First plant-based 'microswimmers' could propel drugs to the right location

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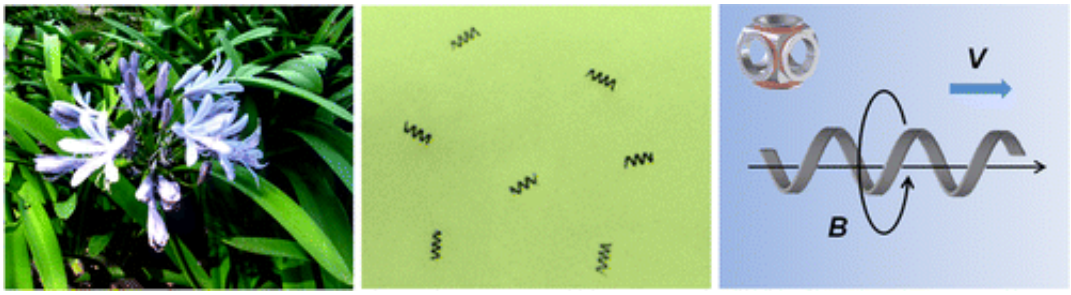

In the quest to shrink motors so they can maneuver in tiny spaces like inside and between human cells, scientists have taken inspiration from millions of years of plant evolution and incorporated, for the first time, corkscrew structures from plants into a new kind of helical "microswimmer." The low-cost development, which appears in ACS' journal *Nano Letters*, could be used on a large scale in targeted drug delivery and other applications

Joseph Wang and colleagues point out that nanomotors have tremendous potential in diverse applications from delivering drugs to precise locations in the body to making biosensors. To realize this potential, scientists have recently taken inspiration from microorganisms that have tiny, hair-like structures that they whip around to propel themselves. But copying these nature-engineered nanomotors requires advanced

instruments and costly processing techniques that make them a challenge to produce on a large scale. To address these issues of practicality, Wang's group also drew inspiration from nature, but turned to plants instead.

They isolated spiral microstructures packed by the million in small pieces of a plant's stem. The scientists coated these tiny coils that are about the width of a fine cotton fiber with thin layers of titanium and magnetic nickel. The plant material makes these microswimmers biodegradable and less likely to be rejected by the human body. The magnetic layer allows scientists to control the motors' movement. When the scientists placed the coated spirals in water or human blood serum and applied a magnetic field, the nanomotors efficiently spun their way through the liquids. The scientists conclude that the microswimmers show great promise for future biomedical uses.

More information: "Bioinspired Helical Microswimmers Based on Vascular Plants" *Nano Lett.*, Article ASAP. DOI: 10.1021/nl404044d

Abstract
Plant-based bioinspired magnetically propelled helical microswimmers are described. The helical microstructures are derived from spiral water-conducting vessels of different plants, harnessing the intrinsic biological structures of nature. Geometric variables of the spiral vessels, such as the helix diameter and pitch, can be controlled by mechanical stretching for the precise fabrication and consistent performance of helical microswimmers. Xylem vessels of a wide variety of different plants have been evaluated for the consistency and reproducibility of their helical parameters. Sequential deposition of thin Ti and Ni layers directly on the spiral vessels, followed by dicing, leads to an extremely simple and cost-efficient mass-production of functional helical microswimmers. The resulting plant-based magnetic microswimmers display efficient propulsion, with a speed of over 250 μm/s, as well as powerful

locomotion in biological media such as human serum. The influence of actuation frequencies on the swimming velocity is investigated. Such use of plant vessels results in significant savings in the processing costs and provides an extremely simple, cost-effective fabrication route for the large-scale production of helical magnetic swimmers.

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