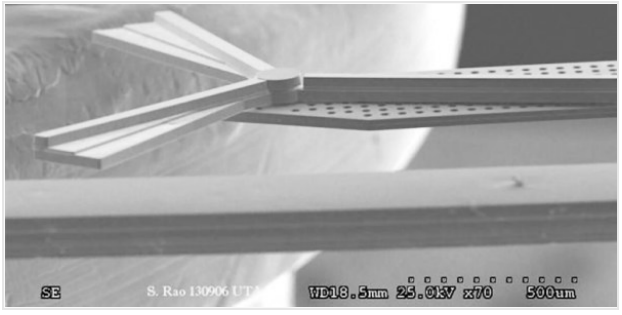
Powered by Wind: World's Tiniest Windmills

by storiesbywilliams on February 20, 2014 in News, Science, Technology and tagged battery, cell phones, clean energy, micoelectromechanical systems (MEMS), Nickle alloy, piezoelectric, piezoelectric fronds, renewable energy, silicon, silicon oxide, tiny windmills, University of Texas, wind power, wind tunnels, wind turbines, WinMEMS

Wind turbines are one of the fastest growing industries thanks to their ability to provide clean, renewable energy. And while most designs are trending towards larger and larger sizes and power yields, some are looking in the opposite direction. By equipping everyday objects with tiny windmills, we just might find our way towards a future where batteries are unnecessary.

Professor J.C. Chiao and his postdoc Dr. Smitha Rao of the University of Texas at Arlington are two individuals who are making this idea into a reality. Their new MEMS-based nickel alloy windmill is so small that 10 could be mounted on a single grain of rice. Aimed at very-small-scale energy harvesting applications, these windmills could recharge batteries for smartphones, and directly power ultra-low-power electronic devices.



These micro-windmills – called horizontal axis wind turbines – have a three-bladed rotor that is 1.8 mm in diameter, 100 microns thick, and are mounted on a tower about 2 mm tall mount. Despite their tiny size, the micro-windmills can endure strong winds, owing to being constructed of a tough nickel alloy

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rather than silicon, which is typical of most microelectromechanical systems (MEMS), and a smart aerodynamic design.

According to Dr. Rao, the problem with most MEMS designs is that they are too fragile, owing to silicon and silicon oxide's brittle nature. Nickel alloy, by contrast, is very durable, and the clever design and size of the windmill means that several thousands of them could be applied to a single 200 mm (8 inch) silicon wafer, which in turn makes for very low cost-per-unit prices.

The windmills were crafted using origami techniques that allow two-dimensional shapes to be electroplated on a flat plane, then self-assembled into 3D moving mechanical structures. Rao and Chiao created the windmill for a Taiwanese superconductor company called WinMEMS, which developed the fabrication technique. And as Rao stats, they were interested in her work in micro-robotics:

> *It's very gratifying to first be noticed by an international company and second to work on something like this where you can see immediately how it might be used. However, I think we've only scratched the surface on how these micro-windmills might be used.*

Chiao claims that the windmills could perhaps be crafted into panels of thousands, which could then be attached to the sides of buildings to harvest wind energy for lighting, security, or wireless communication. So in addition to wind tunnels, large turbines, and piezoelectric fronds, literally every surface on a building could be turned into a micro-generator.

Powered by the wind indeed! And in the meantime, check out this video from WinMEMS, showcasing one of the micro-windmills in action:

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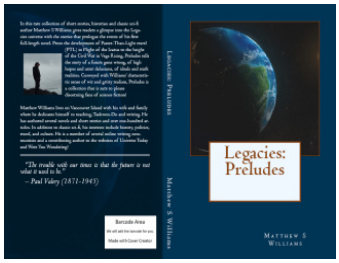

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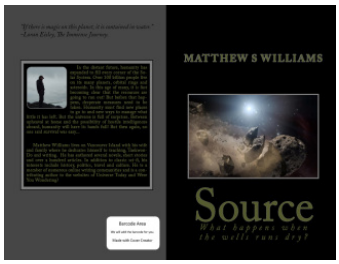

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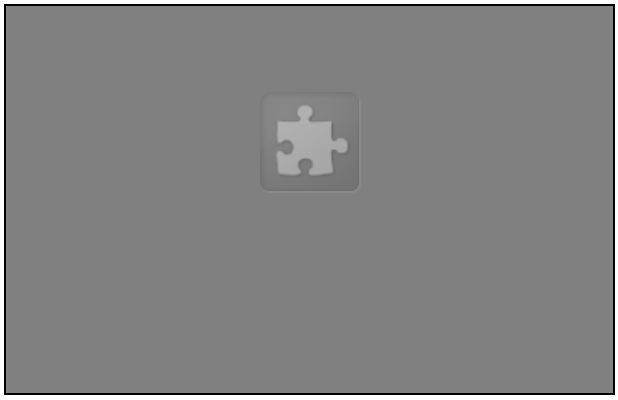

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