

Micro-thrusters

Propelling cell phone-sized satellites through space

What if we could build a satellite as small as a cellular phone? The concept is not that far-fetched. The device that is probably in your pocket right now is capable of taking photos or video, transmitting these images wirelessly over long distances, and recording its exact location using an internal GPS receiver. These are precisely the key functions of many Earth-orbiting satellites. While traditional satellites cost tens of millions of dollars and can be as large as an automobile, cell phone-sized satellites would be inexpensive, could be mass-produced, and could be deployed as large swarms that act collectively to provide global coverage. It seems the only thing your cell phone would need to function as a spacecraft is a tiny rocket engine.

Lyon B. King leads a research program whose goal is to develop micro-scale propulsion systems for use on cell phone-sized satellites. King has patented a technology to build micro-ion thrusters out of wire needles not much thicker than a human hair. Each needle emits a small stream of ionized liquid metal that is accelerated by electrostatic forces to produce a few micro-Newtons of thrust. The needles can be used individually or assembled into an array to propel the tiny vehicle.

In order to function efficiently, the micro-ion thruster needles must be very sharp—the required tip radius is a few tens of nanometers. Prolonged thruster operation can occasionally cause the tips to dull, thereby reducing the performance of the micro-thruster. While this problem has been an impediment to past research, King's group has developed and patented a method for repairing damaged tips using electric fields to shape self-assembling nanostructures. The technique uses electrostatic attraction to shape liquid metal into a sharp cone known as a "Taylor cone," then freezing the metal in place to preserve the nanometer-scale tip. The process can be repeated numerous times, enabling a spacecraft to fix itself while still in orbit.



Lyon B. King
Mechanical Engineering-
Engineering Mechanics

The smallest satellites currently in orbit, known as picosats, are four-inch cubes weighing only 2.5 lbs.

