

Dr. Ilsoon Lee's Recent News Media Exposure on Wrinkle-free Film

Our recent nanoparticle work on "**Wrinkle-free Films**" that was published in Nano Letters has gained a lot of publicity world wide including 'Discovery Channel News,' 'Chemistry World,' 'Times on line,' 'Nano World News,' 'MRS Bulletin,' and 'Science Daily.' In addition, this research was introduced throughout the MSU media such as MSU today, MSU Newsroom, MSU News Bulletin, and The State News. More detailed news can be read through (www.egr.msu.edu/~leeil). This work opened a new research and business paradigm of designing, processing, and applying nanoparticles and films. Especially, cosmetic applications for human skin wrinkling have attracted a great deal of interest from the industry including the P&G Company and Dow Chemicals. We applied for a patent on this novel founding for the potential commercialization such as cosmetic application, artificial skin, and microelectronic devices. Some news articles are attached.

Hendricks, T.R.¹; Lee, I.³ "Wrinkle-Free Nanomechanical Film: Control and Prevention of Polymer Film Buckling," *Nano Letters*, 7 (2), 372 -379, (2007). [**Featured in more than 70 news** including Discovery Channel, Chemistry World, MRS bulletin, Times on line, Medical News Today, and Science News Daily] (ISI journal impact factor (2006)=10.0):



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Nanoparticles Join War on Wrinkles

Tracy Staedter, Discovery News

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Jan. 25, 2007 — The latest development in cosmetic nanotechnology could help stop wrinkles before they start.

When added to thin polymer films used in industry as protective coatings or transistors, tiny nanoparticles help prevent the materials from buckling in a way that can reduce performance. But researchers think the particles may have cosmetic applications as well.

"In the industries of biomechanics, artificial skins, plastic surgery, and cosmetics, controlling and ultimately preventing such unavoidable wrinkling phenomena is of great interest to many people," said Ilsoon Lee of Michigan State University, who collaborated on the research with Ph.D. student Troy Hendricks.

Lee thinks that the same technique he developed for polymer films could be applied to human skin.

Wrinkles, in both polymer films and skin, occur for similar reasons. External forces, such as those from heat (in the case of polymers) or muscles (in the case of skin) compress the pliable substance, causing it to buckle.

In thin film transistors, buckling is bad because it makes the electric current less efficient. But as computer parts get smaller, and transistors get thinner, the chance for wrinkling increases exponentially.

When buckling occurs in thin films — used as protective surfaces, antireflective coatings and lubricating layers — the result can range from small cracks to catastrophic failure.

>Lee and Hendricks suspended nanoparticles in the film like grapes in a Jello mold. When external forces squeezed the film, each particle deflected a tiny bit of local tension. Working together, the particles reduced the overall strain on the film, preventing wrinkles.

One way to reap cosmetic potential out of the same technique might be to inject the particles into the skin or put them in a topical cream.

Another solution could be done during a cosmetic procedure, such as a facelift or eyelift. In those cases, a film with the nanoparticles could be implanted in the skin or transferred to the skin's surface like a transparent toy tattoo. The film could stay there temporarily or permanently to ward off muscle tensions that cause wrinkles.

But the skin is not a smooth surface to begin with, said Vladimir Tsukruk, professor of materials science

and engineering at Georgia Institute of Technology in Atlanta. It has a complex topography of pores, hairs and its own protection oily layer.

"It is not obvious that such a complex 'sandwich' will behave accordingly," he said.

Currently, Lee's team is applying the nanoparticles to various cells and proteins to see if there are any toxic reactions.

But even if the body rejects the silica nanoparticles the team is currently using, Lee thinks other FDA-approved particles could be substituted.

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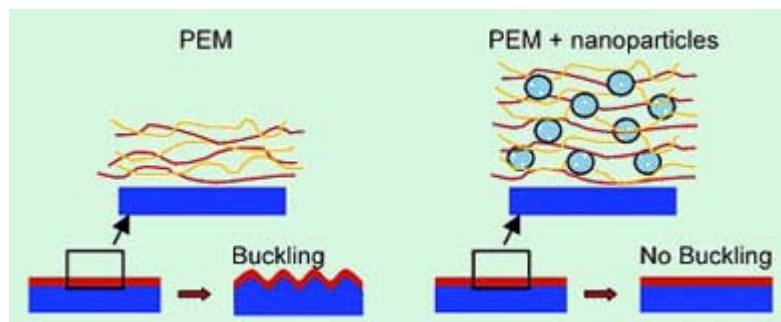
A nanotech solution to wrinkled skin

09 January 2007

Those of us unhappy with our ageing skin may find solace in nanotechnology. Researchers who have discovered that nanoparticles prevent thin polymer films from buckling say their concept could be applied to stop human skin wrinkling too.

