

INSPIRE

Vision

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INNOVATE

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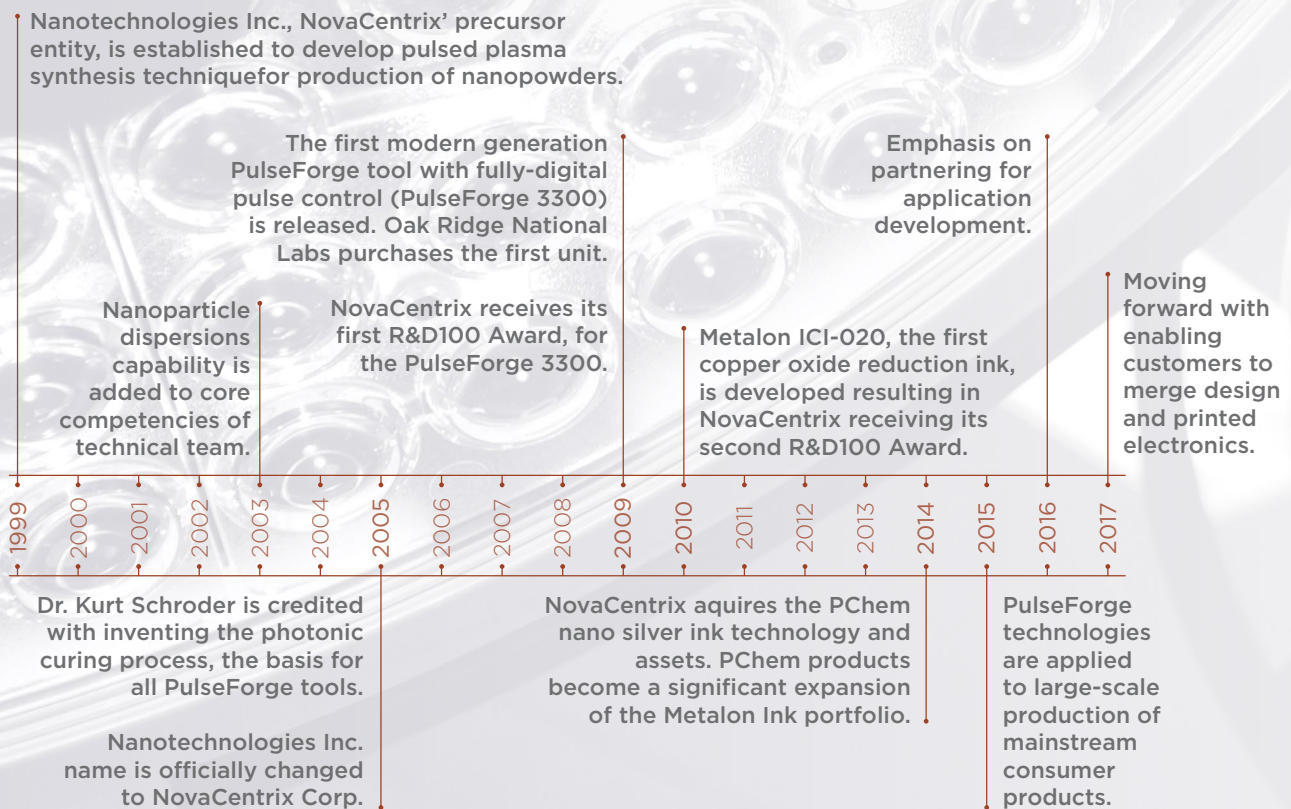
VISION

NovaCentrix partners with you to take ideas from inspiration to implementation. Through our innovative PulseForge® tools and Metalon® Inks products, we continue to enable advancements in printed electronics for researchers, product innovators and manufacturers as technologies and markets evolve.

