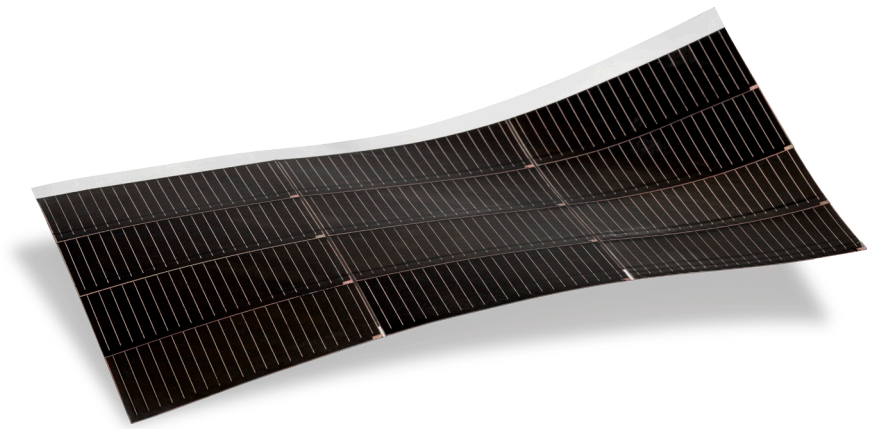


Mobile Power Applications



Introduction

Batteries are about to get a boost from an unexpected source: the sun. That's right, solar power. Not the heavy installations you'd see on a rooftop, but thin, flexible cells that can easily be integrated into the wing of an unmanned aerial vehicle, the back of a smartphone, or the roof of a car.

This new take on solar power solves an issue that has long plagued users and designers of digital and mobile devices: the need to constantly recharge or replace batteries. Brighter screens, more functions, and faster processors drain the life out of well-designed digital devices, while long-lasting batteries are far too heavy for wearables and unmanned flying vehicles. Using solar power to increase battery life provides a new era for mobile power — freeing consumers from the hassle of constantly recharging their devices, allowing manufacturers to develop new and exciting applications, and saving significant amounts of energy as devices are taken off the grid.

Traditional solar power relies on silicon-based cells that convert sunlight to electricity and are typically seen on rooftops or giant arrays in the desert. Silicon-based photovoltaic cells do a reasonable job generating power, but are bulky and rigid, hardly suitable for use with mobile devices. Thin-film solar technology in use today greatly reduces bulk, but those cells are relatively inefficient and difficult to integrate into other products.

Solution: Alta Devices' AnyLight™ Power Technology

Alta Devices' AnyLight™ Power Technology utilizes the sun to significantly extend battery life in many devices. For low-power applications like sensors, it can even eliminate the need for batteries altogether.

This proprietary, thin solar cell technology is made from gallium arsenide. The packaged cells are no thicker than a sheet of aluminum foil, but generate as much as four times more electricity per unit area and per unit weight than competing technologies. With an efficiency rating of 28.8 percent from the National Renewable Energy

Lab (NREL), Alta Devices' technology holds a world record.

Alta's solar cells can be integrated into a wide variety of devices, even curved surfaces like the wing of an airplane. Imagine a tent with solar cells woven into the fabric, or a charging mat so light and flexible it can be folded like a blanket.

AnyLight™ Power Technology is so efficient that over a quarter of the light that lands on the solar cell is converted into electricity, which means it can produce power on a cloudy day or even convert the glow of indoor lighting into small, but usable, amounts of electricity. According to NREL research, Alta Devices solar cells are far less

sensitive to fluctuations in temperature than silicon-based cells, a big plus in hot, sunny weather.

Because Alta's cells are so efficient and lightweight, they are extremely well suited for use in unmanned aerial systems, wearables, mobile phones, sensors, automobiles, or anywhere that size and mobility are at a premium.

How It Works

Are all solar cells created equal? Definitely not. The cells you see on rooftops, in commercial power arrays, and on roadside emergency phones can be made from a variety of materials, including silicon. Some convert less than ten percent of sunlight into electricity. Others are slightly more efficient, but are heavy and brittle. The difference is in the materials used to construct the cells and the process technology used in their manufacture.

No matter how they are constructed, all photovoltaic cells do the same task – converting light to electricity – in the same fundamental way. When a photon enters the cell from a light source, an electron is excited into a higher energy state, which ultimately results in useable electricity.

The material used to make the cell determines many things: efficiency, thickness, flexibility, voltage, and temperature performance characteristics. Although silicon is the most commonly used material, Alta Devices builds cells from gallium arsenide (GaAs). Used in space for decades, it is a very efficient material, but more expensive than silicon and traditionally thick and brittle.