Nanoparticles are already marketed in cosmetic skin products; usually because they can penetrate much deeper into skin than conventional creams, delivering vitamins that are supposed to plump and soften the skin, reducing wrinkling. The approach of Ilsoon Lee, of Michigan State University, US, is somewhat different: nanoparticles in sufficient concentration, he suggests, may stop the skin ever wrinkling in the first place.

That's because the same underlying principles of wrinkling lie behind human skin and the polymer film systems which Lee has been investigating. Human skin, Lee says, consists of a thinner outer layer (the epidermis, around 50-100 μm thick) resting on top of a thicker layer (the dermis, around 1-3 mm thick). Similarly, thin polymer films used to create anticorrosion, water-repelling, or biocompatible surfaces, and also in electronic devices like thin film transistor (TFT) screens, are formed on top of a thicker substrate - a flexible plastic, for example.



Nanoparticles in a thin polyelectrolyte multilayer (PEM) film prevent buckling.

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Although skin is a living material, vastly more complicated than a polymer film, Lee believes that both heated film and aged skin wrinkle permanently because they stiffen up more than the soft plastic or dermis below them. The same effect is seen in dried fruits, when thin dried skin stiffens over a soft interior.

Lee and his colleague Troy Hendricks wanted to prevent polymer films from buckling as they were compressed or heated during the manufacturing process. Wrinkled films, Lee told *Chemistry World*, can be a problem for electronic applications; for instance, the wrinkles can approach the size of the increasingly small features printed on the film, disrupting an electronic device's function.

The researchers found that 50 nm silica particles deposited in layers through a thin polyelectrolyte film stopped the film from wrinkling up when heated or compressed. Lee suggests that the particles work by redistributing stress forces out of the plane of the film. The nanoparticles might affect the film's performance, Lee conceded; though in the case he tried, the film stayed transparent to light as required. His group are testing different sorts of nanoparticles, of varying size and shape, to see if they have the same anti-wrinkling properties.

In themselves, said Geoffrey Ozin of the University of Toronto, California, US, these results are 'extremely interesting and scientifically surprising'. But Lee thinks that the same principles could be

applied in a cosmetic product or implantable device to stop skin wrinkling too.

'We don't mean that people will literally bombard their skin with nanoparticles,' Lee told *Chemistry World* (though he pointed out that injecting a toxin, Botox, into one's skin to remove wrinkles also sounds strange). Instead, he speculates that wrinkle-free film could be sandwiched between protecting layers, to be used in artificial skins for surgery, or implanted onto a face. Another route involves a topical cream containing materials which act in human skin as the nanoparticles behave in thin films.

There are obvious health and safety issues with such applications - the nanoparticles will have to be cleared for toxicity. Nor may Lee's technique be generally applicable, if skin doesn't behave in the same way as thin films do. But it's an intriguing possibility: one more cosmetic spin-off to add to nanotech's lengthening list.

Richard Van Noorden

References

T Hendricks and I Lee, *Nano Letters*, 2006, doi:10.1021/nl062544q

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From The Times

January 20, 2007

Breakthroughs, tips and trends

John Naish

Better than botox?

Botox injections may be replaced with something much smaller and longer-lasting, claims a chemical engineer, who says his new nanotechnology system may one day prevent your skin from buckling into wrinkles.

Ilsoon Lee, a professor at Michigan State University, has been exploring the use of nanoparticles in stopping layers of extremely thin polymer film from buckling. The films are increasingly used in high-tech systems such as electronic monitors. The thinner the films, the more prone they are to wrinkle.

Now he says he has realised that the same system of infinitesimally small chemical support may be used in human skin. Ilsoon suggests that the nano-thin films could be injected between the thinning outer layer of a person's skin, the epidermis, which tends to stiffen and buckle with age, and the thicker dermis beneath it, which remains more pliable as we get older.