ABOUT US



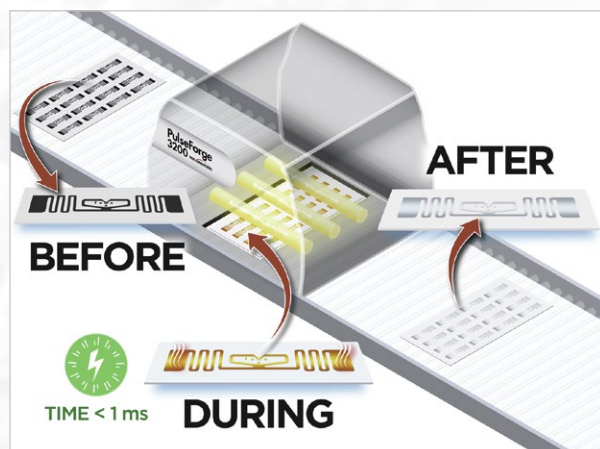
NovaCentrix offers industry leading photonic curing tools, conductive inks, material and expertise enabling development and production of next generation printed electronic devices - some already on the market. PulseForge® tools utilize photonic curing which is a cutting edge technology that dries, sinters, and anneals functional inks in milliseconds on low-temperature, flexible substrates such as paper and plastic.



PHOTONIC CURING

Photonic curing is an industrial thermal process in which a thin film is heated with pulsed light from a flash lamp. When the film is heated on a substrate, the bulk of the substrate stays relatively cool since the exposure time is so brief (~1ms). When this transient processing is performed on substrates that have relatively low thermal damage threshold, such as plastic or paper, it is possible to attain significantly higher temperatures in the thin film without damaging the substrate than possible with an ordinary oven. Since photonic curing tools quickly cure thin films at high temperature on low temperature substrates, it is ideal for roll-to-roll processes on polymer or paper.

Photonic curing was first developed by NovaCentrix and is incorporated into the PulseForge® set of tools. It has become a transformative process used in the manufacture of printed electronics as it allows inexpensive and flexible substrates to be substituted for traditional glass or ceramic substrates. Additionally, the higher temperature processing afforded by photonic curing reduces the processing time exponentially, often from minutes down to milliseconds, which increases throughput all while maintaining a small machine footprint. NovaCentrix holds the key patents to this technology worldwide.



Printed conductive ink with limited or no electrical performance on low temperature substrates is transformed through photonic curing into a highly conductive printed electronic pattern with superior performance and throughput not possible by other methods.



Inks are heated yet substrate is not, exposure time is less than a millisecond.

APPLICATIONS

DISPLAY, PACKAGING, CIRCUIT, WEARABLE, PHOTOVOLTAIC, ANTENNA, 3D FABRICATION, OLED

The maturing complexity of modern printed electronics for applications demands high throughput manufacturing and improved device function. As the demand for more functionality out of each device grows, the multiple layers designed into each printed electronic device require more versatile processing techniques. Photonic curing is uniquely suited to complement the processing needs in the manufacture of modern printed electronics. The photonic curing process can provide a fast, reliable and transformative processing step to meet the most demanding production designs. Photonic curing enables lower thermal processing budget with current materials, and it can provide a path to incorporate more advanced materials and functionality into future printed electronics.

PulseForge tools allow the use of new materials and reduced processing steps:

- Utilize different substrates.
- Inclusion of lower-cost materials.
- Efficient utilization of costly materials
- Product differentiation and competitive advantage.
- Allow alternatives to transparent conductive oxides, including metal meshes and indium-free oxides.
- Explore alternatives to plasma or sputter-based depositions.
- Opportunity for novel product configurations or form-factors.

PULSEFORGE® TOOLS

- Enable new product concepts through new form factors
- Achieve better device performance
- Reduce device material costs
- Increase production throughput and economics

INTERNET OF THINGS

- Design with novel form factors
- Develop new sensor designs
- Utilize materials efficiently and economically

DISPLAYS

- Thinner material stack
- Faster OLED switches
- Narrower bezels
- Improved interconnects
- Faster production time

WEARABLES

- Novel form factors
- Expanded functionality
- Stretchable/ conformable
- Durable

PRODUCT PACKAGING

- Add electronic functionality
- Tamper indicators
- Anti-counterfitting
- Logistical support and tracking

PHOTOVOLTAICS

- Flexible modules
- Lower-cost materials
- Explore improved material science for absorbers and coatings

AUTOMOTIVE

- Add electrical functionality to existing structural parts
- Integrate with traditional fabrication methods
- Reduce manufacturing complexity

3D FABRICATION

- Allow use of new materials and combinations
- Design new integrated devices



OUR PRODUCTS

PULSEFORGE® TOOLS



PulseForge® family of tools utilize photonic curing which heats functional inks and thin films in milliseconds without heating underlying or adjacent substrates. The tools are used to dry, sinter, or anneal thin-film materials on substrate materials such as polymers and paper. The tools also drive UV processes, and initiate and modulate reactions in mate-

rials such as the Metalon® ICI-series of copper-oxide reduction inks. These tools process a wide array of depositions including but not limited to metallic, non-metallic and semiconductor-based inks, as well as PVD metals and metal oxides. An integrated material and tool simulation package, SimPulse® enables rapid assessment of the photonic curing capabilities in combination with experimental results.