Alta Devices invented a manufacturing process that produces thin, flexible gallium arsenide cells at a substantial reduction in cost.

Making the World's Most Efficient Solar Cells

The manufacturing process used and developed by Alta Devices starts with a wafer, a square of gallium arsenide. The wafer is placed in a reactor vessel and treated with a process called metal organic chemical vapor deposition (MOCVD), which "grows" thin layers on top of the original GaAs wafer. One of these layers is made from aluminum arsenide, which has the same crystalline properties as gallium arsenide. This makes it possible to separate the solar film from the original wafer.

The wafer, now with a new stack of layers on top of it, is then bathed in hydrofluoric acid, which removes the aluminum arsenide layer, and leaves the original wafer intact. Then new, very thin layers of gallium arsenide film are separated from the wafer. This production process allows the wafer to be reused many times without any significant degradation.

Solar Power Helps Unmanned Aerial Vehicles Fly Longer

A game warden in South Africa's Kruger National Park and a U.S. soldier in Afghanistan have very different missions, but both are in need of dependable aerial observation. That is why Alta's AnyLight™ Power Technology is the right choice to extend the flight time of unmanned aerial vehicles.

Until now, most battery-powered UAVs were limited to just a few hours in the air. Their batteries simply could not supply the energy needed to power engines, cameras and radios for extended periods of time. Solving that problem isn't easy because the systems that power the aircraft must be as light as possible, generate as much power as possible in a small amount of space, and not interfere with the aerodynamic qualities of the vehicle. That's where Alta Devices come in.

Alta's thin-film solar cells are an excellent solution for aerial applications because:

- The cells are very light, generating approximately one watt per gram, which is two to four times as efficient as competing technologies, a big plus in a low-power vehicle.
- They generate roughly 250 watts of electricity per square meter of surface area.
- They can be integrated directly into wing panels, a feature that improves aerodynamic efficiency and saves additional weight.

Alta has teamed with AeroVironment, the company that developed one of the first small UAVs for military use more than 30 years ago. AeroVironment's unmanned aircraft systems support U.S. and allied Armed Forces with reconnaissance data, help protect endangered wildlife, and preserve the environment.

In 2013, an AeroVironment solar-powered Puma AE flew for over nine hours without recharging. That feat was made possible by the use of Alta's AnyLight™ Power Technology, which radically extended the battery life. "This is a critical milestone with far-reaching implications for the many ways small (UAVs) can benefit military, public safety and commercial customers," said Roy Minson, AeroVironment's senior vice president and general manager.

Protecting Africa's wildlife is a critical and very dangerous job for the men and women who patrol South Africa's Kruger National Park. Pilots are asked to fly low, slow, and often at night. They have even come under attack by heavily armed poachers. These manned flights are costly and dangerous.

The Wildlife Conservation Fund has challenged UAV makers to design aircraft that can be launched in the bush, operate for hours over the rugged terrain, detect and locate poachers, and communicate over existing commercial infrastructures. Alta Devices and RP Flight Systems have answered the challenge by doubling the range of the Cyclops UAV to 10 hours by adding Alta's solar cells to the wings. RP Flight Systems and Alta Devices are supporting the efforts of this organization to put a stop to needless poaching.

Solar Power for your Car

How often have you come back to your parked car on a sunny day and realized that parts of it were too hot to touch and the interior felt like an oven? That everyday occurrence illustrates two reasons why solar power is a great addition to an automobile.

Much of the sunshine that heats the outside of a car can be put to use. A solar array on the roof or the trunk captures sunlight while the vehicle is parked or driving and converts it into electricity. In the case of hybrids or all-electric vehicles, electricity generated by the solar cells could easily be routed to the battery. While a solar array on the roof does not generate enough electricity to fully recharge a battery, it easily adds miles to a car's range.

A solar array can also be used to power various accessories in a hybrid or conventionally powered automobile. If your car is parked on a hot day, you can't leave the air conditioning on, of course, but a small fan powered by roof-top solar would keep the interior cooler until you returned.

In addition, auto manufacturers can receive off-cycle credits from the National Highway Traffic Safety Administration (NHTSA) toward continuously more stringent Corporate Average Fuel Economy (CAFE) standards for installing a solar roof. It's a win-win.

Keep your Fitness Devices Charged with Solar Power

Wearable fitness devices, smart watches, and tracking devices are popular and getting more popular every day.

