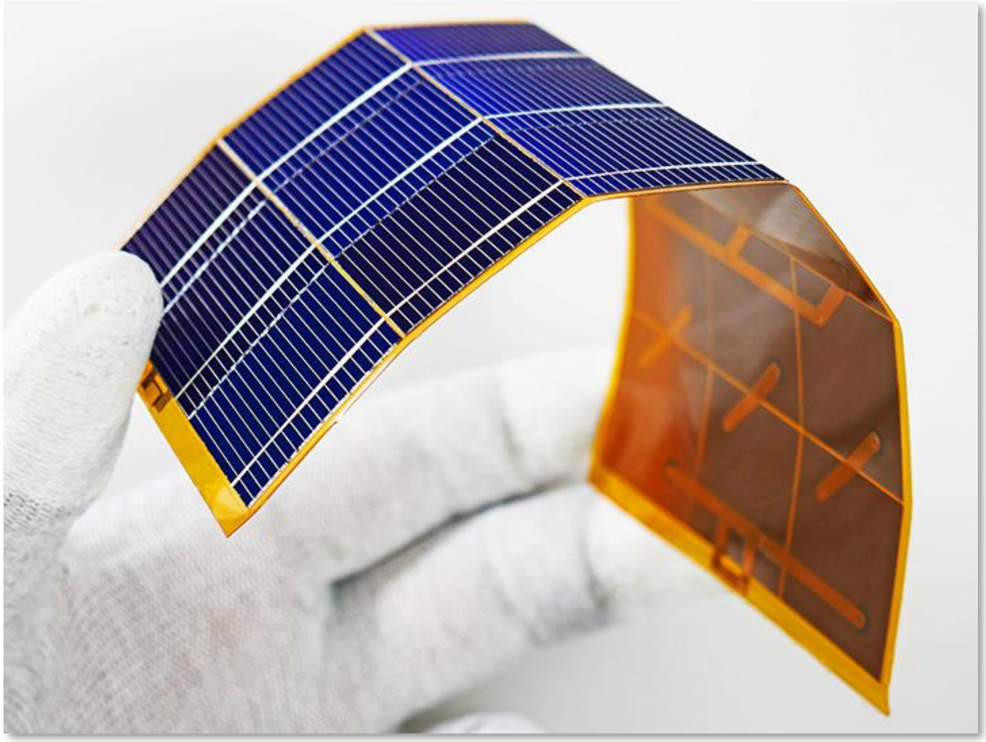
mPower TECHNOLOGY

A Revolution in Space Power

September 2020



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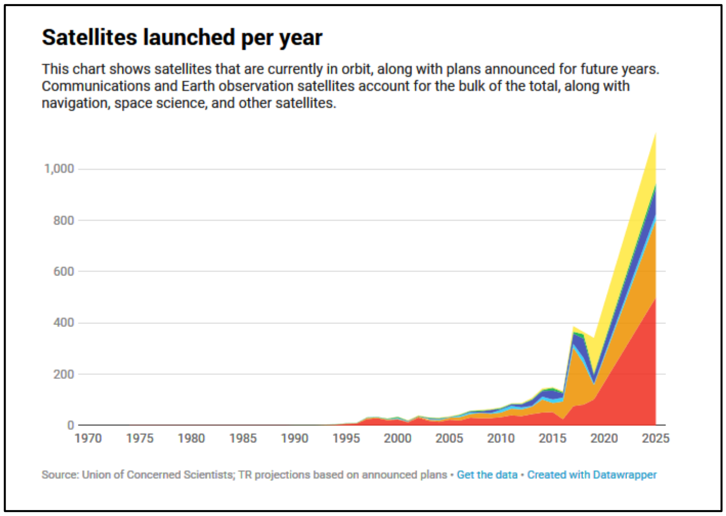
A Revolution in Space Power

mPower Technology Inc.