Safety Features

Recognizing the likely range of materials to be used, and the expected range of user skills and backgrounds, the tools are designed and built with multiple redundant safety features.

Exposure Parameter Settings and Control

With over 10 separate control parameters at the user's fingertips, the PulseForge tools allow the exact thermal profiles in the materials to be controlled. Special capabilities such as pulse-shaping allow even narrow process windows to be expanded and optimized for any given material combination.

Monitoring Output and Capturing Data

For R&D, it is not just the results that matter, but also understanding how those results were achieved. Accordingly, the PulseForge tools are specifically designed and built with integrated versatile data ports and integrated signal processing for included and optional instrumentation.

Additional Features, Design Elements, and Capabilities

- Water-cooled lamps that can be easily changed without the use of tools. Replacement lamps are only \$500
- Direct applicability from development to production
- Capable of processing depositions >30 micron.

SIMPULSE®

NovaCentrix has developed the world's first integrated photonic curing simulation. SimPulse® is an interactive numerical model for PulseForge® photonic curing tools. SimPulse dramatically decreases process development time and reduces the number of samples needed for optimization. SimPulse reduces trial and error, and allows users to close the loop. SimPulse is included with every PulseForge tool but is also available separately.



Rapidly Accelerate Research and Development

SimPulse takes the guesswork out of optimizing pulse conditions. SimPulse allows a quantitative determination of the impact of each variable on the final results. Time required to build a material stack in SimPulse, set the exposure conditions, and run the virtual experiment is about 30 seconds. Compared to the time required to build and evaluate actual lab samples, hours if not days can be saved. Materials stacks and process conditions can be optimized to save costs and improve performance without requiring expensive and time consuming physical design of experiments.



OUR PRODUCTS

PULSEFORGE® 1200

The PulseForge® 1200 is designed for processing the majority of conductive inks on polymer and paper substrates. As a tool for curing early-stage designs and prototypes, process conditions developed with the PulseForge 1200 will still scale straight into pilot and volume production. The PulseForge 1200 comprises the ideal R&D platform for photonic curing development, while a low price point makes it ideal for tight lab spaces and budgets.

PULSEFORGE® 1300

For R&D users working with advanced high-temperature materials, or complex thermally-conductive substrates, the PulseForge® 1300 delivers the highest peak power available. Like the PulseForge 1200, the PulseForge 1300 embodies capabilities stemming from the experiences of our own team of scientists and applications engineers. With advanced multi-touch user interface and wide control of processing parameters, users can quickly optimize material configurations and process conditions. The process conditions developed with the PulseForge 1300 also scale directly for production.



PULSEFORGE® 3200

The PulseForge® 3200 is designed for production scale roll-to-roll and conveyor-based thermal processing of conductive materials on PET and paper. This tool is ideal for full-volume production and can be integrated into an existing manufacturing line.

PULSEFORGE® 3300

Intended for production, the PulseForge® 3300 is designed for the highest temperature thermal processing. This tool produces high processing temperatures required for recrystallization and annealing, but without damaging low - temperature materials like polymeric substrates, glass (including thin flexible glass) or adjacent organic materials. This is accomplished by using proprietary high-intensity lamps that flash light in short durations to heat materials quickly, ideal for production.

CONFIGURATIONS

All PulseForge tools can be configured for processing sheets or rolls of material or integrated into existing manufacturing lines.

