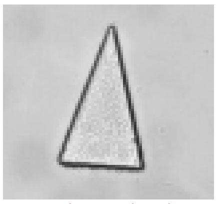
Tiny organisms move microstructures

10 July 2007

Researchers in the US have harnessed bacteria to move micrometre-sized sheets of epoxy through a liquid. The motion could be stopped and started by simply switching an ultraviolet light on and off and could be either linear or rotational. The researchers say that that the technique could eventually be used to power tiny machines of the future. (*Appl. Phys. Lett.* 90 263901).



Moving a triangle

Tiny machines on the micro- or nanometre scale could someday be used, for example, to deliver drugs to a precise location in the body via the bloodstream. However, before this is possible, scientists must work out how such tiny devices would be powered. Nature may provide a solution in the form of flagellated bacteria, which propel themselves using biomolecular motors. Since the motion of some flagellated bacteria can be controlled by simply shining a light on them in a process called phototaxis, some scientists have suggested that bacteria could be used as “beasts of burden” that power tiny machines of the future.

Now Min Jun Kim and colleagues at Drexel University in Philadelphia have worked out two ways of using the common bacterium *Serratia marcescens* to move tiny triangular sheets of epoxy. This bacterium is known to move very quickly, except when exposed to ultraviolet light, which stops it from moving.

The researchers first created “swarm plates” of bacteria in Petri dishes containing agar -- a gel that is widely used to grow bacteria. The bacteria were introduced at an edge of a plate where they quickly multiplied before starting to move across the surface of the plate in waves.

In one experiment, the surface of a swarm plate was covered with a thin layer of “motility buffer” -- a liquid nutrient that makes the bacteria move faster. A triangular sheet of epoxy measuring about 50 µm across and 10 µm thick was submerged in the buffer so that it rested on a leading edge of a wave of bacteria that were moving across the surface of the agar.

The triangle was carried forward by the bacteria at a speed of about 9 µm/s – but when the sample was exposed to ultraviolet light, the bacteria and the triangle stopped. Once the UV light was switched off, the bacteria and triangle began moving again at about 9 µm/s.

On other regions of the plate the bacteria formed swirling vortices and when a triangle was placed on such a vortex it rotated at a

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Appl. Phys. Lett. **90** 263901

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frequency of about 1 rad/s. This rotation could be stopped by applying UV light, and started again when the light was tuned off.

In a separate experiment, the triangle was carefully removed from the agar such that a layer of bacteria remained stuck to its surface. The triangle was then placed in a tray containing only motility buffer, where the action of the bacteria caused it to rotate. Once again, the rotation could be stopped by applying UV light, and then restarted when the light was switched off.

Kim’s team have used bacteria to move other simple shapes such as squares. But, he told *Physics Web* that he believes that microstructures of any shape and on the 1-500 µm size scale could be manipulated using the technique.

About the author

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