

Clothing and textile manufacturers worldwide look for competitive edge in fibre innovation.

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WITH so much competition in design and price within the apparel and textile sector, manufacturers are always looking for an edge. One way in which they can steal a march on competitors is with fibre innovation. And with new technology allowing the incorporation of increasingly complex arrays of chemicals and particles, even on the nano-scale, the opportunities to develop a revolutionary new fibre or mix of fibres are maybe greater today than ever before. Here just-style takes a global survey looking at some of the top centres of fibre research.

EUROPE

A burgeoning research industry for smart textiles has stimulated a great deal of activity in Europe, with the European Commission and its scientific bodies, such as the Joint Research Centre ([JRC](#)), funding a range of projects and innovations for fashion, health, sports and medicine-based textiles.

The European Space Agency (ESA) is funding work by Ohmatex, a Danish textile company, to create a sock with integrated electronics and embedded sensors to monitor the muscle activity of astronauts, which will be used to protect against the muscle-wasting effects of time spent in [zero gravity](#).

Meanwhile, Cetemmsa, a Barcelona-based smart materials technology company, is researching electronics that can be integrated into clothing, such as heart rate monitors, cooling technology and low-power lighting. These are meant to be incorporated into clothing for [emergency services](#). The company is working on integrated power sources, such as organic photovoltaics, in a Euro 4.2 million three-year project to develop clothing to remotely monitor the vital signs of elderly people. The intention is to develop a vest made of sensor-yarns that will measure heart rate, breathing rate and temperature, and relate the information via the Internet to the wearer's doctor or [carer](#).

"Such designs will enable an elderly person to wear a shirt that monitors them remotely, so they can get on with their lives without being interfered with. That will be important with an ageing population," said Prof George Jeronimidis, professor of composite materials at the UK's University of Reading.

Prof Jeronimidis specialises in [biomimetics](#), a field of textile research that he anticipates will become commercially mainstream within the next three years. Biomimetics works on the premise that nature exploits biological composites to create functional and responsive structures. But investigating how this is done, researcher can provide ideas for integrated performance in materials.

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"If you look at skin, it is like a textile with multiple properties. Penguin feathers have several hooks on them which allow air to be both trapped and to escape when the bird dives--it works like a 3-D Velcro," he said. "Mimicking such properties will enable textiles to store energy or work as springs. You could have such textiles that work like external muscles."

Prof Jeronimidis believes such properties can be installed into traditional fabrics such as cotton or polyester. "I wouldn't say it is comparatively easy but it is certainly possible," he said.

"You could have a textile that is both permeable and non-permeable. Instead of carrying several items of clothing when you go for a walk you could have a t-shirt that works like a raincoat when it needs to. The military will always have a need for these textiles, but fashion will be a big, big driver and is pushing this very hard," said Prof Jeronimidis. Several European companies are working to develop 'cool' colours for textiles--non-white materials that reflect heat in the way that white does. By optimising the near infra-red reflecting properties of pigments (the heat-generating part of solar energy, which humans cannot see), scientists are now able to make colours that look dark but which are in fact cooler. "The key is to reflect the near infra-red light from the surface before it has the chance to be absorbed," said Dr Trevor Sayer, managing director of Expertas, a colour science and technology company. This is achieved by manipulating synthetic platelets in pigmentation chemicals--making them saucer-like to reflect rather than absorb heat. Although the colours appear dark, significantly less solar energy is being absorbed, which means less heat builds up through transmission. The colour is not affected, because the only element of the fabric's composition that has been altered is the part that humans cannot see.

This research, initially targeted at military requests for heat-reflecting camouflage equipment, is now expanding into commercial fabrics. The Germany-based chemical company BASF is looking to develop a "cool" black for motorcyclist clothing to reduce sweating, and also on range of darker clothing that could be worn in hot summer weather.

Beyond Europe, the Australian company Mountain Designs has developed a treatment involving encapsulated paraffin that can be applied to outdoor gear in a process known as phase-change plastics. Employed in hats and windcheaters, the paraffin solidifies in cold weather to keep heat in but becomes liquid in warmer weather to allow heat to escape. Another Australian company, Australian Wool Innovators, is looking to develop a machine-washable sock that can keep toes warm in all weathers. The sock contains a small power pack attached at the top of the sock which transmits heat through conductive yarn to a panel at the toe area.

