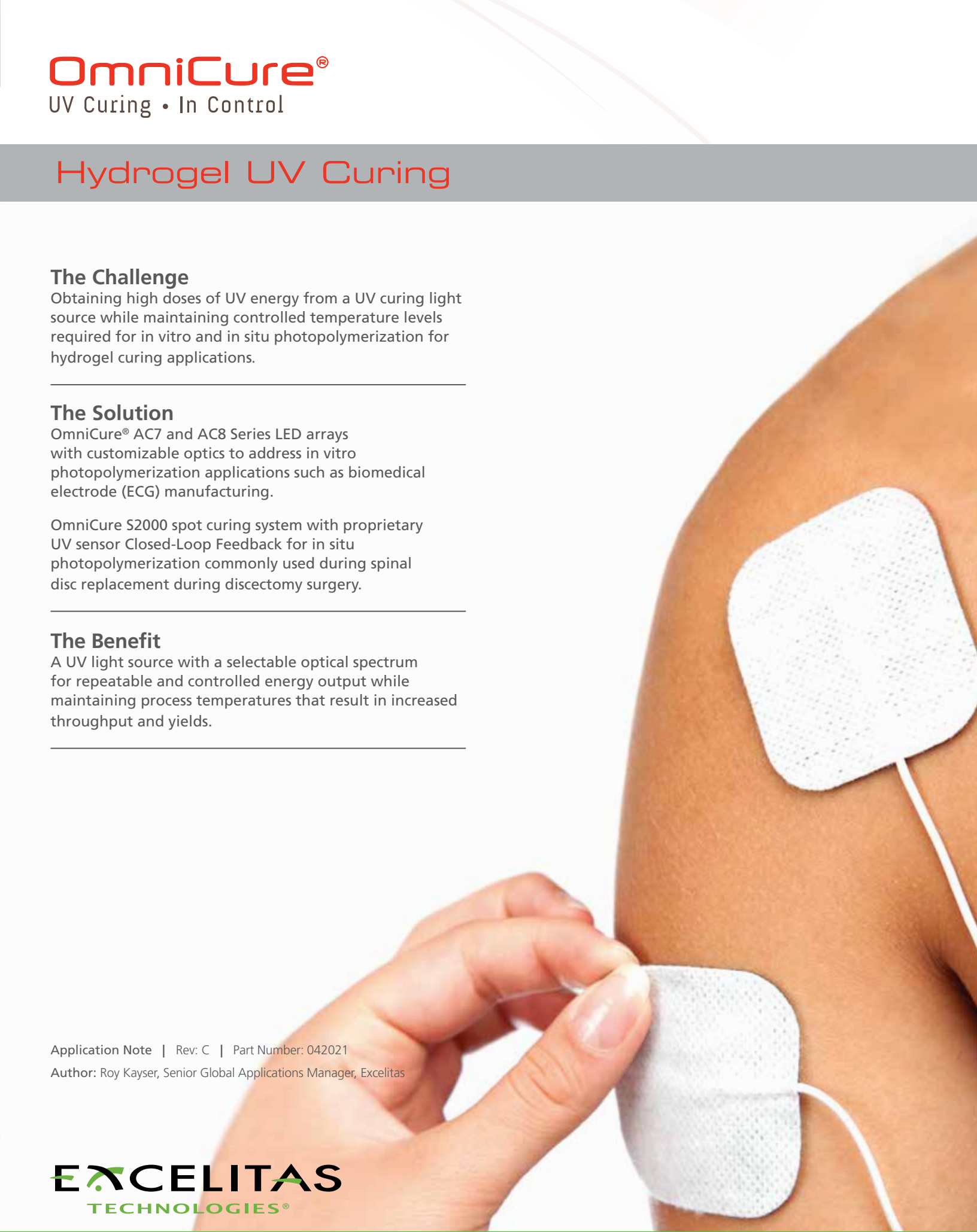
The Solution

OmniCure® AC7 and AC8 Series LED arrays with customizable optics to address in vitro photopolymerization applications such as biomedical electrode (ECG) manufacturing.

