

[Print](#)

Jan 12, 2014 10:27 PM EST

## Micro-Windmills Smaller Than a Grain of Rice Demonstrated

By Mark Hoffman



One of Rao's micro-windmills is placed here on a penny.

Researchers at the University of Texas Arlington have designed a micro-windmill that is fully functional while barely visible: A single grain of rice could hold about 10 of these tiny windmills.

Hundreds of the windmills could be embedded in a sleeve for a cell phone. Wind, created by waving the cell phone in air or holding it up to an open window on a windy day, would generate the electricity that could be collected by the cell phone's battery.

Their work in micro-robotic devices initially heightened a Taiwanese company's interest in having the developers, Smitha Rao and J.-C. Chiao, brainstorm over novel device designs and applications for the company's unique fabrication techniques, which are known in the semiconductor industry for their reliability.

"The company was quite surprised with the micro-windmill idea when we showed the demo video of working devices," Rao said. "It was something completely out of the blue for them and their investors."

Rao's designs blend origami concepts into conventional wafer-scale semiconductor device layouts so complex 3-D moveable mechanical structures can be self-assembled from two-dimensional metal pieces utilizing planar multilayer electroplating techniques that have been optimized by WinMEMS Technologies Co., the Taiwanese fabrication foundry that took an initial interest

in Rao's work.

Currently, WinMEMS has been showcasing UT Arlington's works on its [website](#) and in public presentations, which include the micro-windmills, gears, inductors, pop-up switches and grippers. All of those parts are as tiny as a fraction of the diameter of a human hair.

These inventions are essential to build micro-robots that can be used as surgical tools, sensing machines to explore disaster zones or manufacturing tools to assemble micro-machines.

"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," said Rao, who earned her Ph.D in 2009 at UT Arlington. "However, I think we've only scratched the surface on how these micro-windmills might be used."

The micro windmills were tested successfully in September 2013 in Chiao's lab. The windmills operate under strong artificial winds without any fracture in the material because of the durable nickel alloy and smart aerodynamic design.

"The problem most MEMS designers have is that materials are too brittle," Rao said. "With the nickel alloy, we don't have that same issue. They're very, very durable."

The micro-windmills can be made in an array using the batch processes. The fabrication cost of making one device is the same as making hundreds or thousands on a single wafer, which enables for mass production of very inexpensive systems.

Chiao said because of the small sizes, flat panels with thousand of windmills could be made and mounted on the walls of houses or building to harvest energy for lighting, security or environmental sensing and wireless communication. -- *Source: UT Arlington*