Meanwhile, the Netherlands-based Philips announced several initiatives at an International Display Workshop in Japan last December, including an "emotions jacket," which employs the sense of touch to allow viewers to experience the intense emotions felt by characters on-screen by stimulating the skin of the wearer. The jacket is a tightly fitting garment which incorporates evenly-spaced actuators--based on the vibrator motors used in mobile phones--sewn into the arms and torso. By activating these actuators in response to what is happening on screen, it becomes possible to recreate feelings being experienced by the characters, such as fear sending a shiver down the spine, while excitement results in butterflies in the stomach. Philips communicues argue that when people experience the physical manifestations of an emotion, they also experience the emotion itself.

ITALY

Italy, as ever, is one key centre of innovation in Europe's textile industry that deserves special attention. 'Innovate or perish' has become the mantra of Italian textiles producers. Thanks to ferocious low-cost international competition and the more recent slump in global demand, the new generation of 'Made in Italy' companies are investing in cutting-edge technology to maintain a competitive edge.

New fibres are clearly fundamental to this strategy, which has to a certain extent also been adopted by apparel manufacturers. Italian sportswear and specialised apparel producers realised the potential of the newest technologies some years ago, and in high- end sports and casual wear segments performance-enhancing fibre additives or membranes to increase wash, stain and odour resistance or weatherproofing have become widely utilised. Thermal regulating, fire retardant and antibacterial fibres have also found robust markets in the protective clothing and medical segments.

Many of the breakthrough ideas have come about thanks to the cross-fertilisation of ideas between the science and design sectors. It is no accident that many of Italy's leading fibre consultancies are also collaborators or consultants to the aerospace industry.

Nanotechnologies have played the most significant part in this process, as has the increasing local availability of applications such as plasma coating that makes fibres impermeable with a negligible environmental impact.

The technology has slowly been filtering through from sportswear to more fashion-focussed segments.

Multi-faceted enterprises historically associated with fine tailoring, such as Ermenegildo Zegna (NOTE--SPELLING CHECKED) for example, has been experimenting not only with nanotechnology applications like a 'cool wool' version of

fibre innovations developed elsewhere that can make dark colours behave like light colours in the summer heat, but also with innovative 'smart' textiles products.

A version of ZegnaSport's Ecotech solar jacket, made from 100% regenerated plastics, was released late last year, incorporating solar panels in the sleeves that can recharge mobile phones, iPods or similar portable electronic devices.

Lapo Elkann's (NOTE--SPELLING CHECKED) Italia Independent label is another new but high profile player, focusing its savvy marketing message on the blending of technical textiles with classic design. Their tailored tuxedo jacket for example uses the DuPont ultra-resistant Cordura fabric with the addition of a wind-proof membrane, while the sports bag of the same collection uses Kevlar, a super strong fibre more commonly associated with bullet-proof vests.

These kinds of garments remain luxury products aimed at the high-end consumer, for while there is no shortage of ideas or technical capability, the cost of most new fibre innovations has constrained their growth in low and mid-range segments. Many of the most innovative new fibre ideas remain niche one-off garments or specialised collections.

Specialised Tuscan consulting firm Grado Zero Espace, for example, developed a fabric that was hailed as the new no-iron fabric nine years ago, using Nitinol, a lightweight shape memory alloy (SMA) composed of 50% titanium that can return fabric to its original shape by the simple application of heat. The company developed an orthogonally woven fabric named Oricarco with this alloy and the first SMA business shirt that can be transformed from a crunched ball to an ironed shirt with a hairdryer.

The cost of the prototype (around Euro 2,800) and the Oricarco material (around Euro 1,400/linear metre) has ensured it continues to be a niche made-to-order article that is mainly used in the cardio-medical sector.

