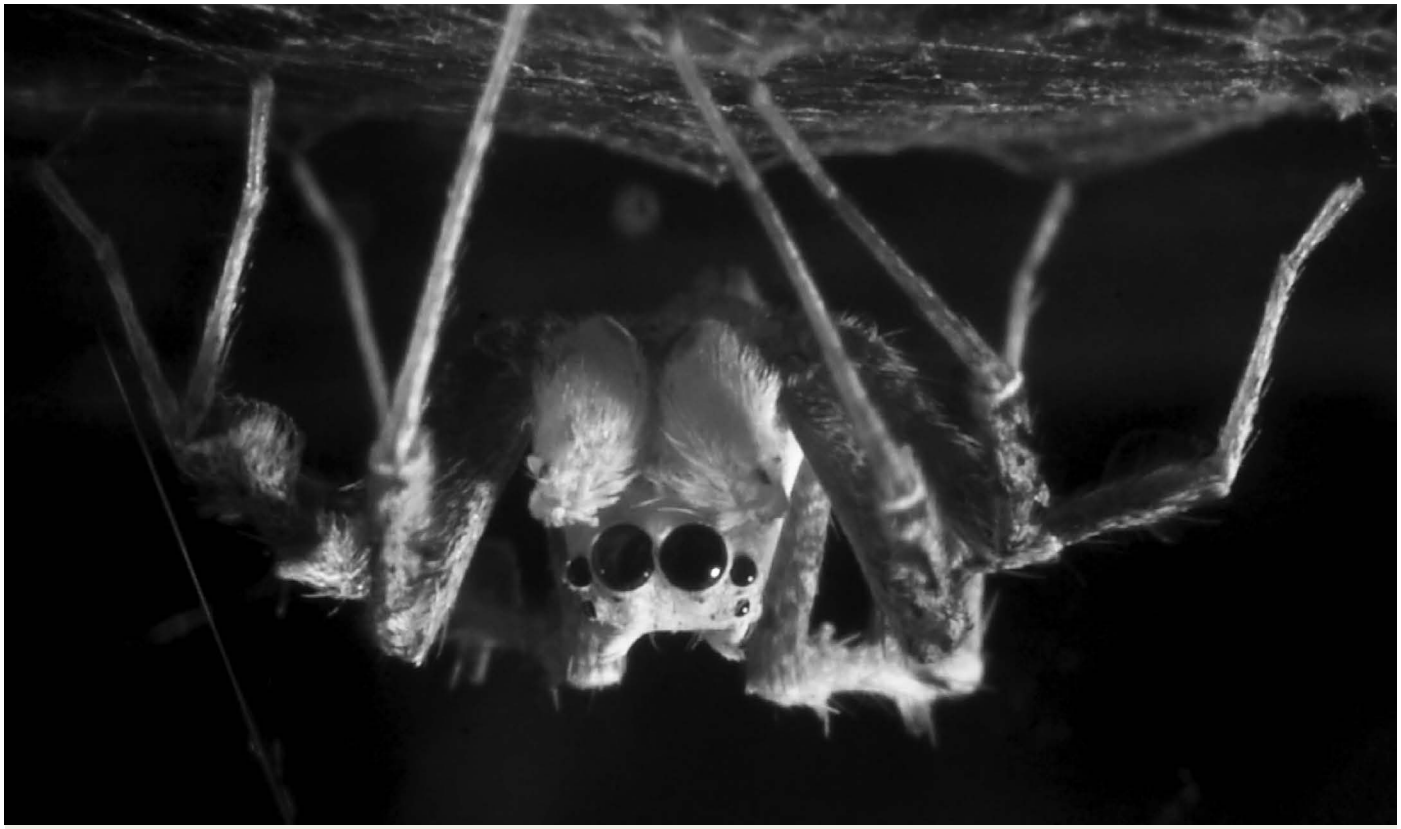


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Spider snooze stages

Sleep is a recurring theme in Shakespeare's tragedy *Macbeth*. The play explores how sleep nurtures health, the consequences of insomnia and how the world changes as darkness falls when, as Macbeth puts it:

> Light thickens, and the crow
> Makes wing to th' rooky wood
> Good things of day begin to droop and drowse
> While night's black agents to their prey do rouse

A doctor attending the sleepwalking Lady Macbeth says that "this disease is beyond my practice". The need to improve treatments for sleep disorders remains. This pursuit might be aided by understanding how sleep evolved. Previous studies have focused mainly on vertebrates, but invertebrates are increasingly taking centre stage. Geiger and colleagues (N. Geiger *et al*. *Proc. Natl Acad. Sci. USA* **123**, e2618030123; 2026) analysed videos of *Portia fimbriata* spiders, which sleep upside down in their webs (pictured).

Rapid eye movement (REM) sleep is a recurring state of human sleep associated with dreaming and is thought to aid memory formation and learning. Sleeping *P. fimbriata* have bouts of REM-like sleep, accompanied by twitching and leg curling. Studying spiders might reveal how these sleep states help the cognition of a predator that depends strongly on its sensory capacities. **Mary Abraham**

corrosion and liquid metal embrittlement[7] (a phenomenon in which solid metals become much less ductile and fracture when exposed to certain liquid metals); and increase the rate of deformation of a material through a mechanism known as creep[8]. Single crystals are not affected by these problems, but their production typically requires the development of complex apparatus tailored for each material.

By contrast, Liu and colleagues' method is generally applicable to a wide range of materials and uses readily available equipment. Because the technique can grow single crystals in predefined shapes and at extended lengths, it could widen the range of technologies to which these crystals can be applied. It is also likely to enable the growth of single crystals of materials that have previously not been available in that form. This, in turn, opens up opportunities to study the phase transformations, recrystallization and deformation of single-crystal materials.

Nevertheless, the method has some limitations at present. The main constraint is the diameter of the crystal that can be grown, which is currently between 6 and 20 millimetres. Another limitation — which it shares with every other melt-growth technique — is that any phase transformations that occur on cooling will disrupt the crystal's long-range order and, in some cases, lead to fracture and fragmentation. Indeed, one of the single crystals grown by Liu *et al*. is a titanium alloy that solidifies in a cubic lattice but transforms to a hexagonal structure on cooling. Such transformations can be useful, but the interfaces between phase variants can have properties similar to grain boundaries and could therefore be problematic for some applications. This problem could be avoided by growing single crystals in the solid state, but this has rarely been reported for metals[9].

Despite the current limitations, Liu and colleagues' method creates exciting opportunities for future technological and scientific developments. For example, if the method can be extended to synthesize single crystals of oxide or carbide ceramics with high melting temperatures, it might lead to new materials for applications such as transparent armour, optical hosts in lasers (transparent materials