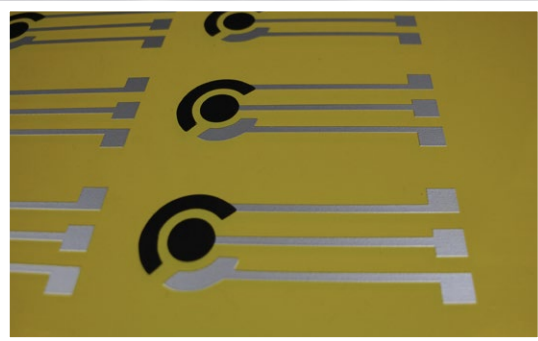
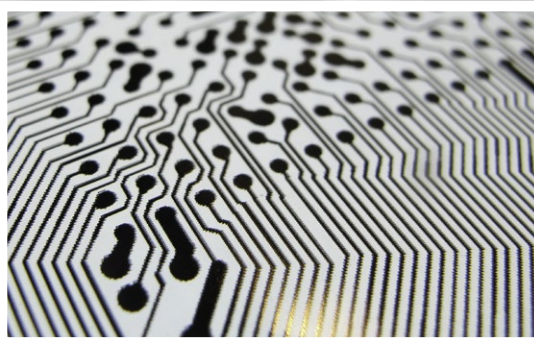


OUR PRODUCTS

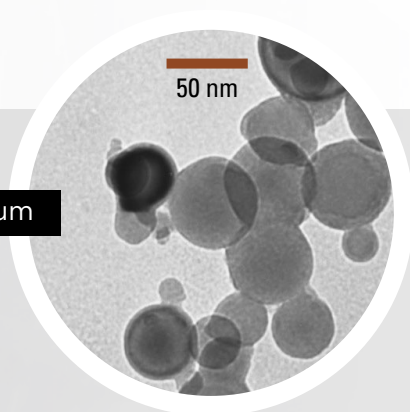
CONDUCTIVE INKS

NovaCentrix offers high-performance Metalon® conductive inks that capitalize on advanced materials and formulation to provide conductivity options for printed electronics applications. Although conventional thermal curing can be used with most of the ink products, enhanced performance is possible when prints are processed with PulseForge tools given the need for high temperature processing of inks on low temperature substrates. Utilizing nanoparticles and flakes, Metalon inks are available in off-the-shelf formulations as well as custom formulations for specific applications and print methods. Sheet resistances as low as 4 milliohms per square and resistivities as low as 1.5X bulk have been attained with the Metalon silver inks. Sheet resistances below 10 milliohms per square and resistivities as low as 3X bulk have been attained with Metalon copper-oxide inkjet reduction inks. Performance varies depending on print method and substrate, and curing used.

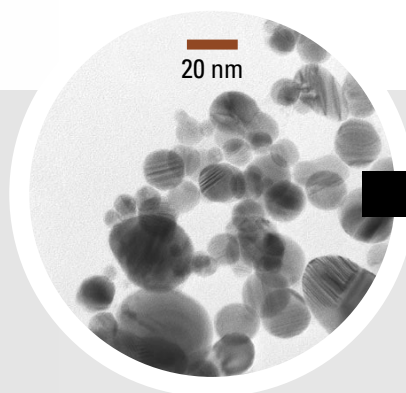
- Designed for use with temperature-sensitive substrates such as paper, polycarbonate, PET, and other plastics as well as for substrates used with higher temperature curing such as glass.
- Primarily water-based for ease of handling, clean-up, and for environmental consideration.
- Solderable, resistive, magnetic and stretchable conductive properties offered.
- Can be selected based on desired substrates, performance, and cost.
- Available in off-the-shelf formulations as well as custom formulations for specific applications and print methods.



NanoAluminum



NanoSilver



NANOPOWDERS

NanoAluminum

NovaCentrix 80 nm powder has become the standard in nanoaluminum powder for DoD and DoE applications and is used in high performance and green energetics including primers, propellants and explosives. Nanoaluminum-based chemistries enable green energetics with a high reaction rate fuel allowing use of a wider range of oxidizers, including those that are relatively benign, such as water and metal oxides. Their products are much less hazardous than traditional energetic compounds that use perchlorates, which release hydrochloric acid, or lead-based compounds that have long lasting toxicity.

NanoSilver

NovaCentrix manufactures nanosilver powder for both the conductive ink market, and for biological uses with average particle size of 25 nm, with a specific surface area of 23 m²/gm. Silver nanopowder is used in electrically conductive inks for inkjet and flexographic printing. Silver has also been shown to have antimicrobial properties.

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Photonic Curing Technology - US Patents and patents pending: 7,220,936, 7,820,097, 20080020304, 20090181184, 20100007285, 20100098874, 20110038974, 20110247851, 20110248026, 20110262657, 20110300676, 20120051046, 20120255192, 20120207941.

Foreign patents issued and pending.

The Photonic Curing process is patented by NovaCentrix. Violators will be prosecuted to the fullest extent allowable.

