

# smarttextiles and nanotechnology

the news service for textile futures

## Wearable Technologies



## Zoll's smart system is saving a life a day

**Zoll Medical – currently in the process of being acquired by Japanese corporation Asahi Kasei – reports that more than 60 000 patients at high risk of sudden cardiac arrest (SCA) have now been prescribed its LifeVest wearable defibrillator.**

The LifeVest is worn by patients at risk of SCA, providing protection during their changing condition and while permanent SCA risk has not been established. It allows a doctor time to assess a patient's long-term arrhythmic risk and make appropriate plans.

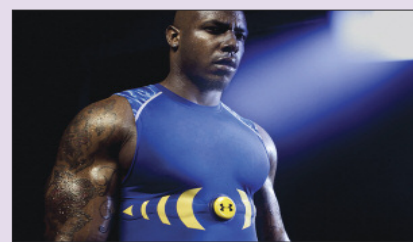
Lightweight and easy to wear, the LifeVest allows patients to return to their day-to-day activities with peace of mind. It continuously monitors the patient's heart and if a life-threatening heart rhythm is detected, delivers a treatment shock to restore normal rhythm.



### Ever increasing

"The fact that over 60 000 patients have been prescribed the LifeVest by their physicians demonstrates the ever increasing adoption of this therapy as part of the treatment protocol to protect patients at risk of SCA," says Richard A. Packer, Chief Executive Officer of Zoll. "The powerful result of partnering with physicians to protect so many patients from SCA is that

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the life of more than one patient per day is being saved by this technology.”

The LifeVest is used for a wide range of patient conditions or situations, including following a heart attack, before or after bypass surgery or stent placement, as well as for those with cardiomyopathy or congestive heart failure that places them at particular risk.

It is covered by most health plans in the USA, including commercial, state and federal plans.

Asahi Kasei will now acquire Zoll for approximately \$2.21 billion, having made a cash tender offer to purchase all of the outstanding shares in the company.

It is planned that Zoll will become a wholly owned subsidiary within the Asahi Kasei Group, managed by the current management team and with all current business units and operations remaining intact.

Asahi Kasei plans strategic investments to accelerate the realization of Zoll's mission of leading the world in resuscitation technologies and to build on the platform to achieve Asahi Kasei's long-term strategic objective of creating a globally competitive

healthcare business with a clear and unique focus on the field of critical care.

Asahi Kasei has identified healthcare as a key strategic sector that will power a new phase of growth for the group and believes that the acquisition represents a significant milestone in fulfilling its core vision for the healthcare sector: improving patient quality of life through the creation of innovative technologies and devices for critical care.

“We are very excited to be joining forces with Zoll, with whom we have enjoyed a productive partnership over the past nine months,” says the President and Representative Director of Asahi Kasei, Taketsugu Fujiwara. “In the medical devices business, the US market leads the world, not only in size and scope, but also in technological innovation, so establishing a strong infrastructure in the US is an important step for Asahi Kasei. Together we will pursue new opportunities in the high-growth markets of Asia.”

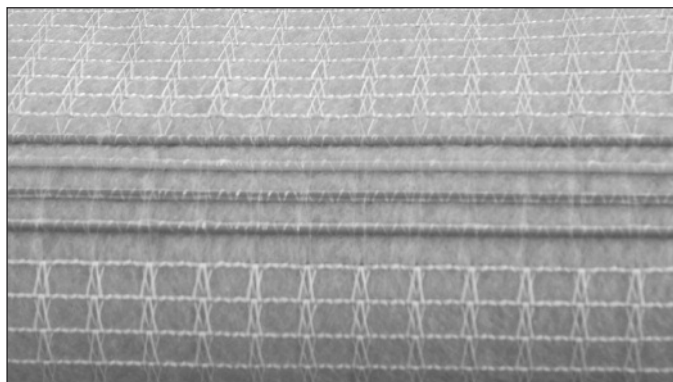
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## e-Textiles



### Monitoring the Yellow River

**TenCate Geosynthetics and AGT International are to collaborate on the installation of TenCate GeoDetect technology in a dyke body at the Yellow River in Dayulan (Zhengzhou) in the Henan province in China.**

TenCate GeoDetect is a monitoring system based on geotextiles with interwoven fibre optics, which registers changes in embankments and dykes and will be used in the AGT Flood Early Warning System (FEWS).

The AGT FEWS will be employed to collect and analyse data on dyke stability and deformations and on the risk of flooding. These will provide a basis for taking measures to prevent subsidence or dyke failure as quickly as possible. The system is also able to carry out a flood prognosis and can assist decision makers in timely evacuation. It will provide the manager with information about the condition and stability of the dyke.

“The collaboration of AGT International and TenCate Geosynthetics is another great example of open innovation within our industry,” says TenCate Global Group Director Wally Moore. “The combination of our geosynthetics and sensor technology with partners such as AGT International gives us an innovative and

differentiated approach to the tracing of possible defects and problems with dykes and the hydraulic-infrastructure segment of our water and environmental activities.”

“By bringing Dutch know-how in water management, we are uniquely positioned with TenCate and other partners to implement this ground-breaking system,” says Pieter-Christiaan van Oranje-Nassau, Head of AGT International in the Netherlands. “Our solution collects real-time information from new and existing systems to generate a real-time assessment of the river conditions. Our advanced prediction and simulation software will generate alerts and recommendations to affected areas. Another key element for the full realization and success of the project is our commitment to turning key project findings into shared learning opportunities.”

For a number of years TenCate Geosynthetics, using TenCate GeoDetect, has been involved in projects involving intelligent dyke monitoring, including the IJkdijk project in the Netherlands. GeoDetect has been tried and tested in hydraulic works structures such as embankment dams, canals and levees, and is already used in the building of roads and railways and the construction of retaining walls, bridge abutments and underground constructions worldwide. TenCate GeoDetect is patented and was specifically designed for geotechnical applications.

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## Smart Manufacturing

# Hybrid three-dimensional printing and printed electronics

**Stratasys and Optomec have successfully completed a joint development project merging three-dimensional (3D) printing and printed electronics to create the world's first fully printed prototype aircraft wing.**

The companies believe the development of the 'smart wing' for an unmanned aerial vehicle (UAV) model with functional electronics has the potential to change product development in industries including medical devices, consumer electronics, automotive and aerospace.

"Bringing together 3D printing and printed electronic circuitry will be a game-changer for design and manufacturing," says Jeff DeGrange, Vice President of Direct Digital Manufacturing at Stratasys. "It has the potential to completely streamline production by requiring fewer materials and steps to bring a product to market."

An Optomec Aerosol Jet system was used to print a conformal sensor, antenna and circuitry directly onto the wing of a UAV model. The wing was 3D-printed with the Stratasys Fused Deposition Modeling (FDM) process. The electrical and sensor designs were provided by Aurora Flight Sciences, a supplier of UAVs.

"We envisage many potential applications of the Stratasys-Optomec approach for hybrid direct digital manufacturing," says



David Kordonowy, who leads Aurora Flight Sciences' Aerostructures Research Group. "The ability to fabricate functional electronics into complex-shaped structures using additive manufacturing can allow UAVs to be built more quickly, with more customization, potentially closer to the field where they're needed. All these benefits can lead to efficient, cost-effective fielded vehicles."

The combination of FDM 3D printing and printed electronics technologies can provide benefits over traditional prototyping, manufacturing and field repair processes. The performance and functionality of products can be improved in two ways:

- 3D printers enable lighter-weight mechanical structures;
- conformal electronics printed directly onto the structure frees up space for additional payload.

In turn, the process has a positive impact on the environment by using fewer materials.

