

Perform, protect, improve

P2i'S PATENTED TECHNOLOGY CREATES DURABLE PROTECTIVE COATINGS ON ALMOST ANY OBJECT AND MATERIAL. WITH CURRENT APPLICATIONS FOCUSED ON SUPER LIQUID REPELLENCY, BUT FUTURE POSSIBILITIES VIRTUALLY LIMITLESS, THIS COMPANY IS THINKING BIG ABOUT NANO-SCALE DEVELOPMENTS.

DR STEPHEN COULSON REPORTS.

The science fiction author Arthur C. Clarke formulated three 'laws' of prediction. According to the Third Law, "any sufficiently advanced technology is indistinguishable from magic". This is often a problem for nano-scale technologies: it's hard for ordinary people to understand the benefits they provide, especially when the underlying mechanisms are imperceptible to the naked eye.

However, as the world leader in liquid repellent nano-coating technology, P2i is fortunate in this respect. Our intellectual property is clearly visible in action. When liquids such as oil and water come into contact with a surface that carries P2i's nano-coating, they form beads and simply roll off. In all of the diverse product sectors that have already commercialised our technology – such as performance footwear, laboratory consumables, hearing aids and specialised filtration – the nano-scale difference is visibly clear. P2i's revolutionary process enables our customers to improve the performance of their products and protect them from the effects of water and all other liquids.

However, while it may look like magic, our technology relies on perfectly rational chemistry and physics, albeit in an innovative, multi-patented and commercially-proven implementation. What we have created is a process that molecularly bonds a nanoscopic, 40-80 nanometres layer of a protective polymer over every exposed surface of a product. In footwear, for example, this includes the laces and stitching.

How P2i performs, protects and improves

P2i's protective polymer is created using a special patented pulsed plasma,

created within a vacuum chamber at room temperature. Although conventional continuous plasmas cause monomers to fragment, P2i's pulsed plasma avoids this limitation. It activates the surface of the object to be processed, and effectively polymerises the protective monomer. This leads to the creation of P2i's unique nanoscopic protective coating on every exposed facet of an object. The protective coating dramatically lowers the surface energy of a treated item, down to one third that of PTFE (polytetrafluoroethylene). This provides an amazing level of liquid repellency, as demonstrated by videos on our new website at www.p2ilabs.com.

Unlike traditional water-repellency treatments, such as chemical dips or sprays, P2i's technology can be applied to finished products and three-dimensional forms. It is durable and not limited to materials with specific chemical make-up, having been proven on fabrics, leather, metals, plastics, ceramics, glass, paper, polymers, wool and cotton.

And because P2i's nano-coating is molecularly bonded to the surface of an article, it becomes as durable as the article itself. Being 1,000 times thinner than a human hair, it has no effect on look and feel,

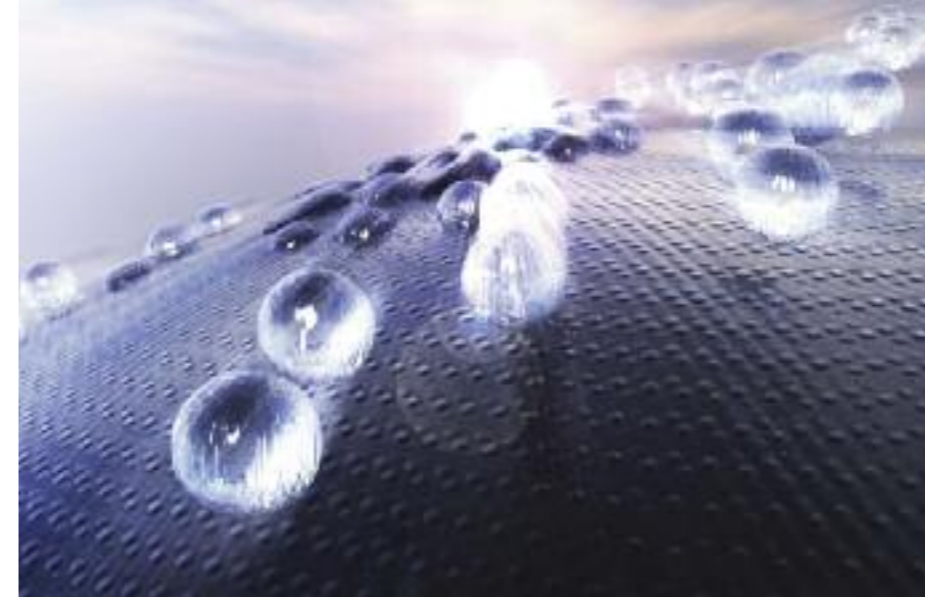
and preserves valued natural characteristics. Finally, and most importantly, P2i's technology is much more environmentally friendly than traditional water repellents. It does not require large inputs of chemicals (using only a tiny quantity of monomer), does not require or create significant heat and is solvent free.

