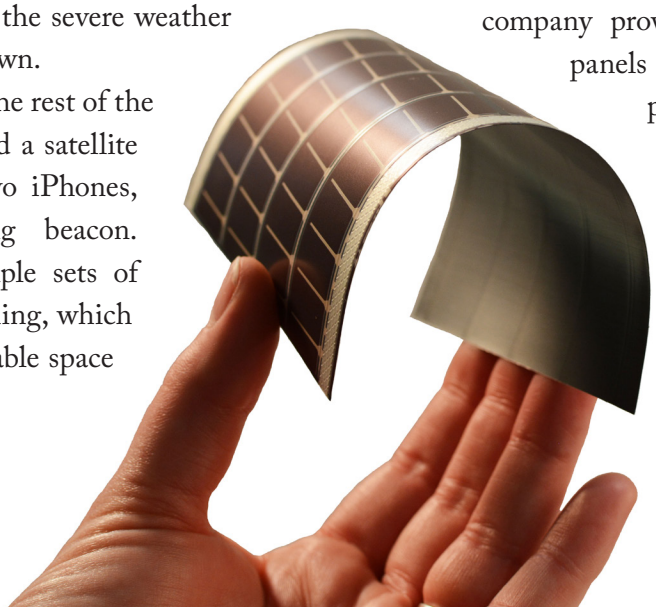
It pays to be...

FLEXIBLE

Flexible solar panels create an off-the-grid power source for both civilians and warfighters

When he's not in court or spending time with his family, attorney Douglas Tumminello of Denver, Colorado, nurtures a fascinating side gig as an extreme adventurer. In his illustrious second career, his accomplishments range from summiting Mt. Everest to setting a world record for rowing 3,600 miles across the Indian Ocean in 58 days. For one of his most ambitions expeditions—a solo ski trip from the coast of Antarctica to the South Pole—he needed gear that could withstand the severe weather but also not weigh him down.

To stay in touch with the rest of the world, Tumminello packed a satellite phone, a base station, two iPhones, and a satellite tracking beacon. Instead of packing multiple sets of batteries to charge everything, which would have taken up valuable space and mass, he found a lightweight, compact, and durable device that met all his needs: a rollable solar panel. Tumminello affixed the solar panel to his tent in camp and on his sled while traveling, and it provided a charge even in the harshest conditions, including during dense whiteouts.



Tumminello represents one of many customers worldwide who have depended on PowerFilm's solar panels for off-the-grid survival. The Ames, Iowa, based company provides rollable and foldable solar panels for outdoors and recreation purposes, consumer electronics needs, and key military applications. It also works closely with clients to build custom solar solutions for special cases. For instance, PowerFilm has created a small, curved solar panel for a smart

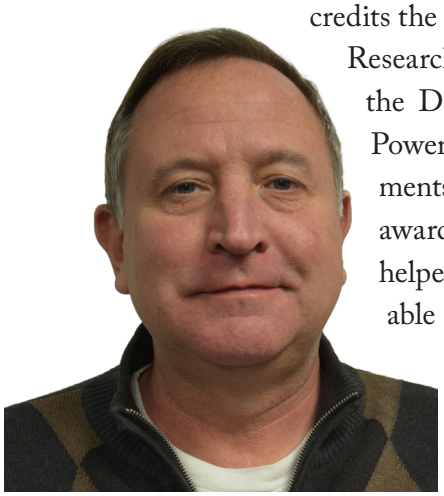
bike lock that notifies owners of a theft, as well as a thin, all-weather solar panel to power an asset tracking system for semi-trailers, cargo containers, or rail cars.

PowerFilm started out, in 1988, as Iowa Thin Film Technologies. The co-founders, Frank Jeffrey and Derrick Grimmer, were research physicists at 3M working on applying amorphous silicon to a roll of flexible plastic. Amorphous silicon, a non-crystalline semiconductor material, can be deposited in thin films onto substrates like plastic to create solar panels. By creating a proprietary roll-to-roll manufacturing process, Jeffrey and Grimmer enabled lower-cost manufacturing and enhanced product functionality through ease of customization.

In addition, the foldable solar panels developed under the SBIR program remain a major commercial revenue stream, helping customers achieve their off-the-grid dreams.