"Manufacturers can implement this hybrid technology in a multitude of applications, not just in aerospace," says Optomec's Ken Vartanian. "This technology can benefit numerous industries by allowing thinner, lighter, fully functional structures that cost less to manufacture."

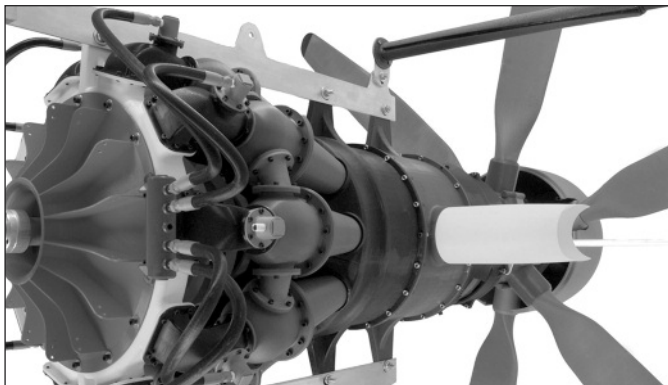
Optomec is a provider of additive manufacturing solutions for high-performance applications in the electronics, solar, medical, and aerospace and defence markets. These systems utilize its patented Aerosol Jet printed electronics technology and LENS powder-metal fabrication technology. The company has a global customer base of more than 100 users that includes many industry-leading manufacturers.

Stratasys is a maker of additive manufacturing machines for prototyping and producing plastic parts. The company markets under the brands uPrint and Dimension 3D Printers and Fortus Production 3D Printers. The company also operates RedEye On Demand, a digital-manufacturing service for prototypes and production parts. Stratasys manufactures 3D printers for Hewlett Packard, which it sells under the brand Designjet3D. In 2011 Stratasys acquired 3D printer maker Solidscape Inc. According to Wohlers Report 2011, Stratasys had a 41% market share in 2010 and has been the unit market leader for the ninth consecutive year. Stratasys patented and owns the Fused Deposition Modeling (FDM) process. The process creates functional prototypes and manufactured goods directly from any 3D computer-aided design (CAD) programme, using high-performance industrial thermoplastics. The company holds more than 285 granted or pending additive manufacturing patents globally.

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## Nanofibres

# Nanofibre smart skin for aircraft

**BAE Systems based at the Farnborough Aerospace Centre in the UK has developed a method for monitoring the structural health of a structure by spraying on a 'smart skin' consisting of a paint formulation containing a dispersion of nanofibres.**

In International Patent Publication 2012/038720, the BAE authors led by Michael Dunleavy explain that structural health monitoring (SHM) has important implications in terms of the support, maintenance and repair of military aircraft and in this respect, a low-cost universal prognostics and diagnostics capability would significantly reduce the through-life costs.

Unfortunately, current SHM strategies suffer from complexity, high costs, limited spatial resolution and are dependent mainly on embedded sensors. They are also not always amenable to being retro-fitted or deployed over large areas without major disruption to the structure.

There has been a proposal in International Patent Publication 2006/004733 to monitor the structural health of a composite structure by applying a conductive ink in a grid pattern and measuring changes in resistance across the grid to detect damage to the structure.

In this arrangement the ink is not intrinsic to a conventional paint structure, but is added as a pattern over or under a non-conductive insulating coating or a paint coat and does not provide the robust environmental- and abrasion-resistance properties offered by a paint.

The BAE inventors have found that a grid structure is problematic on the external surfaces of an aircraft, particularly if the grid is left exposed, because the airflow over it induces erosion at the interfaces between the grid and the underlying structure, which can instigate damage. Further, the provision of discrete grid lines rather than a continuous sensing surface means that events in the interstices of the grid are not directly monitored. The inks referred to in the earlier document are also simple formulations comprising the nanofibres dispersed in solvent, with a thermoplastic polymer being added to form a homogenous dispersion, with no solids content other than the nanoparticles.

### Durable

A durable paint by contrast, and especially an aircraft paint, already has a high solids content with numerous fillers to control the material properties and to provide corrosion resistance. As a consequence, the amount of spare volume in the fluid paint for incorporation of the other material is low. Although there is a mention that nanotubes may be used, there is no indication of a sprayable paint formulation incorporating nanotubes.

In order to provide a suitable smart skin facility BAE has therefore designed a carbon nanoparticle-based paint system that is sprayable so that it can be applied over complex and large areas to detect, for example, strain.

The patent covers this method of SHM, which comprises application by spraying a paint formulation containing a dispersion of carbon nanoparticles to provide a paint layer on the structure to



form part of a durable paint system, and monitoring an electrical characteristic of the paint layer to determine an indication of the structural health of the structure.

Although there are numerous applications, a preferred one is that of providing a smart skin for an aircraft. In particular, BAE has modified the formulation of standard aerospace-qualified paint systems through the addition of carbon nanoparticles to render the material electrically conductive and to induce strain sensitivity.

Aircraft paint systems are highly specialized, containing pigments, binders and fillers. The ability to incorporate strain sensitivity in such paint systems enables an arrangement to be provided in which the structural health monitor is effectively intrinsic to the original paint structure, and does not require modification or recertification of the structure. Further, as there are tried and tested techniques for stripping paint from an aircraft and reapplying a paint system, the smart skin can be applied retrospectively.

### Strain sensing

The layer produced by spraying the paint can be the top coat primer or undercoat. In either event, a strain-sensing function is achieved with minimal disruption of the paint formulation.

The paint formulation can be part of a polyurethane paint such as a two-part polyurethane paint system or part of an epoxy system.

In order to assist dispersion of the carbon nanoparticles, a solvent is added and in addition, or alternatively, is subjected to a suitable energization process such as sonication, to assist dispersion of the nanoparticles.

Where sonication is applied, it is preferably effected over a plurality of spaced time intervals to ensure that the temperature of the paint formulation does not exceed a predetermined value, to avoid excessive solvent loss. After sonication, the paint formulation is allowed to cool prior to the addition of a hardener before spraying.

Although other nanoparticles may be used, carbon nanotubes are preferred with a mean length of between 0.05µm and 20µm. In a preferred formulation, the mean number of walls of the nanotubes is between 3 and 30 and the percentage loading of nanotubes in the formed paint layer is between 1% and 20% weight-by-weight.

The paint layer can be monitored by detecting the respective electrical resistances between spaced parts of the continuous extended paint layer; and deducing at least one of the locations and magnitudes of a structural health parameter. The monitoring operation can be arranged to monitor for abrupt changes in resistance indicative of microstructure damage such as microcracking, and to log these whilst continuing to monitor more gradual changes indicative of elastic and/or plastic deformation of the underlying structure.

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## e-Textiles

## ePatch for health monitoring

**Danish tech company Delta has developed an ultra-low-power wireless platform for medical monitoring applications called ePatch.**

The technology provides a complete battery-powered sensor with data-logging facilities and low-power radio/antenna in a form similar to a normal heart monitor electrode.

The technology inside ePatch is said to make wireless sensing truly viable in a large range of healthcare applications as a result of its:

- biocompatibility;
- ultra-low power consumption allowing a full week's operation before requiring a charge;
- robustness—it can withstand showering and other daily activities;
- modular design principles, which provide simple programmability;
- construction, which packs everything into a 'plaster' with a low profile of a few millimetres;
- flexible radio protocol, which supports data-logging as well as periodic download and alarms, with always-on connection.

The first version of ePatch has a sensor for electromyogram (EMG) monitoring. A wide range of different sensors can be interfaced, including heart monitoring and oxygen level ( $\text{SpO}_2$ ).

The initial version of ePatch can be re-used, by changing the adhesive element and button cell. However, the technology is well-suited for conversion to single-use applications, by integrating the current multiple-device architecture into a low-cost ASIC.