Meeting the commercialisation challenge

P2i's technology is already commercialised in a diverse and growing number of applications, within both consumer and industrial sectors, with manufacturing equipment across three separate continents. Industrial applications include laboratory consumables (e.g. low retention pipette tips), high-performance filtration, engineered textiles, plus engineered glass and ceramics.

Customer applications are currently divided into performance textiles – principally footwear – and consumer electronics. In consumer applications, P2i's liquid-repellent performance boost is a significant unique selling point. Thus to help manufacturers alert consumers to the presence of P2i's technology, we have started developing a suite of application-specific consumer brands.

In footwear, performance wear and related accessories, P2i's technology improves products under the ion-mask™ brand. ion-mask™ makes shoes more comfortable by keeping feet dryer and cooler than ever before. It gives the whole shoe superior water repellency, which helps to stop external water getting in and encourages evaporated perspiration to flow out without being absorbed. As a result, shoes dry out more quickly and won't get heavier over time.



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And unlike membrane technologies, ion-mask™ is not a physical barrier, so it delivers the full natural airflow of the chosen shoe materials as well as reducing weight, which keeps feet cooler. Finally ion-mask™ reduces staining due to much lower uptake of water and dirt – and as mentioned above, it is highly durable. Global footwear brands adidas Golf, Hi-Tec, Magnum, Ecco and Van Dal are already offering ion-mask™ in an increasing number of styles for a growing variety of ranges – from hiking, running and golf to ladies' winter fashionwear.

In the near future P2i will announce a new brand for consumer electronics, where our technology will protect sophisticated devices against damage from water and oil, to improve their performance in challenging conditions. The nano-coating does not affect the performance of finely-tuned acoustic components, and is applied to finished products, protecting them more thoroughly than alternative treatments at the component stage prior to assembly. Independent salt-fog tests have already proved P2i's ability to protect consumer electronics devices against failure due to liquid ingress; bio-compatibility testing has confirmed suitability for skin-contact applications.

Born for the battlefield, worn in the High Street

However, while footwear and consumer electronics epitomise consumer lifestyles, they are far removed from the surroundings in which P2i's technology was born. P2i originated as a project within the UK Government's Defence Science & Technology Laboratory (DSTL), to make soldiers' protective clothing more effective against chemical attack. As a result of this, among the 33 patents that protect P2i's intellectual property, the three core patents are defended by the UK Government. Also, P2i has the sole, royalty-free, worldwide licence to the platform technology developed by DSTL.

The current company, P2i Ltd, was established in 2004 as the first DSTL Technology Transfer process, which was created to commercialise UK Government technologies.

Simplicity and scale for mass manufacture

One of the crucial parts of our commercialisation has been moving from highly-sensitive, laboratory-based, scientist-managed apparatus, to robust, reliable, easily-operated industrial machinery that would be straightforward to deploy (and scale up) in high-temperature, high-humidity mass-manufacturing facilities.

To achieve this we designed, and now manufacture, a family of compact processing machines that are rugged enough to survive international shipment and demanding operations, yet sufficiently sophisticated and precision-engineered to deliver our technology consistently, reliably and continuously. They integrate seamlessly and effortlessly with existing assembly lines, and can be operated at the touch of a single button by existing production-line workers.

Another vital aspect of commercialisation has been developing a viable business model. We make money through a combination of selling our machines and licensing our technology to customers on a per-product-processed basis.

Growing a global business

At the heart of our business is a true platform technology that can be tailored to create a huge range of technical effects in addition to liquid repellency. For example, by working with different coating agents, and adjusting our plasma processing 'recipe', we will deliver anti-misting, anti-microbial, scratch resistant, friction reducing, fire retardant, insect repellent and stain-resistant coatings... to name but a few.

Our goal for the company is to become the world leader in functional nano-coating

technology, enabling our customers to improve the performance of their products and invisibly protect them. We are in the midst of a rapid growth phase, having doubled our workforce between January 2007 and July 2009, doubled our floor-space with the opening of a new Research & Technology Centre at Milton Park near Oxford (July 2009), and opened a US East Coast Office within the Herty Advanced Materials Center in Savannah, Georgia (March 2009).

With £4.1 million of Series C investment raised in the summer of 2009 from new and existing shareholders, P2i is now in the fortunate position of having a solid basis upon which to commercialise and grow a world-class materials technology business.

Dr Stephen Coulson, Chief Technical Officer of P2i, invented the technology while carrying out his PhD at Durham University on 'Liquid repellent surfaces'. He was consequently employed by the MoD to set up a plasma capability and further scale-up the patented technology for industrial applications. Stephen was the founding member of P2i when it was formed in January 2004 and has more than a decade's experience in advanced material sciences and plasma processing.

Nano-coating for the masses: P2i's 40i, one in a family of compact processing machines, is designed for mass-manufacturing, operating simply at the touch of a single button.

