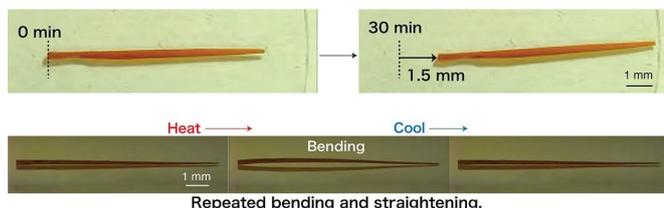


Walking crystals may lead to new field of crystal robotics

23 February 2018, by Lisa Zyga



Images of crystals that “walk” like an inchworm by bending and straightening under alternating temperatures. Credit: Taniguchi et al.

Researchers have demonstrated that tiny micrometer-sized crystals—just barely visible to the human eye—can “walk” inchworm-style across the slide of a microscope. Other crystals are capable of different modes of locomotion such as rolling, flipping, bending, twisting, and jumping. In the future, these moving crystals may open the doors to the development of crystal-based robots.

The researchers, led by Hideko Koshima at Waseda University in Tokyo, Japan, have published a paper on walking and rolling crystals in a recent issue of *Nature Communications*.

“We believe that this finding opens the doors to a new field of crystal robotics,” Koshima told Phys.org. “Currently, robots made from metals are rigid and heavy, making them unsuitable for daily interaction with humans. Our goal is to make symbiotic soft robots using mechanical crystals.”

In their work, the researchers investigated asymmetric crystals derived from chiral azobenzene. In experiments, they showed that exposing the crystals to alternating hot and cold temperatures (changing between 120° and 160° C over the course of approximately 2 minutes) causes changes in the crystals' shapes.

Depending on their dimensions, some of the crystals repeatedly bend and straighten. Over repeated heating and cooling cycles, these shape changes translate into the mechanical motion of inchworm-like walking.

Crystals with other dimensions exhibit bending and flipping under [temperature changes](#). In experiments, repeated heating and cooling cycles caused these crystals to quickly roll across a surface, attaining speeds of 16 mm/second. This was approximately 20,000 times faster than the walking crystals, which crawled along at just 3 mm/hour.

As the researchers explain, the asymmetrical shapes of the crystals is the driving force of both types of locomotion. In particular, the walking crystals have a thickness gradient while the rolling crystals have a width gradient. Both varieties of crystal experience a phase transition at a critical [temperature](#), and due to the asymmetry, this results in a shape change that is more pronounced at one end of the crystal than at the other.

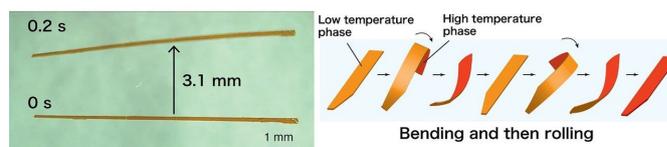


Image and illustration of crystals that roll under alternating temperatures. Credit: Taniguchi et al.

Along with previous research that has demonstrated crystal motion in other types of crystals, the new results suggest that [crystals](#) appear to be promising candidates for robotics. In general, materials that respond to external stimuli, such as temperature changes, have potential applications as sensors, switches, and in a wide

variety of other areas.

More information: Takuya Taniguchi et al.

"Walking and rolling of crystals induced thermally by phase transition." *Nature Communications*. DOI:

[10.1038/s41467-017-02549-2](https://doi.org/10.1038/s41467-017-02549-2)

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APA citation: Walking crystals may lead to new field of crystal robotics (2018, February 23) retrieved 26 June 2019 from <https://phys.org/news/2018-02-crystals-field-crystal-robotics.html>

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