The receiver element of the system is also small and highly portable and can be carried in a pocket, clipped to a belt etc. Delta



has designed this as a module, so that it can be integrated easily into standard consumer products such as a mobile telephone, network access point, etc.

Advanced microelectronics and customized algorithms enable the ePatch to intelligently process and filter data flows. This dramatically boosts the value of these data in providing alarm signals as the basis of treatment decisions and for preventive action.

The ePatches that provide these valuable data are relatively inexpensive, easy to apply and easy to replace.

Despite their low cost, they are said to provide reliable, up-to-date monitoring data of exceptionally high practical value.

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## Smart Materials

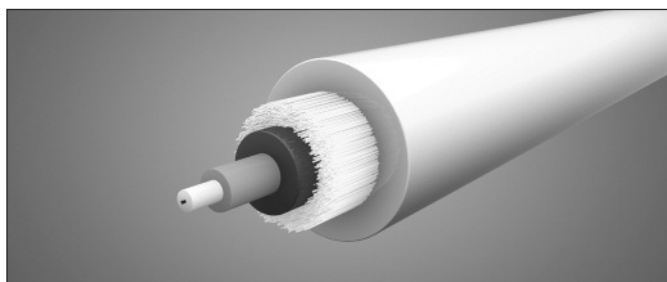
## Aramid tape for compact, non-crush cables

**Optical fibre cables play an increasingly important role in today's telecommunications networks, but while they continue to get smaller, their fragile cores still need protection from various hazards and strains.**

Teijin Aramid's Twaron Tape is an aramid fibre matrix construction that enables the production of optical fibre cables with a diameter as small as 1.2 mm. Simultaneously, it provides three-to-five times better crush-resistance compared with currently used aramid fibre protection.

The production of thinner cables using Twaron Tape brings several other advantages compared with current solutions. The production of 1.2-mm cables, for example, translates into an increased capacity for optical distribution frames of 30–50% compared with 1.6-mm cables. Furthermore, the thinner cables demand less cooling power, thereby cutting costs – and emissions – at distribution centres.

Twaron Tape D2800 is a robust and flexible patented solution that contributes to increased cable production speed. It also enables



quicker and more convenient installation and handling, with easier stripping and connection. The tape consists of a single, spread Twaron yarn which is impregnated and fixed with a matrix material. In order to provide complete coverage and optimal force- and crush-resistance, it is evenly wrapped around the core of the optical fibre cable.

"We were one of the early pioneers of reinforcement technology for fibre-optic cables and as this market has developed, we have gained an in-depth understanding of the market requirements," says Christoph Hahn, Commercial Director at Teijin Aramid.

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## Nanofibres



### Inline process for growing carbon on fibres

**Owens Corning and Applied NanoStructured Solutions, a Lockheed Martin company, have jointly developed Carbon Enhanced Reinforcements (CERs)—carbon structures that are grown directly onto glass or carbon fibres in a continuous, in-line production process.**

Employed in multifunctional composites, the CERs provide useful electrical, thermal and mechanical characteristics that can be tuned for specific end-use applications.

An immediate application is in smartphone shells, where in combination with epoxy resin, their electromagnetic interference

(EMI) shielding characteristics, in addition to toughness, durability and corrosion-resistance, can be provided in very cost-effective solutions.

CERs are already being supplied as fibre tow preregs, fabric preregs and thermoplastic pellets, and for fabrics production, the two companies are currently moving from a 36-cm-wide pilot unit to high volume on a 100-cm-wide new line.

What is different about this technology, say the companies, is that the carbon nanofibre structures are grown directly (infused) on the fibre surfaces of a tow in a scalable production process that in addition to glass and carbon, could also be effectively applied to ceramics or metals.

The infused carbon nanofibre structures appear as a highly cross-linked, entangled network and provide significantly improved electrical conductivity compared with conventional alternatives.

The advantages include enabling reduced design and system costs in multiple polymers, forming an effective, uniform Faraday cage throughout the part and providing excellent electrical, thermal, mechanical and cost performance compared with competing conductive fillers.

Further, they display better dispersion and processability than other carbon nano-forms and unlike conductive coatings, are a permanent shielding solution that is not sensitive to surface damage.

CER improves manufacturing yield and cost by eliminating secondary operations and enables fully recyclable designs.

There are no US Environmental Protection Agency restrictions on the sale and use of CER masterbatches, which enable the construction of thin, lightweight, highly conductive designs with complex geometries.

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## Nanofibres

### Cost-competitive alternative to carbon nanofibres

**Conductive Composites, based in Heber City, Utah, USA, is commercially launching new nickel chemical vapour deposition (CVD)-coated nonwovens following a manufacturing line expansion that has doubled its production capabilities.**

The markets these products are being aimed at include:

- electromagnetic shielding;
- embedded conductivity;
- lightning strike protection;
- surfacing;
- reflectivity;
- cable wrapping;
- preregs;

- filtering;
- heating;
- energy storage;
- catalysis.

This new product brings several advantages to the marketplace. CVD-coated nonwovens are lighter, thinner, and more conductive than nonwovens that are made using conductive fibres.

Using the CVD method, every external surface is coated and protected, and the resistivity of the sheet can be engineered to very low levels. In fact, they are said to have the highest specific shielding performance of any composite solution. Performance characteristics match or exceed sheets of carbon nanomaterials at a much more competitive price and in a continuous roll format.

The continuously coated nonwovens can be wet-processed (since the binder is protected) and conductivity can be engineered with less dependence on caliper.

Coating substrates include carbon fibre, aramid and carbon nanomaterials, and there is no change to conductivity when the materials are infused or cured.

In addition, the nickel provides corrosion-resistance and magnetic properties.

"We are pleased to announce the commercialization of this new product," says President Nathan Hansen. "CVD-coated nonwovens

have clear performance advantages, and we are excited to be able to provide this material in increased volumes for both our existing and developing markets. CVD-coated nonwovens bring game-changing performance and significant cost savings to our customers. Our investment in capacity expansion and commercialization reinforces our commitment to bringing competitive materials to the marketplace."

Conductive Composites creates materials and technologies that enable electrical conductivity and electromagnetic capabilities in composites and plastics.

Its products are key ingredients that deliver performance for proven applications. Materials are manufactured by proprietary methods on commercial-grade production lines in International Organization for Standardization (ISO) standard 9001-compliant facilities.

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## Nanofibres

# Power from the core that outperforms carbon

**AmpStar is employing AGY's S-I HM glass fibres for the high-strength composite core of its new reinforced aluminium conductor (CRAC) cable for high-voltage transmission lines.**

As a high-heat alternative to conventional transmission cables, the cost-effective solution is improving transmission capacity, lowering line losses, limiting sag, and reducing the need for more transmission line infrastructure.

"The high-strength composite core allows for higher aluminium compaction and the use of higher conductive annealed aluminium," says Mike Winterhalter, President of AmpStar. "This can increase ampacity by up to 100% and when compared with other composite core/conductors – including those using a hybrid carbon and glass composite – the AmpStar CRAC offers equal or better mechanical properties, higher glass transition temperature and reduced cost."

The S-I HM glass fibres used in the composite core are a new glass formulation offering the highest tensile modulus available – measuring 90 GPa (13,053 ksi).