But if you ask consumers which features of their wearable devices need improvement, one answer stands out: battery life. Who wants to go out for a run and notice a mile or two from home that your fitness band has run out of power? By design, wearable digital devices are small and light. So their batteries are small as well, and can only generate power for a limited amount of time.

Fortunately, many wearables, particularly fitness bands, are worn outside where there's plenty of sun. What's

needed to take advantage of free and abundant sunlight energy is a solar cell that's small, light, and unobtrusive — yet efficient enough to generate significant amounts of power under a variety of conditions.

Alta Devices' thin solar cells meet those specifications. Alta's AnyLight™ technology significantly extends traditional battery life, and it can, in the case of certain low-power devices, eliminate the need to ever recharge or replace a battery again. Alta's cells are so efficient they can generate power on a cloudy day and can convert indoor lighting into small, but usable amounts of electricity that will help recharge devices as they're worn at home or in the office.

Powering the Internet of Things

The Internet of Things is here. Devices such as smoke detectors, motion sensors, and Bluetooth beacons are collecting data and moving it to servers via the Internet. Before long, connected devices will increase exponentially. Experts foresee billions in less than a decade.

Inside or out, all of these devices will need uninterrupted supplies of power. Changing batteries can be a chore when a device is in a hard to access place like a smoke detector on a very high ceiling or a communications module attached to a radio telescope atop a mountain. Finding a solution that will allow those devices to power themselves is critical.

Solar power is an obvious choice when a device is outdoors, but many low-power devices can operate almost indefinitely when using a technology that harvests energy from indoor lighting.

That's where Alta Devices' AnyLight™ technology comes in. Alta Device's solar cells are small, thin, and flexible making integration into devices at the time of manufacture simple. A single Alta Devices solar cell can deliver 390 microwatts of electricity under bright indoor lighting — more than enough to power a variety of wireless sensors.

Power on the Go

Whether you're a soldier hefting a 100-pound rucksack or a hiker needing to make an emergency distress call, being able to extend the life of your cell phone and other devices without weighing yourself down with extra batteries can be a great convenience — or even a lifesaver.

Cell phones are an obvious example, but more and more of the devices we use every day run on battery power. When we're outdoors, we need to keep them operating. Batteries are heavy, and if you forget to pack extras, you're simply out of luck when your device runs out of charge.

Consider a squad of soldiers in the field. Instead of adding heavy batteries to their already huge packs, solar cells from Alta could be integrated and produce power that extends battery life while they're on the move. If the squad expects to stay put for a while, charging mats, some as small as a dinner napkin, can be unfolded and used to charge a variety of electronic devices.

Charging mats are surprisingly light and powerful. A 10-watt mat using Alta's technology is measures less than a square foot and weighs just four ounces. In full sun, the mat will generate as much power as a wall outlet at home and charge a dead smartphone as quickly as if you'd plugged it in. Larger mats can be used to charge more devices at the same time or to power up devices that need more electricity than a cell phone. A mat that generates 60 watts of power can weigh just a pound and a half.

Alta's cells could easily be integrated into a camping tent, with wires sewn into the seams leading to a charging dock. While the family is off swimming and hiking, batteries for things like lanterns and handheld games could be saving up power for the evening.

Solar Power for Your Smartphone

Modern smartphones have large, colorful screens, powerful processors, and lots of features. All of which makes them great digital companions, but it also means they gulp, rather than sip, battery power. You're not always near a power outlet, but if you're spending much time outdoors, the sun will become your smartphone's best friend.

Gallium arsenide based solar cells are more than two to four times as efficient as those based on silicon or other materials. They can easily be integrated into the back of a smartphone or a separate case to prolong battery life.

Consider a typical smartphone. With Alta's solar cells integrated onto the back, every ten minutes the device is in sunlight will give the user 100 minutes of standby time and ten minutes of talk time. More time in the sun or more cells on the back will increase your battery life even more.

Alta Devices Solves the Battery Problem

Battery power has long been the biggest challenge for digital and mobile devices. Smart devices need to be recharged too often and batteries need to be replaced too frequently. As wearable technology grows in popularity and billions of smart devices connect to the Internet of Things, a solution to that problem becomes ever more pressing.

That's where Alta Devices' AnyLight™ Power Technology shines. Energy from the sun is abundant, but conventional, silicon-based cells are too heavy and too brittle to be paired with mobile devices. By manufacturing thin, flexible cells that are lighter and more efficient than those of competing technologies, Alta cells can be embedded in many types of materials. This leaves manufacturers free to develop all kinds of new and exciting products.

From fitness bands to unmanned aerial vehicles to the Internet of Things, Alta Devices leads the way to longer battery life and smarter, more powerful electronic devices.