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Nanotechnological footwear

Nanotechnology involves the study and application of extremely small things and can be applied across all the other science fields, such as chemistry, biology, physics, materials science and engineering. It is hard to imagine just how small these particles are as one nanometre is one billionth of a metre. For instance, there are 25,400,000 nanometres in an inch and a sheet of newspaper is about 100,000 nanometres thick.

It involves the ability to see and to control individual atoms and molecules. Literally everything on earth is made up of atoms but they are impossible to see with the naked eye or even with a conventional microscope. It is only during the past 30 years with the invention of the scanning

tunnelling microscope (STM) and the atomic force microscope (AFM), that the age of nanotechnology has been made possible.

Nanoscale materials (nanoparticles or NPs) have however been unwittingly used for centuries. For example, alternate-sized gold and silver particles created colours in medieval stained glass windows although nobody was aware that the process being used to create them actually led to changes in the composition of the materials themselves. Scientists and engineers are finding ways to deliberately make materials at the nanoscale to take advantage of their enhanced properties such as higher strength, lighter weight and greater chemical reactivity than their larger-scale counterparts. And this, now includes footwear.

NANOFOOT PROJECT

Nanofoot is a European R&D project to develop advanced and innovative nanotechnology-based solutions for leather and polymer components for footwear and is supported by the European Executive Research Agency (REA). It is hoped that this, in turn, will lead to a new form of sustainable and customer-driven production of consumer goods, where health and the environment, high quality components, fair marketing information and competitive pricing are combined to make companies more competitive in world markets.

The project involves five SMEs (small- and medium- sized enterprises) and four RTD (research and technical development) centres. The SMEs involved are Curtumes Aveneda and

Indinor (Portugal), Cammina Leggero (Italy), TPSP and Evathink (Spain). The RTDs are CTCP and Porto University Sciences Faculty (Portugal), Inescop (Spain) and Consiglio Nazionale delle Ricerche (Italy). Together they create a balanced and interdisciplinary team combining the practical know-how of the SMEs with expertise from the universities and research centres. Working this way helps the project develop knowledge that is more easily transferable to manufacturers and so promote innovation and commercial application. It also enables the SMEs to validate the results obtained.

The project aims to change the concept of the shoe and make it functional in all respects, from its production using easily accessible, low-cost and high-performance materials, to its final disposal. This in turn requires the materials used to have a very low ecological impact such that the only 'footprint' that the footwear will hopefully leave will be the shape of the sole on the ground. A technological or, more precisely, a nanotechnological shoe that is able to

combine comfort with environmental care.

PARTICULARS

Antimicrobial properties, thermal and electrical conductivity, water resistance and breathability are some of the functional characteristics of a shoe which it is believed could benefit from the use of nanotechnology and lead to the development of more comfortable footwear. The Nanofoot SMEs particularly want to explore the potential and possible benefits of using NPs that are already on the market in the development of new functional materials and products. Their final objective is to create new and different high added value and marketable materials and finished products that satisfy the needs and expectations of modern consumers.