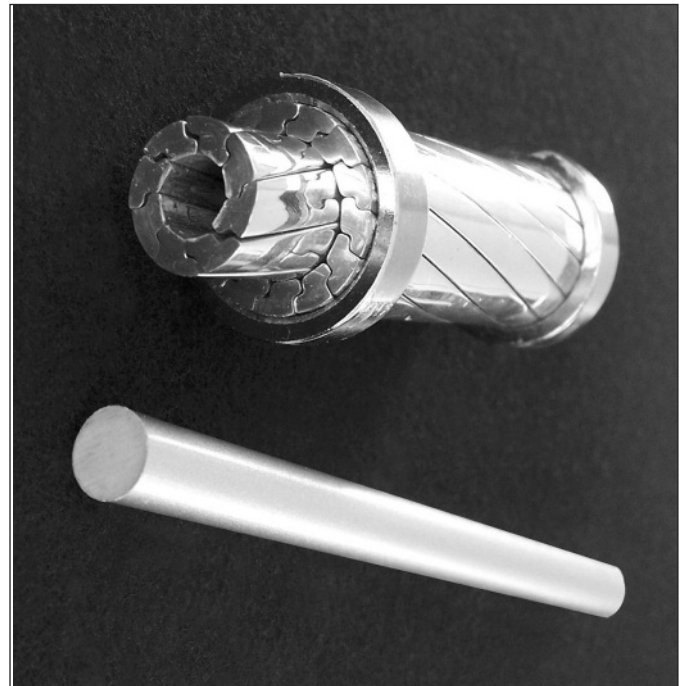
"The S-I HM glass fibres were developed as a next generation of S-Glass products," says Drew Walker, President of AGY. "The proprietary glass formulation, available as a roving package, is designed to maximize performance properties while meeting the economic needs of the reinforcement market."

AmpStar developed this latest version of CRAC in response to an industry need to increase properties, particularly tensile properties, but keep the same beneficial pricing. The resulting design combines the properties of the S-I HM glass and a high-temperature reactive matrix.

"The S-I HM material is the reinforcement that meets our higher performance specifications," explains Winterhalter. "It has excellent tensile and modulus properties. We combine the reinforcement with a proprietary resin package that affords higher temperature operation of the core/conductor, allows for increased throughput, and has a synergistic effect with the reinforcement package. Designing a composite part, especially a tensile member, necessitates that the properties of the reinforcement and the resin system work together. This is true not just for the material properties, but for the chemical compatibility of the two as well."

"Toughness is especially important as it directly speaks to the rod's ability to accept hardware such as splices and dead-ends, and how it can handle bend radius extremes. High-heat performance is essential for overhead conductors because the transmission of electricity inherently builds heat. The higher the current, the higher the heat. In contingency operations, the conductor cannot fail due to developed heat."

In addition to toughness and high-heat performance, the CRAC also has the ability to mitigate line loss.



"All conductors have some line loss," says Winterhalter. "However, using a composite core can reduce the loss by as much as 30%. This increased efficiency can result in reduced carbon footprints for the power generator and cost savings in fuel."

As the demand for power continues to increase, re-conductoring is a more efficient way to improve transmission capacity.

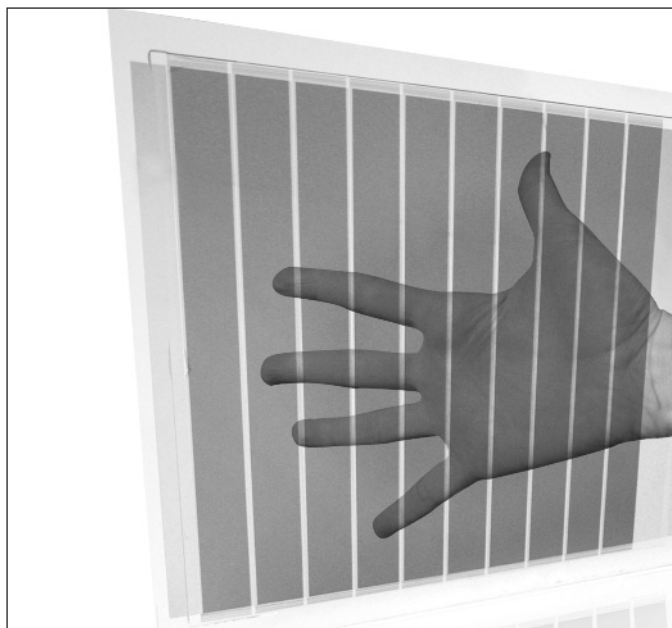
"It is not possible to simply add transmission corridors to increase delivery due to the cost, and to the many environmental hurdles," says Winterhalter. "So, the alternative is to re-conductor with high capacity/more efficient conductors capable of delivering more electricity on the same towers with essentially the same hardware. New lines are also being designed with an eye for efficiency. Since our conductor is stronger, the spacing and size of towers and the purchase of rights-of-way become less costly. This is a major cost advantage."

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## Smart Materials



### Recognition for Heliatek's 'reverse organic light-emitting diodes'

Heliatek received the Materials Award at the recent *IDTechEx Printed Electronics Europe 2012* exhibition in Berlin for its organic solar film technology, which promises to deliver a lighter, greener and more versatile alternative to traditional solar panels.

"Our technology is essentially the reverse of organic light-emitting diodes (OLEDs)," explains the company's Chief Technology Officer Dr Martin Pfeiffer. "They take in electricity and emit light while we use light to create electricity. Heliatek is the only commercial player specializing in the vacuum deposition of small molecules in organic photovoltaics (PVs), following the successful manufacturing approach of all major OLED display companies. There are many clear advantages for using this approach to create a patented tandem cell structure, such as the excellent uniformity of the roll-to-roll vapour deposition process and scalability. We can use the tried and tested OLED manufacturing equipment to enable us to have a rapid ramp-up. In addition, ours is the first truly green solar technology, since very little energy and material are required in our non-toxic production process, so the energy payback time of our cells is much shorter – under six months – than that of silicon cells."

One of Heliatek's unique strengths is its in-house Chemistry Laboratory for developing and synthesizing new molecules. The material that won the award is a new, small molecule, absorber material called HDR14. It offers high and broad absorption as well as good thermal and photo stability. HDR14 has been the key to Heliatek setting a series of world-breaking efficiency records for organic PV cells, with the most recent being 9.8 % independently certified by Fraunhofer ISE Callab last November.

"We are pleased to have won another prestigious award," says Chief Executive Officer Thibaud Le Séguillon. "Our solar technology offers many advantages over traditional panels and opens up new application areas thanks to its key features, namely being ultra-light, ultra-thin, flexible and transparent. The Heliatek solar cells keep working efficiently in real-world conditions since they maintain the same efficiency in low lighting and in hot conditions. Our cells have reached efficiency levels that start to make them marketable and we are confident that we will reach our goal of achieving 15% efficiency in the next few years."

Heliatek has just opened its first proof-of-concept production line with a roll-to-roll process in Dresden, Germany, and is currently raising its next round of financing of €60 million from current and new investors for a 75-MW line to expand production volume rapidly after the official start of production in late summer 2012.

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## Smart Materials

### New ASTM International Standard for Aerogel Insulation

ASTM International recently issued a first-ever generic material specification for aerogel insulation. **ASTM C1728-12, Standard Specification for Flexible Aerogel Insulation** establishes minimum performance standards for aerogel-based insulation materials such as **Aspen Aerogels' Cryogel, Pyrogel and Spaceloft products**.

"This is an important milestone for our customers, employees and the company as a whole," says Don Young, President and Chief Executive Officer of Aspen Aerogels. "We believe that the new ASTM standard reflects the growing acceptance of aerogel technology among end-users, engineers, distributors and contractors."

Since their launch in 2006, Aspen Aerogels' products have been specified and used by many of the world's largest oil producers, refiners and petrochemical companies, and by innovative companies within the power, building and construction, transportation and other market sectors.