"Roll-to-roll fabricated amorphous silicon is extremely durable, flexible, and lightweight. You can roll it around a pencil, and it won't sustain any damage," said Daniel Stieler, President of PowerFilm. "It's also very durable, so you can drop stuff on it or drop it. Even if it were to get a hole in it, the solar panel is still going to be functioning at near 100 percent."

The properties of roll-to-roll amorphous silicon—the key technology behind PowerFilm's products—made it ideal for military applications. While the company got initial funding from the Department of Energy, Stieler credits the Small Business Innovation Research (SBIR) contracts from the Department of Defense for PowerFilm's later accomplishments. One of the key SBIR awards from the Army in 2002 helped PowerFilm develop foldable solar panels which could be incorporated into the fabric of military tents.



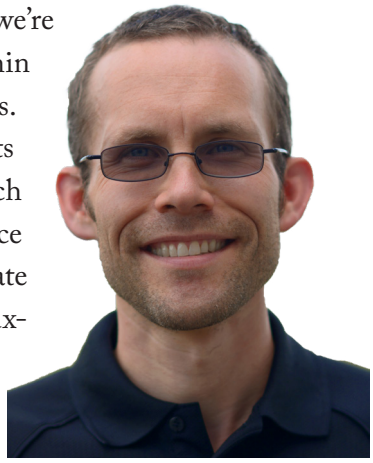
Wes White

"The SBIR awards were really critical to PowerFilm's success and making it to the 30-year mark. Early funding focused on building up manufacturing, but didn't bring us to an end product or help us with market development," said Stieler. "The Army SBIR helped us cross the valley of death, and we came out the other side with products that we could sell to both civilian and military customers."

The Army SBIR-funded work resulted in the PowerShade, a shade structure that comes in three sizes with integrated solar panels capable of both generating electricity and reducing air conditioning load by up to 30 percent. Since 70 percent of convoys involve the delivery of fuel and water, use of the PowerShade at forward operating bases (FOBs) can dramatically reduce costs and even save lives, as these convoys have long been prime targets for militant attacks. In one test, it reduced FOB fuel use from 20 gallons per day to 2 gallons per day.

But the military applications don't end there. Wes White, Director of Military Business Development at PowerFilm, leverages his background as a retired Army officer with 20 years active duty to anticipate military needs that might be fulfilled by the company's products. He specializes in solutions for basing power (like PowerShade), solar panels for vehicles to cut fuel costs on the battlefield, and man-portable products that fit easily in a rucksack.

"In terms of basing power, we're putting lightweight, flexible, thin film solar panels on structures. They come in very handy on tents that can't take a lot of weight, such as a first-aid station or maintenance bay," said White. "We also integrate solar power on vehicles to give auxiliary power, such as unmanned aerial vehicles. And with an amorphous silicon panel that



Dan Stieler

The flexible solar panels created by PowerFilm have led to any number of astonishing applications, allowing both civilians and warfighters to take their power sources with them.

folds up nicely in the soldier's pack, he can charge just about every battery that he carries: radios, night vision devices, range finders, etc."

After a fundraising campaign, Iowa Thin Film Technologies went public in 2007, and changed its name to PowerFilm. A few years later, the company pivoted to more unique niche markets to give itself an edge over cheaper competitors from Southeast Asia.

More recently, PowerFilm has been making a name for itself as an original equipment manufacturer for custom solar solutions. PowerFilm is taking advantage of the growing internet of things (IoT) market by seeing how solar energy fits into sensors and tracking—to power thermometers in refrigeration trucks, for example, or level sensors in liquid nitrogen tanks.

In addition, the foldable solar panels developed under the SBIR program remain a major commercial revenue stream, helping customers like Tumminello achieve their off-the-grid dreams.

"Other than the funding, which helps any small company, the SBIR program helps with efficiency," said White. "We can sit here all day and try to guess what products we need to make in the future, but if the military comes out with an SBIR solicitation, it gives us that much-needed direction regarding what we need to focus on."

Iowa Thin Film Technologies, Inc. (PowerFilm, Inc.)

Modernization Priority: General Warfighting Requirements (GWR)

Boone, IA • SBIR contract: DAAD18-02-C-0009 • Agency: Army • Topic: A00-162, Flexible Photovoltaics for Fabric Structures