

IMPROVING US MANUFACTURING ONE SKI AT A TIME

"Our goal and strategy with the graphene additive from MITO was to add that extra strength and muscularity to our skis as well as a damping quality, which is really hard to achieve in a full carbon fiber ski."

MIKE MCCABE
Founder of Folsom Custom Skis



INDUSTRY:
SPORTS AND RECREATION

GRAPHENE'S CURRENT CHALLENGES:

- Must order in large quantities
- Need for a prototype before committing
- Loss of downhill performance

RESULTS:

18% REDUCTION IN WEIGHT

- 50% Ultra High Molecular Weight Polyethylene
- 20% Carbon Fiber
- 15% Wood Core
- 15% Steel

FOLSOM CUSTOM SKIS

A MITO CASE STUDY

Folsom Custom Ski founder Mike McCabe noticed in 2013 that graphene was being used in bike frames to use less materials, creating a lightweight system with strength and stability. Immediately, Mike saw the application possibilities for skis.

FILLING THE GAPS

Graphene takes the voids that are generally filled with just resin and fills them with more useful, matching molecular compounds to carbon fiber, making those voids stronger and denser. Ultimately, less of the original material can be used to create a lighter weight system. Mike found these science claims believable as the bike company had a good reputation in the market and the specific science information was not from a company trying to sell him an additive product.

LIGHTWEIGHTING

For Folsom Ski, this lightweighting option would improve skiing for clients. In the world of non-mechanized skiing, grams matter. Essentially, people strap skis with touring bindings on them, and touring boots that allow you to walk uphill for very long periods of time. Every gram that can shed on the way up is really significant. When people spend the day in the backcountry climbing to a peak, a lighter ski means less exertion on the way up and more energy on the way down. When considering the uphill walk in touring boots, shaving off grams is important.

NEW MARKETS

Potential of the additive would enable Folsom to pursue a new market, ultra lightweight. The goal became creating a lightweight ski while adding extra strength and muscularity to the skis as well as a damping quality, which is difficult to achieve in a full carbon fiber ski. A concern with entering the ultra-lightweight markets was a potential for performance loss, which would require testing to determine.

OVERCOMING COST BARRIERS

From this first introduction to graphene as a potential additive, Mike looked to source samples and hit his first roadblock - large sample size requirement. The cost outweighed the ability to buy samples for testing. This stopped further pursuit of graphene materials for several years.

When MITO Material Solutions CEO Haley Keith reached out to Mike about E-GO as a potential additive for Folsom products, the initial driving

factors were the reasonable ordering amount. Getting sample product in a smaller amount would allow a proper prototyping sequence without committing to a large purchase of what may not have been a viable additive.

Folsom values responsive suppliers in R&D activities on new products. That requires quick turn around on tech specs and great on-going communication. MITO's entire team was available for every step.

QUALITY COMES FIRST

Quality is absolutely critical to Folsom's build mindset and product. Additionally, there's a certain level of performance people expect from the Folsom brand that Mike and his company knew could not be compromised. The challenge of integration is that carbon skis naturally don't bond as well as fiberglass skis, because it is a thinner composite and there's less volume to really bond in.

TESTING THE CLAIMS

To get the process rolling, Folsom needed to get tech usage specs, follow up with the technical team, get samples in house, run it into their system to see how actually putting this graphene additive into the resin worked, how and if it changed just the production method. Vigorous internal testing commenced as a handful of skis were built for internal people and trusted external testers who understand the Folsom product inside and out.

This included a couple of blind tests, where Folsom actually built skis with graphene and put them in testers' hands without telling them about the E-GO additive. Immediate tester feedback was like, "Holy cow, what did you do to this, it's very different, much



stronger. You know, it has a much more damp feel.” As soon as those test skis made it out into real world conditions, unanimously, every single tester, came back with feedback that there was something majorly different. It was clear that E-GO changed the performance of the ski and was not a placebo effect.

SIGNIFICANT RESULTS

Over the course of another season of building for both clients, and internal people with this graphene, Folsom noticed they tended to be careful with how they were using E-GO because the changes were so significant. It added a lot of strength to the ski, more than originally anticipated. From there, Folsom began producing skis while continuing to reduce materials to test the effect on the ski.