OmniCure S2000 spot curing system with proprietary UV sensor Closed-Loop Feedback for in situ photopolymerization commonly used during spinal disc replacement during discectomy surgery.

The Benefit

A UV light source with a selectable optical spectrum for repeatable and controlled energy output while maintaining process temperatures that result in increased throughput and yields.



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Introduction

Hydrogels have been used for over 50 years in various biomedical applications including but not limited to, biomedical electrodes (ECG and defibrillators), contact lenses, spinal disc (nucleus pulposus) replacement, tissue scaffold implants, 3D encapsulation of cells, drug delivery systems and artificial muscles. Traditionally, hydrogels were created using chemical cross-linking, however photopolymerization cross-linking is now dominating the hydrogel arena.

The global market for biomedical electrodes will surpass US $1.9 billion by 2020.[1] There are over 85 FDA approved biomedical electrode manufacturers globally (FDA classification code DRX and KRC). Some of the major players in biomedical electrodes include 3M Corporation, Ambu A/S, CONMED Corp, Medtronic/Covidien, C.R Bard Inc., and ZOLL Medical Corp. among others.

The tissue engineering market which encompasses discectomy surgery (nucleus pulposus replacement), wound and burn dressings, 3D hydrogel scaffolds for skin grafts and organ regeneration has surpassed $7 billion dollars and continues to grow.

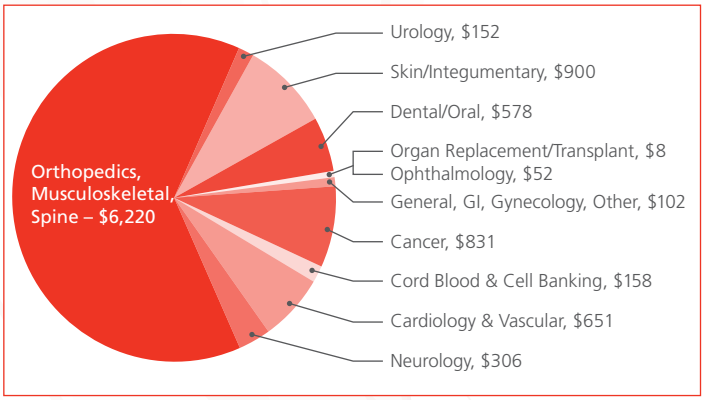

FIGURE 1: Tissue Engineering and Cell Therapy Market, by Clinical Category, 2009-2018 ($Millions).[2]

There are over 150 FDA approved hydrogel related, tissue engineering support product manufacturers globally (FDA classification codes MGQ, NAE, ODR and NTC). Manufacturers such as Advanced Prosthetic Technologies, Amedica, Biomet, Cervitech, DePuy Spine, Covidien, Spinal Kinetics and Globus Medical are involved in this globally expanding market. The need for intelligent and versatile UV light sources, for both spot and area curing, has risen accordingly.

Application Overview

Hydrogel curing in a biomedical electrode application is a low temperature, high dose and high speed application. Many varieties of electrodes require close monitoring of residual monomers; the ability to deliver repeatable and controlled dose levels while ensuring process temperatures are maintained will allow manufacturers to minimize maintenance and Quality Assurance testing costs.

FIGURE 2: Biomedical Electrodes.

Hydrogel temperature typically must be kept below 50°C to prevent degradation of the hydrogel itself. The hydrogel carrier is often a pliant foam material which will distort if exposed to high continuous irradiance levels. Delivering high irradiance packets of UV energy will ensure proper hydrogel reactions while maintaining low carrier temperature levels.

FIGURE 3: Defibrillator Electrodes.

Biomedical electrodes are often produced at conveyor speeds of 8 cm/sec to 10 cm/sec while requiring in excess of 10 J/cm^2 for proper curing and removal of monomers.

The OmniCure AC7 and AC8 Series are high power LED arrays with optical line lengths of 150mm and 300mm respectively. The AC8 Series optical line length is 225mm. The AC7 and AC8 Series is a suitable light source for this application which provides customizable front-end optics that enable each unit to be easily integrated into virtually any unique process. Instant ON/OFF features result in the ability to deliver high levels of time modulated energy. Available in 365nm and 395nm, a suitable AC7 and AC8 Series model can be selected to match the specific hydrogel requirements.