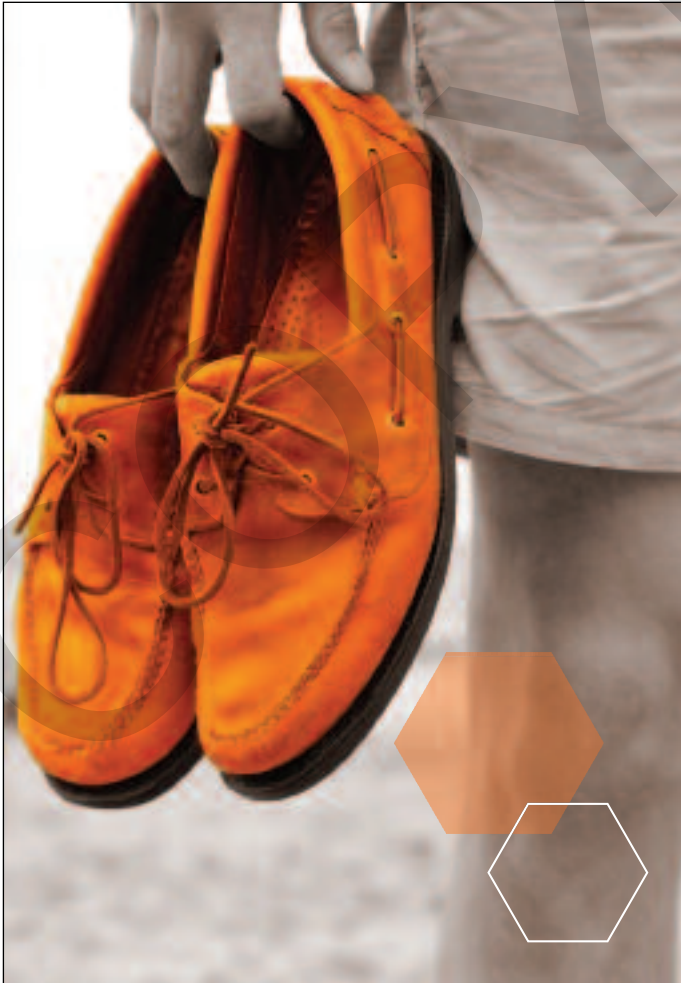
The RTDs are undertaking a more diverse set of activities. They are screening commercially available NPs to see if they might be cost-effective and, if so, investigate the feasibility of using them in processing products, coatings, leathers and microfibres.

They are also looking at developing polymeric nano-composites for use in footwear components and developing advanced antimicrobial and thermally auto-regulated footwear.

With regard to footwear manufacturing itself, they are exploring ways to create an integrated approach that safeguards operatives, consumers and the environment. They will then analyse the results and, where appropriate, produce prototypes for further evaluation. The project also aims to decrease the environmental impact of industrial processes by replacing bulk materials by NPs and improving nanoparticle-based formulations and their manufacturing procedures.

Nanofoot is a 24-month project that began September 2013 and will finish in September of this year. It is therefore still very much a work in progress. However, some positive benefits are foreseen for both the consortium's SMEs and the wider industry.

Aveneda, as a leather manufacturer, specialises in the manufacture of differentiated leathers with higher added value and improved properties. It



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will explore the nanoleathers developed with a view to bringing to market innovative new leather products with enhanced anti-bacterial, anti-fungal, breathability and water resistant properties.

Indinor is a producer and supplier of chemical products for leather tanning, and leather and footwear coating and finishing. It will explore the processing products and coatings developed with the use of nanotechnology to see what new opportunities there are for the leather and footwear industries.

Evathink is a polymer compounder with extensive experience in EVA processing for orthopaedic footwear applications. Its aim is to be able to offer a range of nanocomposites with advanced thermal and electrical conductive properties for orthopaedic and similar applications such as safety footwear and technical floorings.

TPSP is a speciality footwear manufacturer that will explore the potential of nanotechnology for customised and orthopaedic footwear. This will take the form of shoe and custom-made orthopaedic insoles, with