These kinds of specialised applications appear set to characterise the destiny of new fibres in Italy. According to a recent study on the future of technical textiles by Genova-based consultancy firm D'Appolonia, (whose clients have included exclusive fashion houses Hugo Boss and Lanificio Cerutti), commercial applications in Italy are likely to be concentrated around the protective textiles, geo-textiles and eco-textiles sectors (both the sport and technical clothing sectors retaining a healthy but relatively minor market share).

Aldo Tempesti, head of TexClubTec (NOTE--SPELLING IS CORRECT), an industry group that organises the principal conference devoted to nanotechnologies and textiles in Italy, said that technical textiles represented around 30% of the entire European textile market, in a sector that was growing by 3 to 6% a year.

"Technical textiles require technological know-how and this is difficult to copy so this makes it ideal for our highly specialised workforce," said Tempesti.

Italy remains however a minor league player on the world stage of nanotechnology research. According to the 2009 Organisation for Economic Cooperation and Development (OECD) science, technology and investment scorecard, the number of Italy's nanotechnology patents is the lowest in the G7, and well below the average of other OECD nations, thanks largely to meagre government funding and the low rate of investment by enterprise in R&D.

Grado Zero Espace product manager Giada Dammacco (NOTE--SPELLING IS CORRECT) said that commercial success also depended on non-technological factors. "Design is very important to the development of new fibres as it helps us understand how to structure the technology and how it can be applied but new fibres are essentially invisible to the consumer. They rely on coordinated marketing to communicate value," she said.

Already foreshadowed at last year's fibre trade fair Pitti Filati, in Florence, the technologies ready to play a greater role in the near future are "wellness" fibres, such as those with slow-release nano-particles containing vitamins or substances associated with weight loss, skin improvement or relaxation.

Grado Zero Espace has recently developed children's bedding and apparel using performance-enhanced fibres from the bark of a Japanese Cypress tree called the Hinoki, which sports natural antibacterial and relaxant properties. "What we are certainly seeing are moves towards fibres that cure the person, that operate on the emotive sphere," said Ms Dammacco.

FRANCE

Geoffrey Beene, the New York fashion designer, claimed in the 1980s that the influence of Paris on fashion had become "minimal". However, other commentators continued and even continue today to see France as a leading beacon of chic, but as far as the development of new materials for the clothing sector is concerned, Beene was right. While other fashion centres invest significant funds in so-called smart fabrics, French fashion designers appear to remain largely uninterested in investigating in new-fangled materials.

In 1992, ENSAIT, the arts and industrial textiles school near Lille, northern France, created GEMTEX, a laboratory dedicated to research into materials. This is one of the leading research centres into smart materials, but as Vladan Koncar, the school's head of research, admits, little impetus is coming from the fashion sector. "Lots is

happening in France in the area of new materials," says Koncar, but he adds that "in most cases this research is aimed at technical applications" rather than clothing. "Previously there was a little bit of research into fabrics, but at the moment there is not really any interest in fashion applications," he told just-style.

Koncar explained that "in the 1990s/2000, there was research looking at the use of fibre optics in fabrics"--this would allow the wearer literally to light up when he walked into a room. France Telecom was one of the pioneers of this technology, inventing a prototype flexible fibre-optic screen that could be woven into clothes. The idea was picked up for use in various items of clothing from those worn by the security or emergency services to luxury wedding dresses. Elisabeth de Senneville and Olivier Lapidus were two French designers who experimented with the new fabrics. However, Koncar says that after an initial flurry of excitement, the idea was largely left on the catwalk largely because of the "high costs" associated with fibre optics.

French company Uranium Jeans found itself facing similar price problems when it launched its range of jeans in 2006 that had flexible colour micro-screen display panels embedded into them. The screens allowed the wearer to display scrolling text messages on his/her derriere. The company sold some products, but they "were not a commercial success," noted Koncar.

Rather than fashion, therefore, Koncar and his colleagues in France have turned towards more practical uses for smart fabrics, such as sensors that can detect changes in body temperatures, the air or heart beats. Such sensors can be embedded, for example, in the uniform of a fireman and warn him when he is likely to injure his skin because of elevated temperatures or in the clothes of a professional fisherman to automatically alert the emergency services if he falls overboard, explained Koncar.