The space market is going through a massive transformation. Companies such as SpaceX, Amazon, Telesat, and OneWeb, as well as groups from countries such as China, India and Russia have announced plans to launch “megaconstellations” of smaller Low Earth Orbit (LEO) satellites that could put over 45,000 satellites into orbit during the next decade. That’s more than five times the number of objects sent to space in the past 60 years, which totals just shy of 9,000 according to the United Nations Office for Outer Space Affairs.

What’s driving this massive growth in space? Undoubtedly, it is the world’s unquenchable thirst for information. People and companies continue to increase their need for data bandwidth and connectivity, any time, any place on any device. The new megaconstellations are being launched to provide high-bandwidth data connectivity from anywhere on earth without the transmission delays associated with much higher geosynchronous orbits.



Satellite launches have increased exponentially over the last several decades

This new era of space commercialization is necessarily forcing a massive rethink of how satellites and spacecraft are built and launched. Recoverable, low-cost commercial launch vehicles have exponentially reduced the cost of putting a satellite into orbit. Electronics needed for controlling and monitoring satellites have been miniaturized and require far less power than ever before. At the same time, the computing power onboard a satellite has increased by orders of magnitude.

Despite these tremendous advances, there is one crucial building block for all space projects that has remained stubbornly stuck in the past – power. Power is needed for every mission and application in space whether it be constellations of communications satellites, lunar space stations, commercial space tourism, asteroid mining, manufacturing in space or manned flights to Mars. Yet, solar power in space has been largely provided by the same technology for decades, GaAs-based solar cells, otherwise known as III-V cells.

This 40-year-old technology has dominated the market since the 1990's but has two fundamental problems when it comes to this new era of space commercialization.

- First, III-V cells are simply too expensive, particularly for the large-scale constellations that are expected to dominate the world's space power needs for the foreseeable future. After the payload, the most expensive system on a satellite is its power generation and management systems. Multijunction III-V solar cells have historically cost upwards of $200/watt. More recently, they have declined in price, but are still far too high for today's large-scale constellations that require multiple megawatts of power.
- Second, there is simply not enough global supply to meet the huge demand from these constellations. Each constellation alone would nearly exhaust global supply capacity of III-V solar cells, and expanding capacity would mean adding expensive, highly specialized reactors that require massive capital investments and time to ramp production volumes. Given the unpredictability and market timing for these constellations, these investments are not easily justified.

Clearly a new solution is needed, one that meets the changing needs of the space market. Enter mPower's DragonSCALES™, a vastly less-expensive, high-performance alternative to current III-V technology.

OneWeb Low Earth Orbit (LEO) Satellite

DragonSCALES consist of a completely flexible, interconnected mesh of high-efficiency silicon solar cells. They are built using traditional silicon PV cells and assembled using existing high-volume fabrication processes from the microelectronics industry to meet customized applications requirements. The result are space-grade solar modules that are three to five times less expensive than III-V solutions and available in virtually unlimited supply.

But it doesn't stop there. DragonSCALES cells also present a long list of compelling performance benefits for today's space missions when compared with III-V solutions:

- DragonSCALES cells are significantly lighter since they are flexible and thus require less structural materials
- Because they are flexible, they can dramatically reduce required stowage volume
- The interconnected design means that DragonSCALES cells have smaller fault containment regions and are more tolerant to damage from micrometeorites.
- It also means they are more shade tolerant and less sensitive to voltage mismatches
- Because DragonSCALES cells are smaller and completely customizable, they can achieve higher packing factors (~95%+) by more completely filling a usable area
- With the right design, DragonSCALES cells can offer higher radiation resilience and even recovery for the demanding radiation environments of LEO missions
- DragonSCALES panels come "deployment ready" and are simple to integrate into the solar array, removing the majority of expensive touch labor.

DragonSCALES™

The net result is that solutions based on DragonSCALES are not only much lower in cost but, in many cases, will also lower launch costs and be more resilient. And, with the higher packing factor and radiation resilience/recovery, DragonSCALES can potentially offer comparable end-of-life power levels for the same array area as III-V cells.

With over $25 million in engineering and development work and years of rigorous testing, mPower Technology's solar solutions are ready to power the next generation of space.