"ASTM C1728-12 helps protect aerogel users from inferior materials by ensuring that products complying with the standard deliver the extraordinary thermal performance that aerogels are known for," says Young. "We believe that the standard will also simplify the specification of aerogel insulation by capturing all relevant performance parameters within a single, easily referenced document."

Aspen supplies reinforced, flexible aerogel insulation products that provide up to five times the thermal performance of other widely used insulation materials. Aerogel insulation delivers thermal and other benefits that enable customers to conserve energy and to save money in many industries including oil and gas production, and



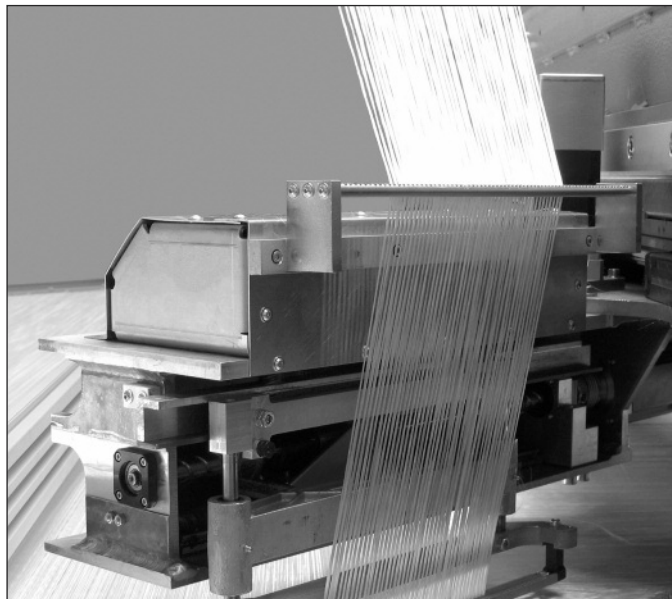
processing, liquid natural gas (LNG) transportation and storage, building and construction, outdoor apparel, appliances, transportation, military and aerospace. Headquartered in Northborough, Massachusetts, Aspen manufactures its Cryogel, Pyrogel and Spaceloft products at a high-capacity plant in East Providence, Rhode Island.

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**<http://www.aerogel.com>**

## Smart Fabrics



## Fabrics for composites at new angles

**UK carbon fibre and speciality reinforcements manufacturer Formax announced notable expansion plans at the recent JEC Composites show, including investment in new machinery, an increased commitment to glass production and the development of two unique new materials.**

The company is commissioning a new Karl Mayer Malitronic machine which will increase the company's glass capacity by 25% and support the continued growth of the wind energy and marine markets.

Formax launched two new exclusive materials:

- +/-45 pitch fibre biaxials. The company has developed a range of these fabrics based on Mitsubishi's Dialead fibres. A notoriously difficult material to work with, Formax has mastered the art of converting the high-performance pitch fibre to create +/-45 biaxials that offer up to four-to-five times the stiffness of traditional pan fibre-based versions. In addition, pitch fibres offer very low levels of thermal expansion and consequently, Formax pitch fibre biaxials are suitable for any application demanding ultra-high modulus, or high levels of thermal stability;
- +/-30 lightweight carbon multiaxials. This fabric has been developed through the commission of the Karl Mayer Malitronic machine and is available in a range of weights from 75 gsm per ply.

The new +/-30 works at a shallower angle, enabling greater longitudinal stiffness. This robust fabric is suited to long, thin structures such as ski's, snowboards, surfboards and wings.

"We understand the design complexities manufacturers face, but also appreciate the need for cost efficiency," says Formax Managing Director Oliver Wessely. "We are confident we can deliver a competitive edge with our bespoke solutions."

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**<http://www.formax>**

## e-Textiles

## Digital plaster reaches the wards

**The Sensium disposable digital plaster developed by UK company Toumaz is currently being trialled at a hospital in Los Angeles.**

It will be deployed initially to a small number of rooms with gradual expansion to all general ward beds at the hospital.

As an ultra-low power sensor interface and transceiver platform, Sensium continuously monitors key physiological parameters of the body.

The device includes a reconfigurable sensor interface, a digital block with an 8051 processor and a radio frequency (RF) transceiver block. On-chip programme and data memory allows local processing of signals. This capability can significantly reduce the transmit data payload.

Together with an appropriate external sensor, the Sensium provides ultra-low power monitoring of electrocardiograph (ECG), temperature, blood glucose and oxygen levels. It can also interface to three axis accelerometers, pressure sensors and includes a temperature sensor on chip.

As an ultra-low power technology, it provides unobtrusive, continuous, wireless monitoring of vital signs for up to six days. It provides a wireless link from the patient to the hospital's electronic information system, allowing constant monitoring of heart rate, respiration and temperature.

Sensium was granted 510(k) approval by the US Food and Drug Administration (FDA) for use in US hospitals in July 2011.

During 2011, Toumaz also established a joint venture with CCE, a company owned by Dr Patrick Soon-Shiong, to commercialize the disposable Sensium plaster worldwide. The joint venture, Toumaz US, is owned 20% by Toumaz and 80% by CCE. Toumaz will sell Sensium chips and boards to the joint venture and receive royalties on the sale of all products containing Toumaz IP.

The disposable product will be mainly used in hospitals, but Toumaz continues to work to expand the Sensium product range to applications outside hospitals, including non-disposable devices for wireless monitoring in the home and on the move. This includes a non-exclusive license agreement with a newly established company to use Sensium technology for sports and fitness applications in the UK.

Quanta Computer, meanwhile, has developed a prototype product based on Sensium technology targeting diabetes type II sufferers. Prototypes are currently being tested.

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## SPECIAL FEATURE e-Textiles

# Sensors for sports and health monitoring—the fifth function

**Wearable sensors are revolutionizing the sports industry with new levels of interactivity—even zombies are getting in on the act. By Editor Adrian Wilson.**

**It is promising to be a strong year for the development of e-textiles for sports monitoring, with, among other things, the Olympic Games in London casting a global spotlight on physical achievements.**

One of the clear winners will be Adidas, with its Performance Sports Bra now being part of the Women's Adidas by Stella McCartney range. The Beatle's daughter has also designed the red, white and blue Adidas kit which will be worn by the UK's Olympic hopefuls when the Games commence in East London this summer.

## Patented

Earlier incarnations of the Performance Sports Bra, however, have been commercially available for a good few years, initially as the NuMetrex Heart Sensing Sports Bra, which was launched by Textronics in December 2005.

Textronics was spun-off as a stand-alone company from Invista, formerly DuPont Textiles and Interiors, earlier in 2005 and subsequently acquired by Adidas in 2008.

Its patented technology involves knitting conductive sensing fibres directly into stretchy fabrics to monitor physiological conditions comfortably and accurately, with textile electrode garments, straps and wristbands that are machine-washable and reusable. Back in 2005 they could already be used for a wide range of electrocardiograph (ECG) monitoring and recording applications, including cardiac event recorders, stress testing, Holter monitoring, trans-telephonic pacemaker monitors, and respiration sensing devices.

Subsequently, both the design and its functionality have been enhanced and refined, and it now links up to the miCoach real-time training system via two sensors at the front. The Adidas Sports Bra retails at £45 and is likely to be a big hit this summer, especially with the ongoing development of the miCoach training software and apps.

## Monitoring and wireless

The monitoring of sports performance has been around for some time, and Finnish textile and sensor integrator Clothing+ is now making about 3.5 million sports heart-rate strap monitors each year, which are supplied to all of the major brands including Adidas, Garmin, Polar, Sigma Sport and Suunto, among others.

In addition, the world's first production-ready Bluetooth v4.0 heart-rate chest strap is ready to go into volume production and its users will not need a special matching watch as is the case with most heart-rate monitors today.