But even if smart materials need to advance a long way before they are commercially attractive to the French fashion industry as a whole, they do have a handful of loyal supporters. De Senneville and Lapidus, for example, have continued to experiment with various smart materials in recent years. In 2002, Lapidus in association with Nokia and Sony designed a jacket with a built-in mobile phone whose screen and keyboard were concealed in the sleeves and speakers and microphone in the collar. More recently, he has worked with Ceva, the French centre for the study of algae, to see if it is possible to produce microcapsules that can be slotted into fabrics to release various odours. Meanwhile, de Senneville, has investigated the production of clothes that could filter out pollution and dust, following in the footsteps of the anti-perspiration, and anti-bacteria textiles that are already a reality.

The French trouser fashion house Zins also believes that innovation is the future. Two years ago, Gundo Magassa, a designer from Mali, created the Ba Faro--the name of river Niger's goddess--range for the company. Zins describes the range as "ethic ready-to- wear" clothing and says it was designed with social, environmental and health concerns in mind. This means that in addition to using organic fabrics and trims, attempting to reduce carbon dioxide emissions throughout its supply chain and ensuring that workers were well- treated, Zins opted to use technology to benefit its consumers' health. The technology in question is an "anti-waves lining" inside the pockets of the trousers and jackets, which claims "to protect the body from cell phones waves without stopping entering calls". Zins says it is reacting to research that suggests that mobile phone usage can be potentially dangerous and has therefore decided to employ smart materials to protect its customers. Given the economic downturn, now is perhaps not the moment for fashion designers to be splashing out on expensive gimmicks. Nonetheless, Koncar insists that they remain interested in the future of smart materials and continue to frequent laboratories, such as GEMTEX, to see what is happening in the world of research and development. Moreover, he says that fashion students are full of ideas and that end-of-year shows frequently include smart materials. The fashion industry in France may therefore in the coming years start to make greater efforts to try to commercialise some of these more technical applications into haute couture or pret-a-porter. But as Koncar notes, smart materials seem to hold more interest in the Asian fashion world than they do in France, where perhaps consumers and designers "simply don't dare".

USA

The USA textile industry is by no means robust, particularly after experiencing the global financial crisis. Many American textiles manufacturers have relocated production out of the US or are moving to countries with lower wages and less stringent standards, according to a US department of labour statement. It added: "Employment is expected to decline rapidly because of technical advances and imports of apparel and textiles from lower wage countries." Such technological advances include automation and robotics, which have replaced many human workers on the line to make factories more efficient. Nevertheless, research into fibres within the USA is still booming, particularly at educational and science institutes, and many new technologies, fibres and manufacturing processes are on their way or already here.

A University of Philadelphia research team funded by the National Textile Centre, a research consortium made up of eight US universities, is in its final year exploring new ways to produce scented fibres, largely designed to mask the smell of sweat in athletics apparel and accessories.

But while Nike and other athletics companies use the conventional 'microencapsulation method', where tiny fragrance capsules are sprayed onto the

surface of a finished textile and release their scent through friction, these researchers are exploring a completely different process.

"We've teamed up with a company to develop a technique called the 'filament infusion method'," explained principle investigator [John Pierce](#). "When they manufacture the fibres, they add the scent to the fibres themselves during the filament stage, which is when dyes would be added. So the scent is actually in the fibre itself."

Pierce said their most recent observations show "intensity and durability that is comparable to [microencapsulation](#), plus it's much cheaper to do." He explained: "Microencapsulation scents are often released during shipping, packing and in stores because the scent is on the surface. With filament infusion the odour is more durable." Pierce said filament-infused scents last at least 20 wash cycles, which is the industry standard. Research partner Tennessee-based Fiber Innovation Technology will own the patent to the new method, but Pierce said the idea could have many commercial applications outside the conventional athletics sector.

"A lot of what we're envisioning is products for certain times of the year. So, pine-scented curtains could come out each holiday, or you could have baby-powder scented products for a new baby," he said. "People scent their homes all the time with candles and those sorts of things. So there is certainly a market for it."

He said they are now investigating adding antimicrobial agents at the filament stage, too, which would help fight bacteria causing unpleasant odours rather than just mask them with perfume. Pierce said this innovation could have applications for athletes as well as people suffering from incontinence.