Spinal disc replacement and repair (discectomy surgery) is another hydrogel application which is migrating to less invasive surgical techniques.

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FIGURE 4: In-situ Application for Nucleus Pulposus replacement.

Studies have successfully demonstrated that a damaged spinal disc can be repaired non-invasively by drawing out the disc fluid (nucleus pulposus) and injecting a specially formulated UV curable hydrogel. The hydrogel is subsequently cured and conditioned by introduction of precisely controlled levels of UV energy through a small light delivery fiber. Currently, the OmniCure S2000 spot curing system with proprietary UV sensor Closed-Loop Feedback and patented Intelli-Lamp® technology is the most suitable and preferred source. The Closed-Loop Feedback system actively monitors lamp degradation and ensures that each and every delivered dose meets the unique programmed requirements within the specific manufacturing process.

FIGURE 5: Spinal Disk (nucleus pulposus).

Available optical light delivery guides range from single 1mm fibers through to 8mm diameter bundles as well as multi-legged guides, both in liquid and fiber versions.

Benefits of the OmniCure AC7 and AC8 UV LED Curing Systems

- Advanced PLC controls allow precise spatial customization of optical energy delivery.
- Specialty optics ensures precise delivery of energy and higher utilization of available optical power.
- Maximum flexibility via adjustable intensity control for desired optical output to meet specific application requirements.
- Higher optical efficiency resulting in lower operating costs.
- Instant ON/OFF control for time-modulated energy delivery.
- Zero IR content and selective narrow-band optical emissions ensuring low heat generation.
- Absence of ozone emanation reduces operating and integration costs by eliminating the need for external venting.
- Reduced frequency of lamp replacements resulting in reduced maintenance and lower operating costs.
- Reduced downtime with remote temperature monitoring (AC Series only) of output and preventative control (via intensity control).

		AC7150	AC7300
Typical Irradiance (W/cm²)		365nm	395nm
Working Distance	10mm	3.3	5.0
	20mm	2.6	4.0
	30mm	1.9	3.0

		AC8150		AC8225		AC8300	
Typical Irradiance (W/cm²)		365nm	395nm	365nm	395nm	365nm	395nm
Working Distance	1mm	4.0	8.5	4.0	8.5	4.0	8.5
	10mm	3.0	6.2	3.0	6.2	3.0	6.2
	20mm	2.3	4.5	2.3	4.5	2.3	4.5
	30mm	1.9	3.8	1.9	3.8	1.9	3.8
	40mm	1.5	3.0	1.5	3.0	1.5	3.0
	50mm	1.2	2.5	1.2	2.5	1.2	2.5

Benefits of the OmniCure S2000 UV Spot Curing System

- Closed-Loop Feedback technology automatically monitors and maintains a constant output for a repeatable spot UV curing process using an integrated UV sensor.
- Intelli-Lamp technology ensures optimum operational lamp temperature and on-lamp storage of accumulated lamp hours.
- Guaranteed lamp life of 2000 hours.
- Controllable spectral output through selection of custom designed optical filters (320-500nm, 250-450nm, 365nm, 320-390nm and 400-500nm).
- The OmniCure S2000 provides up to 30 W/cm² of optical power with a 320-500nm filter.
- Programmable in 1% intensity increments or with irradiance values via integration and calibration with the OmniCure R2000 radiometer.
- A feature-rich PLC and RS-232 interfaces allow for integration into any production line.

For full specifications, please follow the links:

- https://www.excelitas.com/product/omnicure-ac7-led-large-area-uv-curing-system
- https://www.excelitas.com/product/omnicure-s2000-spot-uv-curing-system.

Learn more about OmniCure

For additional details, please visit www.excelitas.com or contact us at omnicure@excelitas.com today.

References

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2. MedMarket Diligence, LLC: Report #S520, "Tissue Engineering, Cell Therapy and Transplantation Products, Technologies and Market Opportunities, Worldwide 2009-2018" from www.prweb.com/releases/electrodes/medical_devices/prweb4545494.htm

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