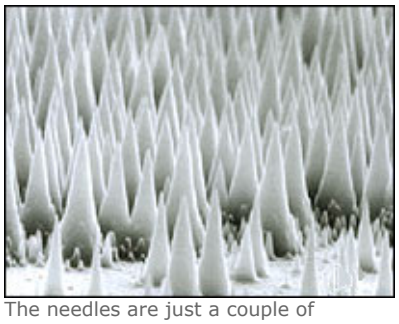
Science plans 'non-stick' submarine

US nanotechnologists are developing what they think could be the ultimate non-stick surface.



The needles are just a couple of millionths of a metre apart

It is covered with nano-scale needles that enable a liquid, for example, to slip straight off it.

One application could be non-stick submarines, which would glide through the water with much less resistance and require less force and fuel to propel them.

"If you think about submarines in a marine environment, the defence department will be very excited to hear about this," CJ Kim, an engineer at the University of California at Los Angeles, told BBC World Service's Discovery programme.

Water hating

Dr Kim explained how the technology worked.

"We call it nano-turf - artificial turf with nano-scale crest structures," he said.

The technology could produce ultra-efficient - if expensive - raincoats

"The surface is repelling water. It is densely populated so it will let the water flow against air instead of a solid surface, which makes it very slippery.

"When we roll a drop of water on this surface, we make it 99%, or more, less sticky than the flat surface."

He added that in order to maximise the non-stop qualities, the miniature spikes had to be sharp, while the material itself should already be as non-stick as possible.

"Right now we're using Teflon, which is one of the best water-repelling materials known to us today," he said.

"Overall, you get a far better slippery effect than normal flat Teflon surfaces."

Expensive raincoat

As well as coating submarines, another application of this technology could be in waterproofing clothes.

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Rain would fall and simply run off any garment either made out of or coated with the nano-turf - and the wearer would never get wet.

However, Dr Kim conceded this would be a rather costly way of staying dry.

"For simple water-repelling, this will work better than anything else you know - but be a lot more expensive."

He added that nano-turf was more likely to appeal to heavy industrial use in the future.

"Fundamentally it is not limited to a micrometer scale," he stressed.

"The surface is slippery to any flow, so if somebody wants to use a macro - or bigger, regular scale - it will still work.

"In principle it is possible to flow chemical ingredients, or even fuels, long distances with a lot less energy consumption."

Gecko inspiration

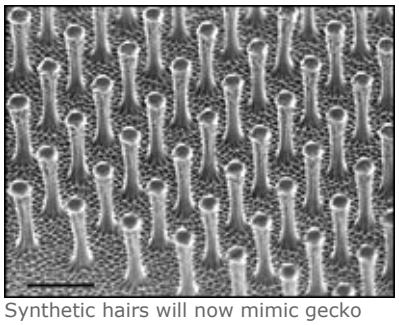
At the other extreme, nanotechnology is also being used to create the stickiest surface possible.

Scientists in both Britain and the US have been using the gecko - which can haul its bulk up glass walls and hang from smooth ceilings - as the inspiration to make the ultimate adhesive tape.

"These animals have evolved the perfect adhesive, using micro and nano-scale hairs," US nanotechnology engineer Metin Sitti told Discovery.

"Imagine your normal hair, and then scale that down a thousand times.

"Then you have these hairs - but at the end of these hairs, one thousand times smaller again, are smaller hairs."



Synthetic hairs will now mimic gecko feet. The scale bar is again two microns.

The hairs on geckos' feet are made of the same material as human nails, and can deform when pressed into a surface. This allows the gecko to cling on.

But the real trick is molecular attraction. The hairs set up tiny forces - so-called Van der Waals forces - that clamp gecko feet down on even the underside of horizontal glass.

Synthetic versions of the gecko hairs have now been developed.

Rescue robots

Dr Sitti said that the first target was to incorporate the new adhesive materials into lightweight robots.

These would be able to climb walls to aid search and rescue missions.

And he added that the US space

agency Nasa had plans to use the materials as early as next year.


Nasa is keen to adopt the ultra-sticky gecko glue

"One big project is space robots - in space, amongst other things, there is not much weight. So the first spider-man will happen in space, not on Earth," he said.

"Astronauts will have these glues and adhesives that they can stick on space shuttle surfaces and walk about."

In theory, being able to stick to the side of the shuttle or space station would make space walks much less dangerous.

But Dr Sitti stressed that real spider-men might still be a little way off.

"The extreme is phone calls we have asking if these glues could carry people on walls," he said.

"I think that's a little futuristic - maybe five or 10 years ahead at least."

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