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Catalytic Clothing – Purifying Air Goes Trendy

Catalytic Clothing is a 'trendy' solution to air quality and a daring environmental-fashion initiative started by former fashion designer Helen Storey and University of Sheffield Professor Anthony Ryan. This experiment between fashion and science is an endeavour to purify the air we breathe through jeans treated with nanosized particles of titanium dioxide – the light-triggered catalyst found in sunscreen. Helen Storey, fashion genius of the Helen Storey Foundation, and Prof. Tony Ryan, polymer chemist, are partnering with *Ecover* to produce a simple nanoparticle formulated 'green' laundry product with potential to turn the public into an air-purifying altruistic community.

Let's face it... our air is a mess. Generally, we are not reaching air emission targets for key pollutants that affect our environment as well as our health, including nitrogen oxides (NO_x) and organic volatiles. According to the EPA, nitrogen oxides form quickly from emissions from cars, trucks and buses, power plants, and off-road equipment. NO_x agents are respiratory disease and cancer causing agents in smog and react to form acid rain. In the UK alone, organic volatiles kill 29,000 people a year, and asthma is a growing problem especially among young people living in big cities with high levels of NO_x and other pollutants in the air. Although several initiatives have been undertaken to reduce NO_x and organic volatile pollutant concentrations in air, emissions standards remain largely unmet. This may be about to change, and at the hand of the everyday citizen. Former fashion designer Helen Storey and polymer chemist Prof. Tony Ryan have suggested a lovely solution: build an air-purifying function into the clothes we wear all day every day. According to Storey, every single surface that is available to us – whether the interior of our minds or the outside of our clothes and our bodies – needs to be getting 'smarter'. Storey and Prof. Ryan are making trendy jeans 'smart' by treating them with tiny particles called nano-titania. Nano-titania, or nanosized particles of titanium dioxide, work as powerful catalyst agents that speed up the conversion of harmful NO_x air pollutants to

harmless by-products that can be washed away with the rain. All right there on the surface of the everyday person's jeans.

Storey and Prof. Ryan seek to engage the public on environmental issues through art and fashion. "Fashion is an amazing communicator," Storey said. "For all its faults, one of the things it can do is spread an idea around very powerfully and coherently. It can galvanize a lot of support for it. Imagine if you could galvanize that kind of energy towards something that would actually save life."

"Tony and I walk around in our air-purifying jeans – not purifying very much based on its need to be at scale - but I wear mine in the hope that I can infinitesimally improve our air quality. Tony says he wears his so that he can fart all day and no one will know!"

– Helen Storey.

Catalytic Clothing – The Solution

"It's all about surface area," Prof. Tony Ryan says about the nanoscale catalysts that he and Storey are using to convert the pair of jeans in the back of your closet into an air-purifying machine. This artist-and-scientist team is trying to harness the "football pitch" of surface area of the clothes we wear on a daily basis to serve a creative and vital function (other than hiding our nakedness or communicating our style): purifying the air around us from harmful nitrogen oxides and other organic pollutants.

"We asked ourselves, could we apply something to the surface of clothing, knowing that the surface area is so much greater than many other surfaces, to solve a world problem?"

– Helen Storey

Catalytic Clothing - The History

Fifteen years ago, Storey ended a commercial fashion career "dressing people like Michael Jackson, Prince and Madonna – celebrities that made a living off of what they looked like or sounded like," said Storey, in order to look for something new. She happened upon a leaflet from The Wellcome Trust about an initiative called 'SciArt'. "What they were trying to do was get scientists and artists together, the idea being that the artists could elucidate or bring to life an area of complex science in a way that the public could engage with," Storey said. 'SciArt' was a springboard for Storey to enter a new world, and perhaps even a new era, of fashion.

“Fashion changes every 3 seconds, whereas science can take 10-15 years to get something right and to market. Catalytic clothing is ... asking fashion to slow down in order to do something that is of value and beyond the moment, and asking science to speed up because the world needs answers much more quickly than it is used to delivering them.”

– Helen Storey

Storey first partnered with Prof. Ryan on a project bridging science, the environment, and fashion after hearing him speak on a BBC Radio Series called Material World. “He sounded a very nice combination between a stand-up comic and a science geek... so I rang him up,” Storey said. The artist and the material scientist hit it off right away; “We started talking about the full extent to which materials could have behaviours, and how far we could push that,” Storey said.

