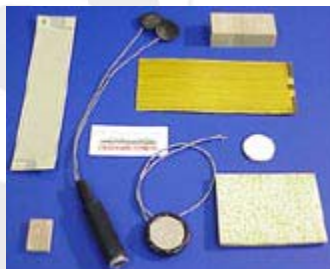


**PROJECT TO
COMMERCIALIZE PZT FIBERS
COMES TO NCC-ET**

In November, the National Composite Center (NCC) announced the news it was awarded \$2.1 million for Commercialization of Piezoelectric (PZT) Fibers for Energy Storage and Smart Systems. NCC, along with team collaborators Advanced Cerametrics Inc., (ACI) based in Lambertville, New Jersey and the University of Toledo, will use the funds to develop a high volume, low cost process for producing piezoelectric materials.



A sampling of piezoelectric fiber composites.

The work is expected to be carried out at the North Central Campus for Emerging Technology (NCC-ET) in Ottawa County. Working with North Central Ohio businesses, NCC established the campus in 2004 to draw on Ohio's unique expertise in aerospace technology and use it to create commercial products through collaboration with universities, government, industry and other key organizations.

ACI has indicated plans to establish a manufacturing facility in Ohio. Pending board approval, NCC

received a letter of agreement in December from Ottawa County.

“Conducting work for this project at NCC-ET gives us the opportunity to access a wider range of resources such as NASA and expand our reach to take advantage of the wealth of expertise available in Ohio,” said Lou Luedtke, President and CEO of NCC. Key resources offered through the campus include:

- Advanced material development (NCC and the University of Dayton Research Institute)
- Power and propulsion development (NASA Glenn Research Center)
- Space ready testing (NASA Plum Brook)
- Electrical engineering (University of Toledo)
- Micro electrical mechanical systems (Case Western Reserve University)
- Materials Laboratory (Wright Patterson AFB)
- Advanced materials research (University of Toledo and University of Akron)

As another technology pipeline, NCC-ET helps to promote economic development and bridge the gap between research centers, SBIR supported company research like ACI's and the final commercialization stage of production level goods.

ACI, the recipient of numerous research and development grants from the Defense Department,

NASA and the Department of Energy, was a good candidate for the project due to its development of a line of piezoelectric fiber materials. The fibers were produced using its patented VSSP manufacturing process to make actively controlled structures.

The 56-year-old company has incorporated its fiber technology in the newest generation of active, smart sporting goods. Head Sport introduced their new line of Intellifiber and Intellichip active fiber composite tennis rackets and skis with energy harvesting actuators made from ACI's patented PZT fiber.

These self-powered products actively dampen the vibration created during a ball strike or edge chatter from a ski turn and use the energy to create electrical force to control the shape of the ski or racket, using ACI's PZT fiber's electrical and mechanical properties to counteract the forces. This active structural control adds up to 15 percent more power to a ball hit and about six percent more functional edge on a ski.

NCC will help to identify product applications, develop cost effective manufacturing processes and fabricate prototype parts. “This is brand new technology for us,” said Luedtke. “We will be conducting research about where PZT fibers can be used and how they can be used in aerospace and transportation markets. We already know there is a huge potential for

this technology, and its use in composite components currently being manufactured for sporting goods demonstrates its capability. PZT fibers will also integrate effectively with many of the current manufacturing processes such as **Rapid Fiber Preforming**, Closed Molding and Long Fiber Reinforced Thermoplastics (LFT) available here at NCC.”

NCC DELIVERS ON LFT PROJECTS FOR FTA AND ARL WHILE ADDING NEW CAPABILITIES

NCC used its 2003 State of Ohio Wright Project grant totaling \$1 million to purchase the equipment needed to scale-up LFT part fabrication and continues to take dramatic strides to bridge the gap between LFT technology development and production level parts capable of delivering increased performance, lighter weight and lower cost . In 2004 NCC partnered with the University of Alabama at Birmingham (UAB) to provide near-term commercialization on projects for the Federal Transit Authority (FTA) and Army Research Laboratory (ARL).

For the FTA project, NCC made flat panel preforms out of long fiber thermoplastics using its signature **Rapid Fiber Preforming** process, and sent them to UAB for molding mechanical property testing. The testing provided the necessary feedback to confirm UAB’s modeling analysis. The university

then plugged the new test data into its model, designed a bus side panel and submitted the design to NCC for next step.