**“Large virtual communities are developing around these products, providing discrete marketing opportunities for manufacturers and allowing them to gain direct knowledge about how users deploy their equipment.”**

The new chest strap has been created by Dayton Industrial using a new Bluetooth low-energy chip from Nordic Semiconductor.

According to Nordic, the strap can be paired with a telephone – including the new wave of Bluetooth v4.0 telephones expected out later this year, or other Bluetooth v4.0 devices – in seconds.

This in turn is poised to spur the development of a whole new range of Bluetooth low energy-based health and fitness apps that could include new ways of collecting, interpreting, and displaying HR training data—including motivational social media-based data and progress sharing.

The nRF8001's ULP performance and size will enable the Dayton Bluetooth low-energy heart-rate belt to run for up to 1.5 years from a CR2032 coin cell under typical usage conditions (one hour per day) while featuring an extremely slim (1.1 cm thick) and compact (3.8 x 6.5 cm) plastic sensor housing that supports a soft fabric finished belt product weighing just 46 g (less than the weight of two AA batteries).

## On-line

What has developed over only a few years is the way in which the data from bodyworn sensors can be uploaded to on-line applications devised to increase motivation and to enable athletes to compete against themselves and others, as well as monitor their own progress.

Large virtual communities are developing around these products, providing discrete marketing opportunities for manufacturers and allowing them to gain direct knowledge about how users deploy their equipment.

Two obvious success stories spring to mind. The first is the Nike+ running application, which by the start of 2011 had four million members, swelling to six million by February 2012 and on target to hit ten million by 2014.

Developed for runners since 2006, in 2012 Nike has introduced new applications for basketball players and training athletes.

## SPECIAL FEATURE e-Textiles



**ABOVE LEFT:** The aim of *Zombies, Run!* is to provide runners with a new kind of immersive experience. It is currently the biggest selling sports and fitness app. **RIGHT:** The Nike+ network for runners now has some six million members. New programmes are currently being introduced for the basketball community. **BELOW:** The adizero f50 football boot has a cavity in its outer sole which houses the miCoach Speed Cell to capture 360° movement and measure key performance metrics.

Nike+ provides meaningful data on a very big consumer base and is an example of how these products are having an influence beyond their immediate use.

In parallel, sports and entertainment companies are seeking to promote fan loyalty and brand commitment by providing opportunities for online and realtime interaction via social media.

### miCoach

The second example is the Adidas miCoach, which was launched four years ago, initially with Samsung.

At that time it contained five key components, which combined provided personalized audible feedback—the miCoach Samsung telephone, a heart rate monitor, a stride sensor chip to fit all Adidas running footwear, compatible Adidas apparel and the miCoach website to create tailored training programmes.

By 2010 the Adidas miCoach Pacer and Zone had been introduced as an interactive training service.

### adizero f50

The technology has subsequently come a long way in a short time, as is evidenced by the adizero f50 powered by miCoach – billed as ‘the first football boot with a brain’ – launched in December 2011.

miCoach turns the adizero f50 into a digital training tool allowing players to track and upload performance data.

The boot has a cavity in its outer sole that houses the miCoach Speed Cell. This captures 360° movement and measures key performance metrics including speed, average speed (recorded every second), maximum speed (recorded every five seconds), number of sprints, distance, distance at high-intensity levels, steps and stride rates.

The on-board memory stores all the measurements during a game or training for up to seven hours and wirelessly transmits the on-pitch performance data to a tablet, PC or MAC.

“Data have been monitored and evaluated to increase performance in elite athletes for many years,” says Simon Drabble, Director of Interactive Technology at adidas. “Adidas is now bringing this service to the consumer, firstly with the launch of the adizero f50, and then



through a further range of intelligent products capable of storing, monitoring and evaluating performance on the field of play.”

The adizero f50 includes other key adidas technologies including:

- Sprintweb, which provides stability during high-speed movements;
- Sprintskein, a single-layer synthetic for enhanced ball-feel and reduced weight;
- Sprintframe, which uses geometrics and a new stud construction to offer a balance between light weight and stability.

The adizero f50 is also the lightest in its class, weighing in at only 165 g.

**“What is very new in 2012 is that you are now able to download the miCoach football video game and play it using your own real-life abilities, as recorded by the miCoach. For the first time you will be able to compare yourself with some of the best players in the world.”**



## SPECIAL FEATURE e-Textiles

### Real-life abilities

What is very new in 2012 is that you are now able to download the miCoach football video game and play it using your own real-life abilities, as recorded by the miCoach.

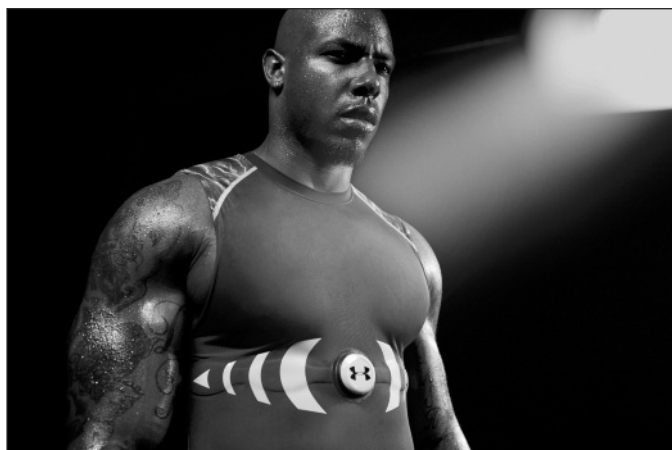
"We've been working to develop a boot with a brain for some time and what we've produced will revolutionize the football industry," predicts Adidas Vice President of Global Football, Markus Baumann. "For the first time ever you'll be able to compare yourself with some of the best players in the world."

### E39

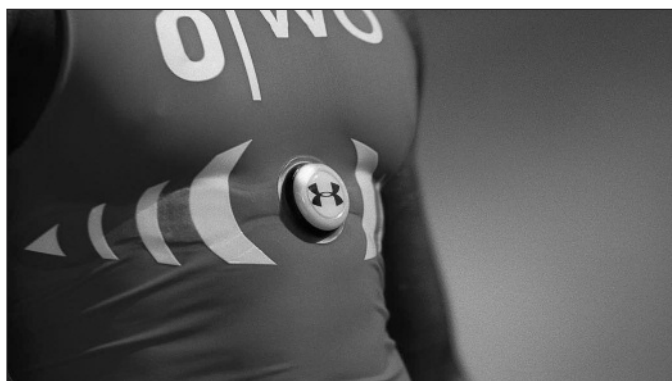
Still on the subject of football, UK Premiership team Tottenham Hotspur is now training with the E39 shirt system designed by US sports brand Under Armour, which during 2011 signed a £50-million sponsorship deal with the club.

The E39, which was first used by select teams in the American Football League last year, and more recently by the Welsh rugby team, features a sensor called the Bug, which sends second-by-second updates on everything from a player's heart rate to core body temperature, breathing rate and acceleration while also storing the data on a built-in 2 GB hard drive.

Coaches can analyse a player's performance during training on their iPad or iPhone and Under Armour has said it also wants to share the information with broadcasters, to give fans unprecedented access to the athletic performance and state of mind of individuals during key moments in a match.



Under Armour's E39 features a sensor called the Bug, which transmits second-by-second updates on body performance and also stores the data on a built-in 2 GB hard drive.



**"We can metrically tell you what is happening to the body of somebody kicking a penalty in front of 60 000 people. You can watch his heart rate as he waits to take the kick. For the first time you can see inside an athlete as they perform. It will add to the drama."**

### Adding drama

"We can metrically tell you what is happening to the body of somebody kicking a penalty in front of 60 000 people," says Mark Dowley, Under Armour's Executive Vice President. "You can watch his heart rate as he waits to take the kick. For the first time you can see inside an athlete as they perform. It will add to the drama."