Innovative fibre technologies are also being used outside the conventional textile market, giving fibre producers a chance to reap spin-off income in other sectors. Cornell University researchers, also part of the National Textile Centre consortium, are currently extracting soy protein from plant-based fibres--such as jute, [ramie](#) and hemp--to create composites which can replace the toxic resins used to bind particleboard.

"Plywood and particleboards all are held together with formaldehyde-based resins, which are known carcinogens," lead researcher Anil Netravali told just-style. "Our materials are soy protein-based. We use no toxic compound, and they don't give off those VOCs [volatile organic compounds] that are [carcinogenic](#)." He added that soy protein is inherently flame retardant, so furniture made with soy composite fibres are much less likely to burn. This 'green' theme seems to be a common trend among textile innovations in the US. Major US textiles company Unifi Inc, based in [North Carolina](#), has spent the last few years promoting its Repreve 100 yarn made from 100% post-consumer plastic water bottles. Halfway through January 2010, the company announced a new partnership with Polartec, a Massachusetts-based performance fabric manufacturer which specialises in water repellent, flame retardant, super thermal, wind resistant, and/or quick drying outerwear fabrics. In the last four years, Polartec's level of recycled content in its fabrics rose from less than 1% of total production to over 30%, according to Unifi. This new partnership will help Polartec offer even more eco-friendly fabrics for its consumers. By spring of 2011, "we expect Repreve 100-based fabrics will hit the consumer market," Unifi said. According to the company, every pound of Repreve 100 yarn contains 27 reclaimed water bottles.

The research is going green at microscopic levels, too. At Harvard University, also in Massachusetts of course, a chemistry team lead by Cynthia Friend has discovered that gold nanoparticles could help lower the costs and health hazards of producing synthetic fabrics, which traditionally require high temperatures and toxic chemicals to manufacture. Professor Friend and her researchers have found that using microscopic gold particles to [oxidise](#) alcohols and other chemicals requires a much lower temperature than the conventional [stoichiometric](#) oxidation process, and without creating nearly as many pollutants. These advantages would [invariably](#) lead to lower energy usage and smaller health impact if the research was commercialised, according to the team.

In an even healthier twist, two University of Texas scientists published a report in October 2009 announcing the development of a new synthetic cloth for medical bandages and wraps, which releases small amounts of [nitric oxide](#). The chemical is a known relaxant which encourages blood flow and can help wounds heal faster. The scientists hope the cloth can be used as wound dressing, and to wrap organs during transport.

JAPAN

Japan's reputation for innovation--whether in cuisine, automobiles or architecture--is well established. Designers here are constantly thinking outside the box and producing items that make the rest of the world sit up and take notice. And while cutting-edge cars and home electronics may grab more headlines--and earn more foreign revenue--there is a growing awareness of the unique fabrics that Japanese companies are putting into clothing that is both fashionable and practical.

It was, after all, renowned designer Issey Miyake (NOTE--SPELLING IS CORRECT) who once told an interviewer, "the cut of a Western garment is determined by the body; a Japanese one by the fabric."

With parts of northern Japan experiencing a harsh winter this year, fabrics designed to keep the wearer warm have been flying off the shelves.

The EcoHeat material sold through the Seiyu chain of stores is 65% acrylic and the combination of fibres enables heat to be generated after moisture--from human perspiration--is absorbed into the material. Similarly, the HeatFact range available through Aeon utilises a high proportion of acrylic and some of the items use ribbed or waffle weaving to create a series of layers that also help to conserve heat.

In both cases, items of clothing are moderately priced, from around JPY1,000 (GBPounds 6.73)--a serious consideration as Japanese consumers continue to struggle with the global economic downturn.

"We're seeing a major boom in this area of clothing in Japan at the moment and all the stores now have their own range of high-tech warm clothing," said Misha Janette (NOTE--SPELLING IS CORRECT), fashion columnist for The Japan Times newspaper. "We are even seeing previous lines being retro-fitted with this technology."