An initial union between fashion and science, a project called Wonderland that featured rather magically disappearing dresses allowed Storey and Ryan to begin engaging the public with notions of materials, how much we consume and where our materials go and don’t go. “We have this awkward conversation with them but through awe and beauty as opposed to scaring them, or making them feel guilty,” Storey said. The team started to realize the power of art and fashion in bringing to the public a message around science, and the possibilities of science, in ways that were much more accessible than through a journal or in the written form.

Storey and Prof. Ryan were sitting in a Wonderland project workshop with 14- and 15-year old students, talking to students about what it was like to be an artist working with a scientist and vice versa, when the idea seed for Catalytic Clothing was planted by a young female student in the audience. “She said, “I think what scientists should be doing is taking advantage of what happens in any case, far more often,” Storey said. “We were both quite struck by this comment – this notion of taking advantage of something that already exists in a new way,” Storey said.

When Prof. Ryan did an ‘under the table’ calculation of what the surface area of a person’s clothing is, he found that we have about a football pitch available to us at the nanoscale. “That is a vast catalytic surface that in essence is doing nothing. It is keeping us warm, and of course our clothes say a bit to the people in front of us about who we are, or who

we want to be seen as – but in terms of being an active surface, it is doing nothing,” Storey said.

And so Catalytic Clothing Was Born

“Given my fashion background, it made sense that we continue to think about what the surface of us could do – the stuff that is there in any case!”

– Helen Storey

Storey and Prof Ryan contacted Cristal Global, the world's 2nd largest provider of nano-titania catalysts, to suggest collaboration on an initiative with textiles instead of traditional hard surfaces. “At first, I think they thought we were stupid,” Storey said. “But they did their tests [with our textiles] – and then they redid them, and they redid them, and they redid them, because they almost went off the scale in terms of efficacy.” Cristal Global had never had to measure catalyst efficacy of this potency before.

“The other thing that we found out is that denim jeans are the most efficacious surface of all,” Storey said, “and they are also the most democratic piece of clothing in the world.” Today, there are more denim jeans on the planet than there are people. “Even if we only ever got this to work on jeans ... we would be doing a good thing,” Storey said.

Catalytic Clothing – The Science

Catalytic clothing is coated with nano-titania – or nanosized titanium dioxide – catalyst. The small particles can be washed into any piece of your clothing, for example your jeans, when you wash them in the washing machine. Storey and Prof. Ryan envision that the catalyst will be delivered through a fabric softener type of product. Catalytic Clothing has partnered with Ecover, a consumer-product company well known for being brave and pioneering in the area of the environment, to formulate such a product for public use.

“...We are not asking anybody to buy something new for the sake of it – but instead adding some radical technology to what you already own, to your existing wardrobe, simply by asking you to wash it with a specific product.”

– Helen Storey

The catalyst particles are tiny balls that measure less than 10 nanometers in diameter (1 nanometer = 1 billionth of a meter). “Because the particles are small, they ‘stick’. Once

they are stuck to the surface of the fabric, they are stuck to the surface of the fabric, and they only fall off the fabric when the fabric degrades,” Prof. Ryan said. When the cotton fibres of your jeans break, and your jeans go white, the particles eventually fall off, but the traditional washing process, or running around outside, create no problem for the catalyst particles.

Nanoparticles have an extremely high surface area to volume ratio compared to particles large enough for the human eye to see. “The majority of the [catalyst] material is surface,” explains Prof. Ryan. More surface area is key when we are talking about catalysts. Nano-titania catalysts use oxygen and light, along with their reactive surfaces, to turn nitrogen oxides into the less harmful water-soluble product nitric acid. The catalysts can also react with organic volatiles to create a familiar water soluble product: soap.

There have been various trials in London on urban surfaces like pavements and school walls using nanoparticles of titanium dioxide to remove NO_x from the air. However, what these trials found was that while the nanocatalysts can keep these surfaces clean, and whilst they can purify small amounts of air, “the volume of fumes coming at them from cars is so relentless that they don’t actually improve the air quality in human terms very much at all,” Storey said.