"You would also be able to tell which athletes were in the best condition on the pitch and over the season and when to pull a player out because he is worn out."

Dowley says he believes that more Premier League teams will be interested in the technology once they see Tottenham employing it.

The Premier League, however, would be unlikely to allow the technology to be shared with broadcasters unless it was available to all 20 clubs in the division—something that would probably depend on Under Armour reaching a commercial agreement with the league itself.

The kit would also require regulatory clearance from Fifa, which could mean it would be initially limited to training applications.

The technology was developed by Under Armour in partnership with data software company Zephyr, which produces similar

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<http://www.sixtostart.com>



applications for the US military and was famously used in the rescue of the Chilean Miners in 2010.

## Underwear

More major sports brands will be launching undergarments with integrated sensor technology in 2012 and 2013, according to Mikko Malmivaara, Product and Marketing Manager with Clothing+.

"Heart rate sensing technology developed with our partners over a number of years is now ready for integration into sports underwear," he says in the latest Wearable Technologies newsletter. "Twelve months ago, working with Danish experts, we demonstrated this evolution in technical sports underwear with the Danish brand PureLime.

The incorporation of sensors into garments is a natural and logical progression. In addition, our medical business unit works closely with some of the giants of the healthcare and medical world, with Philips at the forefront."

The mission of Clothing+ is to develop and manufacture comfortable textile-integrated sensor electronics.

"In other words, our position in the value chain is that of an integrator of textiles and sensors," says Malmivaara. "We don't develop the sensors or algorithms, but for each product, we source the best sensors and integrate them in a comfortable and wearable form.

"Although measuring heart rate (ECG) is our main focus at the present time, we also have the technology and know-how to integrate sensors for almost any kind of bodily measurement such as EEG, EMG, GSR, stretch, posture, acceleration, speed, temperature and sound, etc."

## Medical

Clothing+ has now divided its business into two separate units (BUs)—sports and medical. Whilst the sports BU concentrates on sports, exercise and fitness, the medical BU has a broader spectrum of applications ranging from hospital equipment to homecare, both of which utilize instant, disposable sensor equipment and long-term monitoring for telemedicine etc.

"Our business model also consists of two key services," Malmivaara adds. "On the one hand we offer product development in the form of pilot projects – basically a pre-production run in preparation for the actual production run – and on the other hand, we offer the actual mass production service for demanding textile-integrated sensor products.

**"Adding sensors to garments is an unobtrusive way of collecting all manner of contextual information about the wearer. We look upon this, justifiably, as the fifth basic function of a garment."**



"Our own textile sensor-dedicated production plant in China is equipped with the latest machinery, including laser-cutting, ultra-sonic welding, special connector assembly and machine vision inspection."

Clothing+ employs some 300 workers at the factory, so in essence, it is the gateway to mass production for textile-integrated sensor products.

"Sensors are already finding their way into most everyday objects and the fact that we can now integrate sensors into textiles opens up a brand new avenue via information that was previously vague, inaccurate or even unavailable," says Malmivaara. "This has all the makings of big business. The three basic functions of a garment—namely to cover the naked body, to protect the body from the elements and to portray the wearer's identity, were further enhanced with the addition of pockets. The idea of attaching a pouch to garments suddenly gave the wearer the option to store small valuable items on his/her person, leaving the hands free. We believe that adding sensors to garments is an unobtrusive way of collecting all manner of contextual information about the wearer. We look upon this, justifiably, as the fifth basic function of a garment."

## Interactivity

The very latest sensation in this field also involves a new level of interactivity.

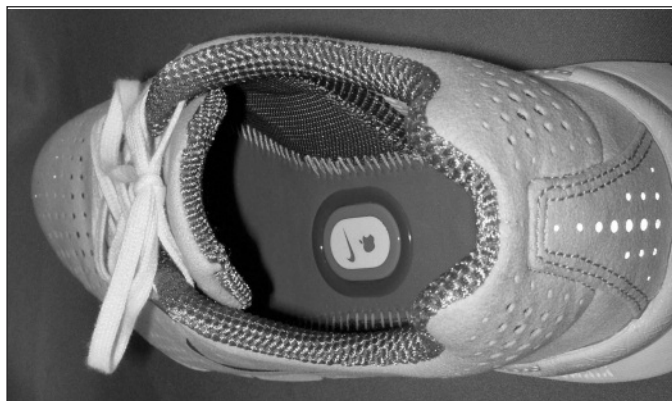
While only released in March 2012, *Zombies, Run!* is already the world's highest grossing health and fitness app, beating rival products from sports giants such as Adidas and Nike.

Sales topped 100 000 by the end of March, despite the app's price of £5.49—the highest price of any game in the global top 200 on the App Store.

The app's developer Six to Start describe it as "an ultra-immersive running game" with a narrative edge. It is suitable for the iPhone, iPod Touch and Android.

Instead of focusing on fitness, it casts the user as the struggling survivor of a zombie apocalypse. Players undertake missions to gather supplies, with the drama playing out in fully scripted audio—success is measured in further segments of the unfolding story.

Interestingly, finance for the app was raised through the website Kickstarter – with \$73,000 very rapidly pledged in funding from 3,464 individual donors – more than five times the initial target.



## Smart Fabrics

# Co-mingled carbon yarns for car parts

**UK-based NetComposites displayed new automotive brackets made from recycled carbon fibre at the recent JEC Composites Show in Paris.**

They were developed using a new generation of high-performance, low-cost co-mingled carbon fibre yarns that were the outcome of the recently concluded multi-partner project called Fibrecycle.

The yarns and fabrics are blended carbon/PET, manufactured from virgin recovered carbon fibre that would otherwise have gone to landfill, and the new materials have almost 100% of the stiffness of virgin materials. They can be offered at a lower cost than similar products currently available on the market, and are also beneficial to the environment and retain the traceability of virgin materials.

Fibrecycle, which completed in August last year, was a UK-funded research project involving six partners: Advanced Composites Group (now Umeco), Tilsatec, Sigmatex, Exel Composites UK, NetComposites and the University of Leeds.

The project produced yarns, sliver and tape, together with both woven and non-crimp fabrics. Composite laminates have been press-moulded, showing that the carbon/PET (50:50 weight ratio) composites offer at least 50% of the tensile strength and 90% of the tensile modulus of an equivalent composite based on virgin fibres.

As worldwide carbon fibre composite usage grows, there is concern about the potential tonnage of waste from manufacturing processes and end-of-life products. The waste related to carbon fibre products will quickly reach a significant level to become an important environmental issue, so there is a strong interest in developing processes for recovering and recycling carbon fibre from waste materials.

NetComposites has created Visteon automotive brackets using the non-crimp fabric with PET, which significantly reduces the weight of the brackets, which were traditionally made out of metals. These brackets are undergoing various mechanical tests.

“The new materials are ideal for the automotive industry,” says NetComposites development engineer Mohammed Riaz. “They offer great strength and are lightweight meaning they are ideal for non-critical load parts.”

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**<http://www.netcomposites.com>**

## Smart Fabrics

# High consistency from Hicotec

**At the recent JEC Composites Show in Paris, Frenzelit, based in Bad Berneck, Germany, introduced its new Hicotec range of needled nonwovens and films.**

These are finding favour with processors and developers in a number of industries as a result of their highly consistent longitudinal and transverse dimensions, combined with minimum basis weights.