FOLSOM ENGINEERING TESTING ARC

PEEL TEST TO CHECK THE BOND

Build a ski; then deconstruct the ski and test how it falls apart. Start with a normal ski without graphene in it, peel away materials and then clamp test how much pressure it takes to rip it apart. Repeat with graphene ski.

RESISTANCE TEST

We use a test cable which is driven by an Arduino. Essentially, you'll take a ski, do a calculation off of the total length of it, and then set up these contact points to saddle Husky through an actuator, that's going to pull down 100 foot pounds of force directly under the center section of the ski to test how much pressure and how much deflection you're getting.

SLAP TEST

We put an accelerometer on the tip of a ski and then pull it off a hard surface, slap it back down so that we then measure the tetrads of how quickly it would damp in the ski back; trackable numbers on the ability to shut down vibration frequencies.

GETTING GRAPHENE OUT OF THE LAB

Real World Testing Arc

- Prototyping
- Blind performance tests
- Cold weather ski testing

In the production testing, the Folsom team was testing how far they could push E-GO enhanced graphene to yield this super lightweight target.

Testing continued through the tail end of the 2021-2022 season and through the 2022-2023 season. The Folsom team worked through exactly how this ultra-light offering was going to look and built about 15 into the market. Once again, the internal and external testing team - every single person - came back with glowing feedback on the difference E-GO made for the Folsom skis.

MADE IN THE USA

Folsom is one of the very few companies left in the US in the ski and snowboard manufacturing sector that do truly everything under one roof - literally every step of the process is handled in the 10,000 square foot facility that Mike McCabe built to grow Folsom. Part of Folsom's commitment to US manufacturing is a circular buying policy. McCabe states, "I want to buy everything that's going in the skis locally, there's no reason I want to have a bigger global footprint than I need to."



The next step in adding E-GO to more Folsom skis was to adjust the production process with a goal to introduce E-GO into the resin, directly at the manufacturer, so that the product arrives ready to go. This would eliminate Folsom having to add actual graphene additives in their resin and make production consistent. To that end, Folsom tapped one of their current US suppliers, Forrest Technical Coatings out of Eugene, Oregon, to work with MITO on creating a ready-to-pour resin with their Verified Functionalized Graphene®.

PUSHING THE LIMITS

Testing continued for Folsom with the ready-to-pour E-GO resin. Calculations proved values and analytics provided verification of improvement. But really, the most substantial source of feedback was just putting the skis out in the market and seeing how they perform. Real world performance includes using skis in temperature variations from 70 degrees during the day to negative 20 at night, a common weather condition in Colorado. That kind of heat is called a solar load. It happens sitting outside on the front range, or having the skis next to a window getting really warm and then moving to a cold area, which is very hard on the chemical and physical bonds that keep the layers of the ski together. The biggest challenge any ski manufacturer has is bonding issues over time due to temperature fluctuation.

THE RESULTS

With the addition of E-GO to the ski bonding, Folsom has created the ability for customers to

carry more weight uphill by making the skis lighter, allowing for a better experience downhill. All without sacrificing bonding performance and while improving damping. This makes Folsom competitive in this market with these ultra-lightweight skis which people need for six-to-eight-hour long approaches - a new market for them.

FINAL THOUGHTS

McCabe declares, "It's been a slow adoption, but now that we've got E-GO really understood, and we see how significant using it is - we're really happy with how adding it aligns with those ideals that we have keeping that quality offering for a lightweight ski. We will be adopting graphene into most of our construction types."

MAKE IT MIGHTY

- Singularity unique product offering
- Proactive and responsive contact from MITO team
- Partnership approach to testing makes customers part of the team
- Willing to create a process with customers



About MITO Material Solutions

MITO® Material Solutions unlocks the power of hybrid polymer materials with specialty additives which dramatically improve performance. The MITO family of products include graphene additive, E-GO™ and cornstarch-based, ACRE™. All of MITO's products are easily dispersible, safe to handle, scalable solutions designed to empower manufacturers. Woman-led, MITO is becoming a startup sensation in the composite industry. Visit <https://mitomaterials.com/> to learn more.