THERMALLY CONDUCTIVE 3D PRINTING FILAMENTS

Matt Smith, TCPoly

Matt Smith, TCPoly co-founder and CEO and member of Innovation Crossroads Cohort 2, has developed proprietary materials that enable printing of value-added parts with enhanced functionalities.

The company's first commercial product, the ice9™ Thermally Conductive Filament, is the world's highest thermal conductivity 3D printing plastic and can conduct heat 50 times higher than traditional plastics. This allows for the 3D printing of new heat transfer products for electronics thermal management, heat exchangers, mold tooling and many other industries.

Accomplishments

From a business perspective, TCPoly's greatest accomplishment was discovering the mold tooling market as a target. Smith and team have been evaluating several markets in parallel and identified 3D printed mold tooling as the market where the company's unique material properties provided the most value. The team is currently working with partners to print and test mold tools for production.

On the technical side, the biggest achievement has been developing a PPSU or Polyphenlysulfone-based Ice9 AeroTM filament. This material has high thermal conductivity and the highest heat deflection temperature of commercially available 3D printing plastics, enabling customers to replace metal molds with 3D printed plastic molds at 10-times the cost and lead time reduction.

"Additive manufacturing technologies will continue to play an increasingly vital role in advancing technologies for the benefit of all people," Smith said. "We're excited about all of the possible ways our technology can impact the world and we believe that by expanding capabilities and discovering new applications where additive manufacturing can provide value, we will accelerate adoption and innovation."

The Process

TCPoly has developed unique high thermal conductivity polymer formulations and high thermal conductivity 3D printing filaments (>5 W/m-K) for use with commercial FDM printers. The patent pending materials allow for rapid prototyping with thermally conductive plastics as well as parts production through farm 3D printing.

The company provides electrically conductive and electrically insulating grades to cover a broad range of applications including polymer heat exchangers, battery packs, heat sinks, cold plates, and

TCPOLY

COHORT 2

Milestones

- Developed proprietary materials that enable printing of value-added parts with enhanced functionalities
- Launched first commercial product, the ice9™ Thermally Conductive Filament, the world's highest thermal conductivity 3D printing plastic that can conduct heat 50 times higher than traditional plastics
- Established manufacturing partnerships and material distributor relationships in the US, Australia, and Europe
- Funding raised: $550,000

"There are not many opportunities like Innovation Crossroads anywhere in the world and deep tech entrepreneurs will be hard pressed to find a comparable opportunity."

Matt Smith, Co-founder and CEO, TCPoly

thermally conductive tooling. Products include filaments, mold tooling, heat sinks, cold plates, LEDs and battery packs.

Smith and team have expertise in rapid prototyping to print large format multi-material and complex prototypes with short lead times as well as thermal design and modeling that can simulate thermal loads and custom tailor cooling solutions for specific applications. Combined thermal design and 3D printing expertise allows TCPoly to create unique products.

The Challenge

TCPoly has been challenged with balancing material properties with printability. Each time a change is made to a composite material formulation, there is a corresponding change made to the required print settings. Extensive testing is often required for every new material formulation to ensure the material can be printed over long periods without jamming or clogging and at different settings.

An additional challenge is lack of market focus. Because TCPoly's filaments have such high thermal conductivity, they can be used in a multitude of markets. According to Smith, it has been time-consuming to determine where TCPoly's materials can provide the most value and where customer development efforts should be focused.

The ORNL Advantage

Collaborating with Oak Ridge National Laboratory's (ORNL) researchers in materials science and additive manufacturing through Innovation Crossroads has given TCPoly a competitive advantage. ORNL's expertise in 3D printing technologies and applications helped to validate materials and markets and to design material formulations and processing strategies for successful printing.

"We have been lucky to work with manufacturing experts on various projects. The Innovation Crossroads team has also been a tremendous resource for TCPoly," Smith said.

Since joining Innovation Crossroads, TCPoly has established manufacturing partnerships and material distributor relationships in the US, Australia, and Europe and has been awarded a SBIR Phase 1 grant from the National Science Foundation.

"Upon graduation from Innovation Crossroads, we will leave the program poised to grow organically through government grants and revenue or through a larger series A raise if we determine additional resources are needed and we would like to accelerate growth," Smith said.

Future Growth

TCPoly technologies are anticipated to be adopted across several industries, significantly improving energy efficiency through increasing manufacturing energy efficiency and reducing waste.

While Fused Filament Fabrication (FFF) is one of the most widely adopted 3D printing methods and is already impacting many industries, TCPoly materials exhibit properties not available on the market today. The materials allow the use of FFF 3D printing technologies in high value markets that previously relied on metal solutions. By replacing metals, TCPoly provides a low cost and energy efficient manufacturing solution for mold tooling, electronics cooling, and heat exchangers.

"We are excited that our materials can enable improvements to energy related technologies such as LED lights, electric vehicles, heat exchangers, and other related products," Smith said. "I would like to spend my career launching technology companies to promote an exciting future and our sustainable existence on this planet. TCPoly has taught me both how difficult and how rewarding a new venture can be."

About Innovation Crossroads

Innovation Crossroads is a fellowship program based at Oak Ridge National Laboratory that matches aspiring energy entrepreneurs with the experts, mentors, and networks in technology-related fields to take their world-changing ideas from R&D to the marketplace.

Through an annual call, up to seven entrepreneurs will be selected to transform their ideas into energy, advanced manufacturing, and integrated grid companies with financial support from the U.S. Department of Energy's Advanced Manufacturing Office and the Tennessee Valley Authority. Innovators will receive a fellowship that includes a personal living stipend, benefits, and travel allowance for up to two years, plus substantial funding to use on collaborative research and development at ORNL.

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