Prof. Ryan explains how Catalytic Clothing works with an example from ‘smart’ architecture. “Self-cleaning windows are a classic example of nano-titania catalysts,” he said. Nano-titania materials in these windows, along with oxygen, react with dirt to create a soap-like product. “Oxidized dirt is soap, and when it reacts, the windows wash themselves,” Prof Ryan said. The technology has also been widely used in architecture. There is a church in Rome, and another in Madrid, that are ‘self-cleaning’ churches. “They stay very very white because of the action of the photocatalyst, which effectively re-bleaches the surface of the church over and over,” Prof Ryan explained.

Catalytic clothing harnesses this same chemistry to remove nitric oxide (NO_x) from the air, but with a twist. While the surface area of most architectural surfaces is not particularly high, clothing has more than we know what to do with. As it turns out, a pair of jeans weighing one pound has a surface area of greater than 195 square feet – this covers the floor space of a modest living room. “The higher the surface area, the more NO_x removal

you get,” Prof Ryan said. Clothes remove far more NO_x per unit area of fabric than architectural surfaces, because the effective surface area of clothing is so high. “The leap of imagination wasn’t so much a new technology, but going back to the 14-year old girl, taking advantage of something that exists already, and just thinking of a completely different field of use. And that is where Catalytic Clothing came from,” Storey said. “There is no new science here, we are just taking advantage of an already established technology,” Prof. Ryan said. Nanoparticles of titanium dioxide are not only found in self-cleaning windows – you can find these particles in toothpaste and sunscreens. Nano-titania is used in sunscreens as a UV-light absorber, absorbing harmful UV rays so that our skin doesn’t have to.

So, how many people would have to wear Catalytic jeans to reach emission targets of NO_x? “We have done the maths on how many people it would take to get the city of Sheffield – where Prof. Tony is based – under the emissions limit for NO_x,” Storey said. For the city, which produces 9000 tons of NO_x every year, the answer is one third of a million people... only two thirds of the city’s total population.

Catalytic Clothing – a Cultural Experiment

“Science often happens behind closed doors. They come out at the end and they say ‘Finished!’ but they often forget to ask if we even want it. I’m trying to narrow that gap, and to join all the dots in between the outside world (society) and the inside world of academia (Universities largely) – whether that is considered an art or a science.”

– Helen Storey

Catalytic Clothing has tried to keep a global conversation going over their future product development, to feed public voice and public hopes and fears for the technology back to the science team creating the textile catalysts product. Storey was able to send a team of graduate students at the London College of Fashion – who were studying a course known as ‘Fashion and Environment’ – out into the public domain to collect public feedback on Catalytic Clothing technology as well as consider more widely how science could impact their own artistic development. See The Living Map of public feedback.

‘The most popular piece of feedback you get from speaking to anybody in the street when they have just begun to understand the concept is the perception that they will become a dirt magnet,’ Storey said. “This is not how the technology works at all,” Storey said. The

catalyst is only triggered and active when it meets UV light and oxygen. “The reaction happens around you, not on you,” Storey said. “The catalyst on your clothes triggers the reaction away from you. In effect, you are walking in your own purer bubble of air,” Storey said. “But the lovely and rather poetic aspect of this technology is that you personally don’t benefit. You benefit the person behind you who walks in your airstream, as you benefit from the person ahead of you, as you walk in theirs. Perhaps this is the world’s first altruistic technology.”

Public feedback was a very good clue to the team about how they needed to begin to speak of their ‘catalytic jeans’ in order to get enough people to wear them to eventually bear an impact on air quality. “A lot of these perceptions of the technology scientists would never have thought it – and neither would I have actually,” Storey said. “To be constantly kept on your toes by the reality of the street means that when this technology does become available it will already have a marketplace hungry for it,” she said.

“It only really works if everybody does it. It really is an altruistic thing to do. The problem is, how do you market altruism? Most sales are actually done on individual benefit – so for marketing departments in big companies, this is a really big issue.”

– Prof. Ryan

This is where the union of art, science, and fashion has its role to play. Art can perhaps carry the science and environmentalism to new heights. “We are trying to get the cultural message out first, before there is a product in the market,” Prof Ryan said. I personally think this is a wonderful and much needed union. Science is often ‘sold’ for science’s sake, leaving non-scientists cold on what could be innovative and successful ideas. What is most interesting about Catalytic Clothing is that in and of itself, the science is not new, but the project as a whole is artfully inspiring, and perhaps capable of radically changing our behaviours and attitudes toward our environment.

By Paige Brown, 21st March 2012,

<https://blogs.scientificamerican.com/guest-blog/catalytic-clothing-purifying-air-goes-trendy/>