He says that his system, which is outlined in the American Chemical Society's *Nano Letters* online journal, would not provide a full facelift, but could be used to prevent tiny wrinkles from growing into facial lines. It may also be used in nip-and-tucks such as eye-lifts, to shore up any improvements.

Ilsoon is testing his nanoparticles to ensure that they are not toxic, before trying them on living skin.

Parasites found: worms help MS patients

Parasitic stomach worms could help people with multiple sclerosis to live free from the effects of the disabling disease, claim researchers in Argentina.

The scientists report in the *Annals of Neurology* that they have discovered that patients with multiple sclerosis, who had also become infected with a form of water-borne parasitic worm, *Schistosoma mansoni*, suffer far fewer relapses of their MS.

Their study of 24 MS patients found that the 12 who had the parasite had a total of three relapses in the space of four years, while the parasite-free counterparts suffered 56. They saw a far more significant increase in their level of disability, too.

Why the difference? The doctors, at the Raúl Carrea Institute for Neurological Research, say that MS is an autoimmune disease, where a person's immune defences attack their own body. Having a parasite at large in their bloodstream may serve to distract the immune system from self-destructing because it has a real job to do.

They speculate that the rise in autoimmune diseases such as MS in the modern world may be because of a decline in the prevalence of infectious diseases. If science can isolate the MS-dampening molecules that the parasite sparks, they may be on the road to a new therapy.

Look into my thighs

Face-reconstruction surgeons say they have found a better site for harvesting bone grafts than the hip bone, their normal source. It's your pubic bone. Doctors at Rush University, Chicago, say that while taking grafts from your hip bone can be painful and cause scarring, pubic-bone grafts causes less trauma, and


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Nanotechnology shows promise as next wrinkle fighter

by Sue Nichols

January 18, 2007 - The next big idea in preventing wrinkles is very, very small.

Nano small.

An MSU chemical engineer has discovered that nanoparticles can stop thin polymer films from buckling and wrinkling. It's a new solution to a critical problem as thin films become more important in new technology such as electronic monitors.

The cosmetic arsenal to fight human wrinkles embraces technologies that seems crossed with science fiction – from microdermabrasians to lasers to Botox injections – and nanoparticles are poised to join the war by warding off dreaded buckles in human skin.

Ilsoon Lee, an assistant professor of chemical engineering, along with Ph.D. student Troy Hendricks, published an online article in the American Chemical Society's Nano Letters in December 2006 that outlines the potential of using infinitesimally small nanoparticles – 50nm – between films to smooth out the tiny buckles that are the origin of wrinkles.

While the article addresses breakthroughs in the buckling of polymer films as they were compressed or heated during the manufacturing process, Ilsoon said the principles show promise to apply to human skin.

The research is supported by the National Science Foundation and the Michigan Economic Development Corp.

On all fronts, it's all about nailing a wrinkle before it starts.

"Everything starts at a really small scale, so if we can prevent the buckling at the very beginning – at the nano level – we can eliminate large scale wrinkles," Ilsoon said. "Wrinkles can initiate from the small scale, and when it grows we cannot remove it."

Nanoparticles already have entered the cosmetic marketplace because they can penetrate deeper into the skin, transporting vitamins and other compounds to plump and smooth tissue. But Ilsoon envisions thin films that can be injected beneath the

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thinning outer layer of the skin, the epidermis, that over time stiffens and buckles with aging, and the thicker dermis beneath it, which remains more pliable over time. Think of a raisin.

Ilsoon explained that nanoparticles spread in a thin film can break up the compressive forces on a plane and redirect them. Once the force is reduced below the critical buckling strain, the film will not buckle. No buckles, no wrinkles. The nanoparticles in the film can be stress busters without affecting the neighboring layers.

“The wrinkle-free films will automatically absorb or deflect the stress and stay flat, just as they are after formation,” he said.

Nanoparticle films wouldn't be a face-lift itself, but Ilsoon sees the possibility in a film that could be added during a cosmetic procedure – such as an eyelift – to stabilize the improvements and prevent further wrinkling. He also sees applications in medical procedures – such as artificial skins for surgery.

The ideas are in the early stages with health and safety concerns to be worked through. Already Ilsoon's lab, with collaborators, is testing polymer films, by applying various cells and proteins to see if there are toxic reactions.

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