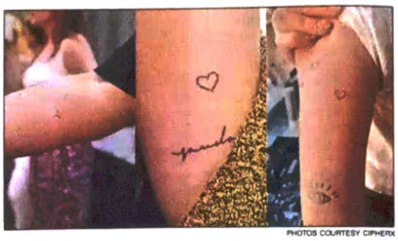
Mathures Paul interviews the materials scientist who has made tattooing painless

Patch tech and vaccine delivery



PHOTOS COURTESY CIPHERX

A technology designed to make tattoos less intimidating could eventually change how vaccines and medicines are delivered. CipherX's proprietary Microdot Technology platform uses microscopic biodegradable needles to deposit tattoo ink instead of a tattoo gun. Ferdinand Kohle (**see pic**) is co-founder and CEO of CipherX. He talks about how Microdot works, why tattooing was the starting point and what the company hopes to achieve beyond body art. Here are excerpts from the interview.

Q Tattoo artists say it is an art form rather than simply pigment delivery. How do you position CipherX?

Our current product is a tool designed for small, monochrome tattoos (currently available in black) delivered using dissolving microneedles. It makes permanent body art accessible to people who may previously have avoided tattooing because of needles, pain or blood. Approximately 35 per cent of our customers are receiving their first tattoo from us, which suggests that we are reaching people beyond the existing tattoo market.

Broadly, we see Microdot technology as more than simply another method of delivering tattoo pigment. The underlying platform allows us to explore the controlled delivery of different pigments and functional materials into the skin. Over time, this could create applications across lifestyle, cosmetics, sensing and medicine.

Q How does the dissolvable microneedle technology work?

The patch contains an array of microscopic, dissolvable projections containing tattoo pigment. A reusable applicator places the microneedles into the superficial layers of the skin in a controlled manner.

Once inserted, the microneedle material begins to absorb moisture and dissolve, releasing the pigment locally. The patch remains in place for approximately 15 minutes to allow this process to take place. The backing is then removed, while the pigment remains in the skin.

The tattoo normally becomes more visible over the following 24 to 48 hours as the skin settles and the pigment appearance stabilises. The process avoids the repeated puncturing movement used in conventional machine tattooing.

Q How difficult was it to convert what was essentially biomedical microneedle research into a consumer product?

This is actually one of the aspects of the work that interests me most — translating a foundational technology into something people can actually use. A laboratory experiment can demonstrate that a principle works, but turning that into a consumer product is a very different challenge. It has to be reproducible, manufacturable, safe, intuitive and ultimately something people would want to adopt. This process of technology translation requires enormous creativity.

Q What were the biggest engineering challenges?

Skin is a flexible and variable biological surface. A key part of our development was creating a standardised application process that performs reproducibly despite that variability. We developed the applicator to reduce variation caused by manual pressure and technique.

Q Could this technology eventually enable applications beyond tattoos?

Yes. Skin is our largest organ and our interface with the outside world. It can be used both to deliver materials into the body and to access biological information. That opens possibilities ranging from drug and vaccine delivery to medical marking, diagnostics and sensing. (Imagine microneedle patches that can deliver drugs and vaccines in a minimally invasive way.)

We are already exploring some of these areas through funded research programmes and collaborations, including with the University of Oxford.

What excites me most is the skin itself as an interface, the combination of its scientific potential and its cultural meaning. Biologically, it offers opportunities not just to deliver materials, but potentially to better understand what is happening in the body. I find it interesting to think that new technologies could open up new ways in which we interact with our skin.

SKIN ART: Tools used for tattooing — a bone needle, a tattoo gun and a Microdot patch

Yes, these plants are carnivores

Darwin could not prove this but Chinese researchers did. **Jack Tamisiea** reports

Charles Darwin loved a deep dive. The famed evolutionary biologist devoted years to studying barnacles and obsessed over breeding pigeons. But one of his most enduring fascinations was carnivorous plants.

In 1875, Darwin published a treatise on carnivorous plants that featured several species he thought could be flesh-eating flora. Among them were hardy alpine plants in the genus *Saxifraga* that had sticky hairs reminiscent of his beloved sundews. Darwin tempted two European *Saxifraga* species with insects during feeding experiments, but he was ultimately unable to prove that the species were carnivorous.

More than 150 years later, scientists have vindicated Darwin's hypothesis. Researchers recently served tiny flies to another *Saxifraga* species native to China. Their findings, published in the journal *Nature Communications*, revealed that the plant does digest and absorb sustenance from trapped prey, expanding evidence of carnivory to a new family of plants.

According to Hang Sun, a researcher at the Kunming Institute of Botany at the Chinese Academy of Sciences and one of the authors of the paper, the findings reveal that carnivory has deep roots. "Carnivorous plants could be more widespread than we currently know and more species are hiding the ability to digest prey," he said.

Carnivory has independently evolved in 14 families of flowering plants and is defined by the trapping and digesting of prey for nourishment. Being a meat eater allows a plant to live in depleted soils and harsh habitats. Two of the most famous examples, Venus flytraps and liquid-filled pitcher plants, reside in swampy environments like bogs.

Rugged mountaintops are other places where plants struggle to cobble together nutrients from bare soil, and that's where you'll find *Saxifraga candelabrum*, a branching perennial that produces two-toned yellow flowers and grows in rock crevices in the Tibetan Plateau. Its stem and branches are covered in reddish glandular hairs that secrete a sticky substance.

THE NEW YORK TIMES/XIN-JIAN ZHANG

During field work on a mountain in the Yunnan province in southwestern China, Sun and his team noticed that many *S. candelabrum* specimens were covered in insects. During one trip, the researchers counted that mature plants, on average, had more than 70 insects stuck to their tiny hairs. The researchers wondered if the plants had evolved to catch and consume the insects.

Proving that a plant is carnivorous, however, is no easy feat. To give that label, the scientists would have to show that the species traps, digests and absorbs its prey.

First they used mesh and glass enclosures to conclude that the plant attracts insects with an odour wafting off its flowers. The plant was picky about which insects it ensnared. The glandular hairs nabbed only small insects like gnats; the larger flies that pollinate its blossoms were rarely caught.

The scientists then coated *S. candelabrum* with a chemical that fluoresces green if a digestive enzyme is present. The plant's hairs did glow, confirming that active digestion was taking place.

Lastly, to investigate if the species got a meal out of the bugs, the team tracked whether the plants incorporated a nitrogen isotope from the flies placed on their hairy stems. It took *S. candelabrum* around two weeks to digest the flies. Afterward, the researchers collected tissue and saw the nitrogen isotope in the samples — proof that *S. candelabrum* absorbed nutrients from its prey.

S. candelabrum is the first confirmed carnivore in the family Saxifragaceae. But the plant is far from unique. Kadeem Gilbert, a botanist at Michigan State University in the US who was not involved in the research, thinks there are hundreds, even thousands, of other species with similarly sticky hairs — including species like the common tomato. Many of these may also be concealed carnivores.

"This truly shows just how possible it is for carnivory to originate at any point in the plant tree of life," Gilbert said of the new research.

Darwin would have been thrilled to probe this expanding bouquet of ferocious flora.

NEW YORK TIMES NEWS SERVICE