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News and Views
Material witness: Does nature know best?
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Judging from recent publications in this journal, biomimetics is thriving. Take the composite made by the sequential deposition of polyelectrolyte films and plate-like clay particles (Tang, Z. *et al. Nature Mater*. **2**, 413–418; 2003), mimicking the mineral/organic laminated micro-structure of nacre. It has a tensile stress that compares favourably with the natural model, although the Young modulus is considerably lower and the work of fracture not reported. Clearly the biomimetic strategy works here, after a fashion.

The same is true of the well-publicized 'Gecko tape' (Geim, A. *et al. Nature Mater*. **2**, 461–463; 2003), a triumph of microfabrication. Admittedly, fabricating the micrometre-scale array of hairs responsible for this plastic material's re-attachable adhesion using electron-beam lithography is laborious and expensive, and the adhesion declines after several attachment cycles. But there is no denying the success of this direct copying of nature's mechanisms, and the decision to demonstrate it by attaching a small pad to a Spider-man toy was inspired.

Gao *et al*. (*Proc. Natl Acad. Sci. USA* **100**, 5597–5600; 2003) argue that in natural composites like nacre and bone, scale is critical. They say it is precisely at the nanometre-scale characteristic of the material units of these substances that flaws in the structure — a nick in a mineral platelet, say — no longer exert a substantial weakening effect by nucleating cracks. Such defects are unable to generate the stress concentration that triggers a crack, and so the flawed nanoscale platelet has a comparable strength to a perfect crystal. A lesson worth heeding, although discouraging perhaps for attempts to copy nacre's laminar form at larger scales. (The principle of crack deflection at weak interfaces should, however, still operate in scaled-up structures.)

The molecular-scale structure of spider capture-silk threads (Becker, N. *et al*. *Nature Mater*. **2**, 278–283; 2003) is a smart solution begging for mimicry. These strands take most of the strain when the web absorbs the impact of a flying insect, and they are capable of a tenfold increase in length while simultaneously dissipating energy so the prey is not catapulted away. It seems that the silk molecules are folded into helices that act as molecular springs: each loop of the coil gets extended at the cost of breaking hydrogen bonds, which absorbs energy. Design of artificial protein-like polymers is now sophisticated enough to place such a molecular structure within reach.

There isn't much here that biomimicry sceptics could take issue with. But it is wise to check out cautionary tales of the past, like those recounted in Steven Vogel's *Cats' Paws and Catapults* (Norton, 1998). In the 1950s, 'artificial dolphin skin' called Lamiflo that allegedly reduced drag on submarines foundered, not only because it didn't really work but because the biomechanical calculations on which it was based turned out to be wrong. Recent claims of drag reduction due to micro-ribbed mimics of shark skin seem better founded, and have even found commercial application; but the reduction remains modest. Biomimicry seems worth the effort, but nature is a subtle teacher.