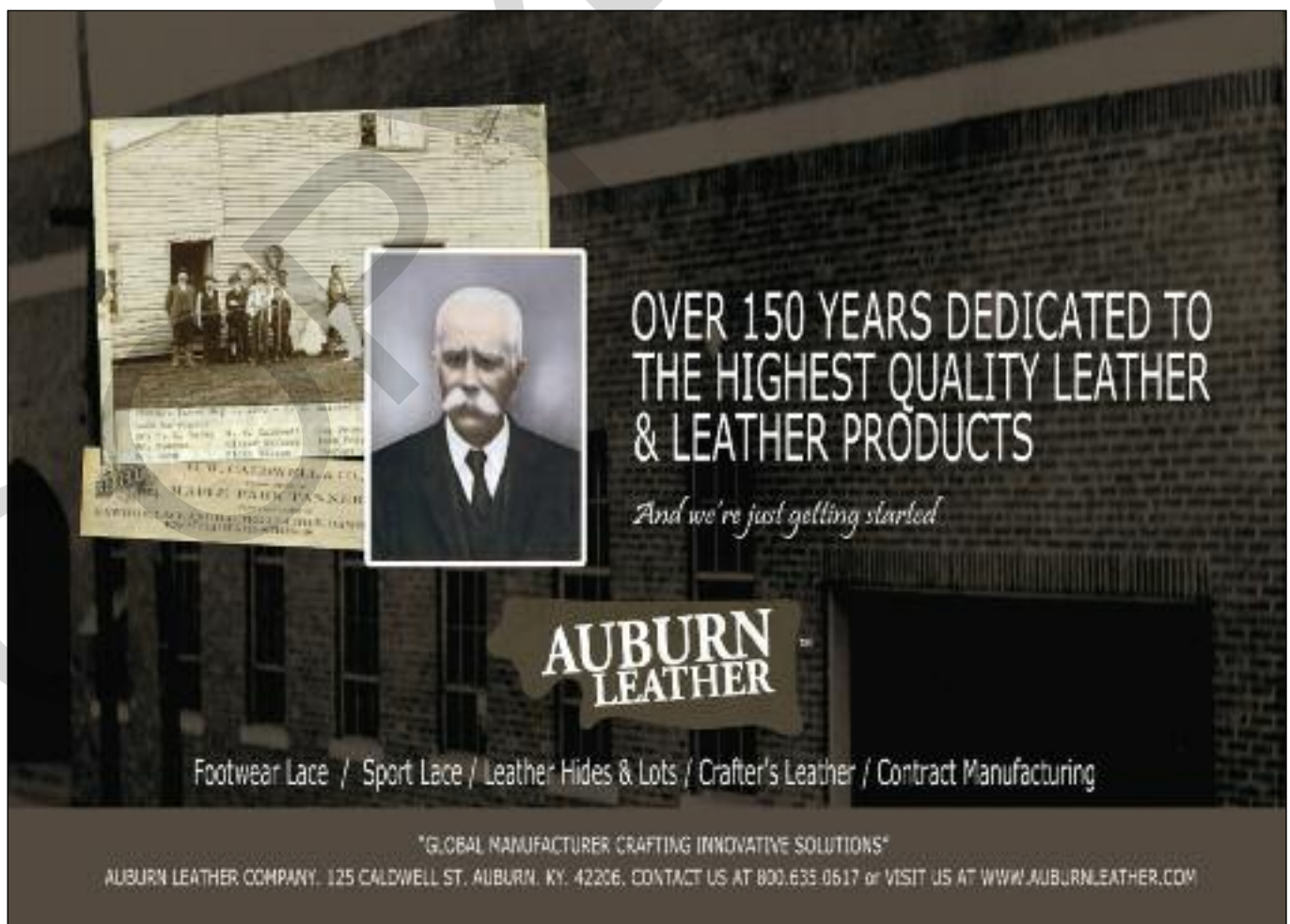


The two year Nanofoot project has involved extensive laboratory research and testing.

different materials and assembling processes, covering the range of processes and applications more usual in this sector in Europe.

Cammina is a small company that designs and produces shoes and accessories made out of eco-compatible materials. The target here is the production of footwear with different nanofunctional and animal-free vegan materials and constructions for its particular market segment.

Furthermore, the nano-based solutions that will be marketed will have real added functions and a higher level of performance than existing ones. This 'increase in product functionality and quality' will attract areas of the footwear market where price, while still relevant, is not the most important factor, resulting in an economic benefit in an added value estimated at 10 to 20% higher than similar products without the new improved functions. Given the multi-level objectives of the project, performance indicators and impacts will be influential throughout the life cycle of both the materials and finished products. 



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