Abstractions

LAST AUTHOR

Manufactured adhesives — used in products from bandages to sticky notes — cannot out-stick those of nature. Phillip Messersmith of Northwestern University in Evanston, Illinois, and his colleagues found success by merging mimics of two natural adhesives. They combined a nanometre-scale structure inspired by the feet of geckos — which can cling to vertical and inverted surfaces — with an adhesive protein similar to those used by mussels to stick to rocks (see page 338). This achieved a first — a strong yet reversible adhesive that works in wet conditions. Messersmith spoke to *Nature* about the material, dubbed 'geckel'.

What made you think of combining mussel- and gecko-like adhesives?

We started mimicking gecko adhesives about two years ago, but our discovery that a component of mussel adhesive protein provides strong, reversible bonds to wet surfaces really accelerated our work. Others had already achieved gecko-like dry adhesion, but none was able to maintain stickiness with repeated use. And gecko-type adhesion is known to perform poorly under water. These factors got me thinking about combining both adhesive strategies in one material.

How was your nanometre-scale gecko-foot design different from previous ones?

We used a silicone elastic polymer — chosen not for its adhesive properties but for its compatibility with the nanofabrication technique — to design nanometre-scale pillars that mimic gecko foot hairs. We also applied a thin layer of mussel-like polymer to the pillar surface.

Is gecko-like adhesion the ultimate objective of engineered adhesives?

Probably not. Several natural biological adhesives remain open frontiers. For example, certain bacteria live in turbulent waters and use remarkably strong adhesives. Their mechanisms are largely unknown. Another classic wet adhesive is that of barnacles, which use different proteins from mussels.

How might geckel be used?

Geckel works well as a dry adhesive, but it is the wet adhesive component that captivates us. For example, bandages often come off in the shower. Another medical use for geckel might be in dermal patches for drug delivery.

What challenges remain for commercialization?

We are now fine-tuning the pillar tip shape to mimic gecko foot hairs more closely. One huge challenge will be finding a cost-effective way to scale up production to make large amounts of this adhesive. Don't expect geckel sticky notes anytime soon. ■

MAKING THE PAPER

Sanjeev Gupta

How a map of the English Channel explained Britain's island status.

The narrow seaway that separates Britain from mainland Europe has shaped history and culture. However, how the English Channel formed has long been a mystery. A massive flood was one popular idea, but evidence to support it was lacking. Now, an analysis of data collected over a 24-year period indicates that at least two catastrophic floods breached an isthmus at the Dover Strait, allowing an ice-dammed lake to pour into what is now the English Channel.

Sanjeev Gupta, of Imperial College London, never set out to learn how Britain became an island. Then, in 2003, the field geologist came across a book describing various hypotheses of how Britain formed — but scant evidence to support a prevailing idea. Realizing technology could now offer a solution, Gupta discussed the problem with his colleagues, geophysicist Jenny Collier, an expert on ocean-floor mapping, and postdoc Andy Palmer-Felgate. But there was a problem: collecting the data would mean taking a small boat back and forth across one of the world's busiest shipping lanes.

During a separate collaboration, Graeme Potter from the UK Hydrographic Office in Taunton provided a solution. For 24 years, his office had been surveying large swathes of the English Channel so that ships could sail more safely. He offered the team these data and a large map — the first image of the English Channel floor. "We could see this huge valley," recalls Gupta. "There was something peculiar about it."

A few months later, the Imperial College team began exploring the data using three-dimensional mapping tools. The researchers determined that the strange valley had a bedrock floor with streamlined islands scattered down its axis. Islands such as these typically form when so much water enters a river bed that the channel splits in two, leaving a raised strip of land in between (see page 342). Gupta saw similarities between these landforms and those of the Channeled Scabland in the US state of Washington. These were attributed to a megaflood that occurred 15,000 years ago.

By contrast, the British megafloods probably occurred between 450,000 and 180,000 years ago. A lake, impounded where the North Sea is now, breached a rock dam at the Dover Strait and floodwaters flowed southwest. The flow, which may have lasted for months and reached peak discharges of a million cubic metres per second, carved a valley, 50 metres deep, into the rock. It would have been a tsunami-like wall of water, says Gupta.

The discovery adds weight to an old idea. The possibility of the existence of a lake where the North Sea is now was mentioned as far back as 1878. And, says Gupta, a 1985 paper proposed that a huge flood had established the English Channel, although the authors provided little evidence for their outlandish hypothesis, and the article sunk into obscurity.

Until reports such as these piqued Gupta's curiosity, most of his research had focused on interpreting desert rock formations. But the discovery of catastrophic floods in his own backyard has taken his work beyond the remotest corners of the Earth — searching for evidence of similar flooding on Mars. ■

FROM THE BLOGOSPHERE

July's Editorial in *Nature Cell Biology* (**9,** 721; 2007) explains the role of the preprint server — familiar to physicists, astronomers, astrophysicists and chemists — to biologists. Centre stage is given to Nature Precedings, and to how posting preprints and other documents on the site affects possible publication in Nature journals.

As described on Nautilus (http://tinyurl.com/2ue2gq), Nature Precedings facilitates the sharing and discussion of prepublication data. It can host slide presentations, preprints, posters and stand-alone data. Postings are citable (DOIs) and attributable to an author. Although screened by in-house curators for scientific legitimacy (not novelty or quality), they are not peer reviewed, and, as a result, content can be posted in less than a day. The content carries a Creative Commons Attribution licence, which requires only proper citation.

The Nature journals, like many others, do not consider a posting on the site as a formal publication that would prevent consideration of a submitted manuscript for publication. But authors cannot post on Nature Precedings updated manuscript versions that evolve due to a journal's editorial process. ■

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