The first to see the possibilities in exothermic and insulating fabrics for underwear was Uniqlo (NOTE--SPELLING IS CORRECT), which unveiled its first HeatTech range in 2006 and has enlarged its range every year since, said Janette. This year, 37 garments in 23 colours were available, keeping the wearer warm thanks to the clothing being woven out of a specially designed hollow fibre that captures "little pillows of toasty, warm air, insulating your body in the same way a heavier wool would and creating a secret weapon against the winter chill."

Uniqlo's HeatTech fabric includes a rayon mix that absorbs the moisture generated by the body and converts it to heat. Milk protein, which contains natural amino acids, has been integrated into the fibres to ensure the fabric is smooth and soft. The company predicts it will sell 4.7 million items over the winter.

Conscious of both the need to conserve our natural resources and the potential that lies in recycling waste materials, Teijin Fibers Ltd. has developed a material recycling system that makes it possible to separate and eliminate additives and colourants from PET bottles and other items made of polyester. Its closed-loop recycling system is so effective that the final product is indistinguishable from polyester freshly produced from petroleum, the company claimed. That technology has been put to the test in an alliance with Henri Lloyd, the Manchester, UK-based brand of marine apparel. The companies are producing Eco Storm, a recyclable, waterproof and breathable material made from recycled fibres from plastic bottles that have been laminated with a highly durable but thin polyester film. And Henri Lloyd is telling its customers that as soon as their garments are worn out, return them and they will be recycled into a brand new product. A similar project is also under way with China's Li Ning Co., producing tennis and training apparel from recycled fibres that are woven into new textiles and dyed. Its inaugural winter 2009-2010 line-up was available at the stores operated by the top domestic sporting goods brand in China from October.

Japan's sporting goods manufacturers are also developing new materials for their ranges, tapping into the new trend towards a more healthy lifestyle.

"More and more people in Japan are becoming health-conscious and there we see a definite trend towards what we consider to be a more healthy lifestyle," said Tadashi Fukunari, (NOTE--SPELLING IS CORRECT) a spokesman for Kobe-based sporting goods firm Asics Corp. "People are realising that taking part in exercise such as running, walking, trekking, swimming and cycling are also enjoyable social activities. "This sporty lifestyle is regarded as fashionable and cool."

Most famous for its revolutionary footwear--the Gel Kayano series is regularly recognised as one of the best sporting shoes available--Asics also kitted out the Japan track and field team for last year's IAAF (International Association of Athletics Federations) World Championships in Berlin. Supplies incorporated its 'Inner Muscle' high-elasticity fabric in the back of competitors' shirts to enhance running and throwing power, as well as the 'Core Balance Belt' around the pelvis to improve posture.

In Japan's fashion world, there has been a definite turn away from the 'natural' look or organic cottons and naturally dyed designs that graced the catwalks 12 months ago. Tokyo Fashion Week took place in October and was dominated by plastic-based fabrics, such as Aguri Sagimori's (NOTE--SPELLING IS CORRECT) use of a black vinylised fabric that was covered by what appeared to be droplets of clear 'rain.'

"I can see these techno-fabrics and the trend for futurism continuing for some time now," said Janette. "There's a new-found interest in these shiny materials and they went down very well at the shows."

And while haute couture is not always appropriate for every-day use, smart Japanese clothing firms are constantly coming up with new products for niche markets.

In October, Okayama-based Haruyama Trading Co. released a suit that it claimed protected the wearer from the deadly H1N1 strain of influenza. Coated with a layer of titanium dioxide, which reacts to light to break down and kill the virus when it comes into contact with it, the suit comes in four colours and sells for Yen JPY 52,290 (GBPounds 352).

Equally innovative was the creation by Konaka of a man's suit that can be worn in

the shower to wash it, making use of an anti-wrinkle process that utilises the natural amino acid L-cysteine (NOTE--SPELLING IS CORRECT). Meanwhile Fujibo Holdings Inc.'s V-Up range incorporates solutions of vitamins C and E into their fibres, which can be transferred to the skin and absorbed into the body.

WRITE OFF

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International News Services' writers for this briefing are Mark Rowe, Philippa Jones, Lee Adendorff, Emma Jackson, Julian Ryall and Keith Nuthall

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