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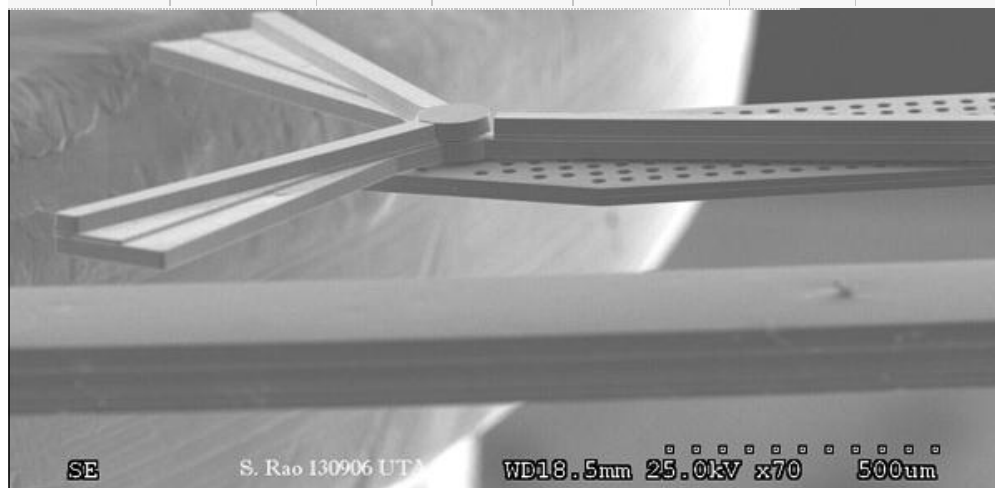
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Jan 24 2014

by Mike Helby

Not even the most psychotic wind-power protester could object to the wind-farms that have been 'built' by two Texas University researchers; the pair has developed a miniature, nickel-alloy windmill that is so small, ten could fit on to a single grain of rice!

At first glance this looks like the sort of scientists-playing-silly-buggers that wins an Ig Nobel Prize, but Professor J-C Chiao and Dr Smitha Rao from the University of Texas at Arlington believe their micro-windmills will have valuable applications for powering ultra-low-energy electronics such as remote environmental sensors, and could even one day be used to recharge mobile devices like smart phones.

"You could place them on a sleeve for your smart phone. When the phone is out of battery power, all you need do is put on the sleeve, wave the phone in the air for a few minutes and you can use the phone again," was how Professor Chiao described how he saw this application for the micro-windmills might work. The tiny windmills - more correctly micro horizontal-axis wind turbines - are the latest in a series of MEMS (micro-electrical-mechanical system) devices and components that the UT Arlington pair have come up with in collaboration with WinMEMS Technology, a Taiwanese-based specialist fabricator. Other devices include micro-gears, switches and grippers, all a fraction of the diameter of the average human hair in size.



PICTURED HERE ON A COIN AND UNDER AN ELECTRON MICROSCOPE IN MAIN PICTURE

MEMS technology, where components and devices are just a few micrometers or microns in size – a micrometer or micron is a thousandth of a millimetre and a human hair averages out at around 100 micrometers in diameter – will provide the components for the first wave of micro-robotics and other, tiny micro devices that will transform things like drug delivering in medicine and environmental monitoring.

Because it lies between the normal and the nano in scale, MEMS technology is a very challenging environment in which to work. Quantum effects, such as the Casimir, which are negligible to the point of non-existence at the normal scale, can become a critical design constraint at this size. While engineering solutions from the normal world, such as lubricated bearings, are unworkable; even the finest lubricant is like a great lump of sticky tar down at this level.

Most MEMS technology to date - and you have almost certainly got some in your life, the air-bag sensor in your car, for example - is made from silicon using variants of semi-conductor manufacturing techniques. Silicon, however, is a fragile, brittle material, not suitable for the rigours of a windmill. This is where the collaborative partnership between the Arlington team and the Taiwanese manufacturer comes up trumps, for WinMEMS Technology is not just a specialist MEMS manufacturer but one that has mastered MEMS fabrication using metal alloys instead of silicon. Alloys that are much tougher and more suited to the stresses and strains that the components of a windmill will undergo, even a very small one.

They also hold out the promise of being cheap because they are made in arrays in a batch process in which the cost of making one micro-windmill is pretty much the same as making thousands at a time. Professor Chiao believes it will be possible to have flat panels with thousands of these tiny turbines that could be mounted on to the sides of buildings to harvest energy, possibly using an electro-static generation method.

FIRST TEST

The first tiny turbines were tested successfully at Arlington last September and were able to operate under the strong artificial winds of the testing environment without any material failures. "The problem most MEMS designers have is that materials are too brittle," explained Dr Rao. "With the nickel alloy we don't have the same issue. They're very, very durable," she continued. "However, I think we've only scratched the surface on how these micro-windmills might be used."

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Chris Hoar - Chief Executive
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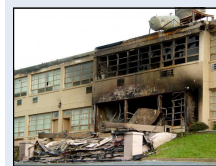
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