Frenzelit is already a leader in areas such as gaskets and gasket materials, but owing to its specific material composition, Hicotec NE is now proving ideal for use in new energy generation and energy storage technologies where minimum basis weights, maximum material homogeneity and specified fibre orientation and conductivity – the preconditions for the achievement of high energy densities with smaller component dimensions – are required. At the same time, low component weight is essential.

Hicotec TP, meanwhile, combines these electrical and thermal functions with the fibre reinforcement properties of carbon fibres. Surface resistance levels that can be set accurately between one and 300 ohms.m<sup>-2</sup>, for electrical voltages of 4 to 400 V and electric power levels of up to 0.8 W.cm<sup>-2</sup> make the material suitable for a number of different applications in the industrial and private radiant heating field. Processing in plastic parts, for example, is an ideal way to integrate functions.

Hicotec CF (composite films) are fibre-reinforced membrane materials made from high-performance polymers, which open up new possibilities in the production of tribologically optimized materials, with the lowest possible wear rates for applications as bearing materials in pumps or slide bearings.

Hicotec HPG is a composite manufactured from a high-performance thermoplastic and reinforcement fibres given a fibre-reinforced functional layer in a finishing process. The result is a composite film that is 35 to 200 µm thick and can be applied to an individual component or in endless form to fine sheet metal as a functional layer for further processing. It carries out sealing functions, reduces abrasive wear and protects surfaces from thermal/chemical attack.

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**[info@frenzelit.de](mailto:info@frenzelit.de); <http://www.frenzelit.com>**



# Diary of Events

MAY 2012

**22–24 May****Swiss NanoConvention**

Lausanne, Switzerland.

Fondation Suisse pour la Recherche en Microtechnique.

Tel: +41 (32) 720-0900. Fax: +41 (32) 720-0990.

[info@swissnanoconvention.ch](mailto:info@swissnanoconvention.ch)<http://swissnanoconvention2012.ch>

JUNE 2012

**4–5 June****Nanofibers 2012**

Tokyo, Japan.

Hidetoshi Matsumoto, Tokyo Institute of Technology.

Tel: +81 (3) 5734-3640.

[info@nanofibers2012.com](mailto:info@nanofibers2012.com)<http://www.nanofibers2012.com>**11–12 June****Smart-Tex 2012**

Weimar, Germany.

Elke Römhild, Stiftung für Technologie, Innovation und Forschung Thüringen.

Tel: +49 (361) 789-2376. Fax: +49 (361) 789-2344.

[roemhild@stift-thueringen.de](mailto:roemhild@stift-thueringen.de)<http://www.b2match.eu/smart-texweimar2012>**13–14 June****CITEXT**

Troyes, France.

Mariana Miu, Marketing Assistant, ABE (Advanced Business Events).

Tel: +33 (1) 4186-4125. Fax: +33 (1) 4186-4989.

[MMiu@advbe.com](mailto:MMiu@advbe.com)<http://www.advbe.com>**18–22 June****International Symposium on Wearable Computers 2012**

Newcastle, UK.

Newcastle University.

Tel: +44 (7) 8139-51638.

[pervasive.local@newcastle.ac.uk](mailto:pervasive.local@newcastle.ac.uk)<http://www.iswc.net>**30 June–7 July****Nanotextnology**

Thessaloniki, Greece.

Stergios Logothetidis, Conference Chair, Aristotle University of Thessaloniki.

Tel: +30 (2310) 998174. Fax: +30 (2310) 998390.

[logot@auth.gr](mailto:logot@auth.gr)<http://www.nanotextnology.com>

AUGUST 2012

**2–5 August****Outdoor Retailer Summer Market**

Salt Lake City, Utah, USA.

Kenji Haroutunian, Nielsen Expositions.

Tel: +1 (949) 226-5794.

[kenji.haroutunian@nielsen.com](mailto:kenji.haroutunian@nielsen.com)<http://www.outdoorretailer.com>

OCTOBER 2012

**22–24 October****CINTE Techtextil China**

Shanghai, China.

Grace Lin, Trade Fair Manager, Messe Frankfurt (HK) Ltd.

Tel: +852 2238-9938. Fax: +852 2598-8771.

[grace.lin@hongkong.messefrankfurt.com](mailto:grace.lin@hongkong.messefrankfurt.com)<http://www.messefrankfurt.com.hk>

MAY 2013

**14–16 May****Smartex 2013**

Sharm Elsheikh, Egypt.

Professor Elsyed Ahmed Elnashar, Kafrelsheikh University.

Tel: +20 (16) 928-8940. Fax: +20 (47) 321-3751.

[smartex@kfs.edu.eg](mailto:smartex@kfs.edu.eg)<http://www.kfs.edu.eg/smartex>

JUNE 2013

**11–13 June****Techtextil 2013**

Frankfurt, Germany.

Michael Jänecke, Messe Frankfurt.

Tel: +49 (69) 7575-6710. Fax: +49 (69) 7575-6541.

[michael.jaenecke@messefrankfurt.com](mailto:michael.jaenecke@messefrankfurt.com)<http://techtextil.messefrankfurt.com/frankfurt/en/home.html>

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## e-Textiles

# CuteCircuit light-emitting diodes for Laura

Italian soul singer Laura Pausini has been making the most of the e-textile magic of the UK's CuteCircuit during her current World Tour.

At one point in her show she appears magically to fly over the audience in an incredibly long skirt of cascading colours.

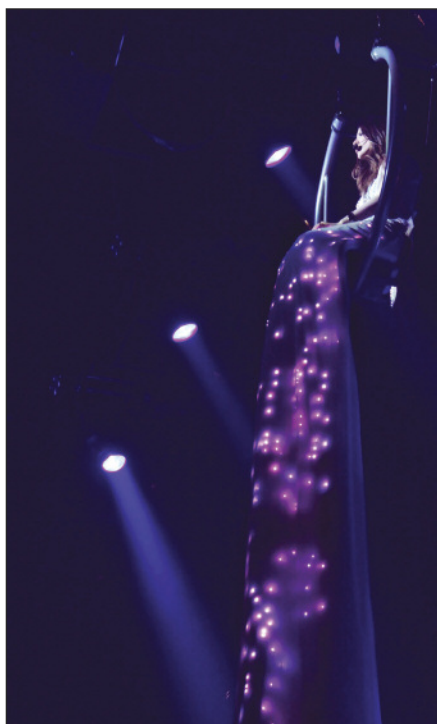
At 4.5 metres long, the silk chiffon skirt incorporates thousands of light-emitting diodes (LEDs) embroidered onto the fabric, making it the world's largest soft wearable display ever used in a live performance. It is decorated with Swarovski crystals in a gradient of greys, lighting up in colour patterns that follow the notes of the romantic song 'Invece No'.

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**Tel: +44 (20) 7502-1994.**

**[cute@cutecircuit.com](mailto:cute@cutecircuit.com);**

**<http://www.cutecircuit.com>**



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 Organization VAT number: \_\_\_\_\_  
 Telephone: \_\_\_\_\_ Fax: \_\_\_\_\_  
 Email: \_\_\_\_\_ Internet: \_\_\_\_\_  
 Nature of business: \_\_\_\_\_

### 3. CHOOSE HOW TO PAY AND SIGN FORM:

- ☐ I enclose a cheque payable to **International Newsletters Ltd**  
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- ☐ Please invoice me (company purchase  
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- ☐ Please charge my VISA / MasterCard / Amex

Card number: \_\_\_\_\_  
 Expiry date: \_\_\_\_\_ Today's date: \_\_\_\_\_  
 Cardholder's name: \_\_\_\_\_  
 Please supply cardholder's address if different from 2.  
 Signature: \_\_\_\_\_

### 4. RETURN YOUR COMPLETED FORM:

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 Droitwich Spa, Worcestershire, WR9 8ED, UK  
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