*Using NCC’s **Rapid Fiber Preforming** technology to spray fibers on a preform for a bus side panel.*



Completed bus panel preform.

The Center produced a prototype of the side panel using **Rapid Fiber Preforming**. The preforms were created using two different types of LFT material – a glass impregnated tape and a co-mingled polypropylene glass strand. NCC wanted to assess the mechanical properties of the two materials. The preforms were sent to UAB for vacuum molding and testing. Tests confirmed that the panels possessed the high impact properties required by the bus manufacturer.

As a result of the advances made with this project, the team has completed initial meetings with its first customer, a US bus

manufacturer, and chosen four component applications. Engineering design and cost models have already shown a 30 percent weight reduction and a 50 percent cost reduction with one of the applications. The other three applications are currently being evaluated with final part selection to take place early this year. NCC expects actual parts production to begin this summer.

In its project for ARL, the team found ways to lighten the load and improve the safety of soldiers using LFT material fabrication techniques. UAB and NCC worked with ARL to select the first application, an artillery training round tail cone made out of aluminum. The Army uses about 250,000 of these test rounds a year at a significant cost. The item was chosen because it is a high volume part that lends itself to the significant costs reductions available with LFT. Following initial design work submitted by UAB, NCC worked with a local Dayton toolmaker to design the necessary tooling.



Tail cones produced with LFT technology.

Two tail cone designs have been selected. The tail cones were then molded at NCC and shipped for assembly to ARL at the Aberdeen

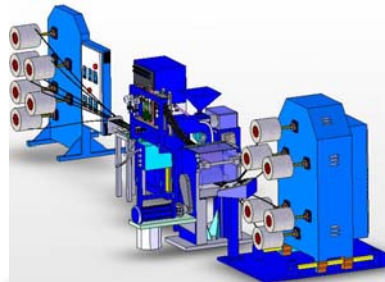
Proving Grounds in Maryland. Test firing is scheduled at the Yuma Proving Grounds early this year. Results from those tests will determine the team's next steps. Special thanks to Dayton-based Composite Technologies Company LLC (CTC) for its assistance with the specialized molding equipment used to manufacture the tail cones.

Initial feedback from ARL following the delivery of the LFT fabricated tail cones was very positive. ARL praised NCC's commitment to customer service and ability to meet delivery deadlines despite the complex technologies being employed.

To further advance LFT technology and expand its application uses NCC also recently installed a continuous Reinforced Thermoplastic Tape/Rod/Pellet line. The equipment allows the Center to combine as many as six different fiber materials into one tape/rod or pellet. Fiber materials are not readily available in the small quantities required for development work on new part concepts to commercial markets.

The new tape line gives NCC the capability to provide these small quantities as well as combine virtually any continuous fiber reinforcement with any thermoplastic polymer to create new types of polymer reinforcement materials not yet available. The thermoplastic tape line will also make it possible for the Center to build a property database using

controlled input materials and a uniform testing protocol.



NCC's new thermoplastic tape line.

In addition to this latest piece of equipment, NCC is also installing a state-of-the-art Thermal Analysis Laboratory. The lab will be equipped with a Dynamic Mechanical Analyzer (DMA), Thermogravimetric Analyzer (TGA), and Thermomechanical Analyzer (TMA) from TA Instruments. The trio of analyzers will be used to quantify the thermal characteristics of materials produced by the tape line. The data mined from this in-house analysis will be used to support modeling and molding of prototype applications. You can read more about this in an upcoming feature article in Reinforced Plastics Magazine.

VECTOR GRABS CUSTOMER INTEREST WITH COMPOSITE WINGS AT DMC

Vector Composites Inc.'s composite wings, produced for an Army Future Combat Systems missile, became the center of attention at the Defense Manufacturing Conference (DMC) held in Las Vegas, Nevada Nov. 30 – Dec. 2. Using carbon

fiber composite material, the wings were constructed from unidirectional fabric and woven cloth with NCC's Resin Transfer Molding (RTM) and **Rapid Fiber Preforming** processes.

The proof of concept wings were delivered in December to Lockheed Martin Missiles and Fire Control based in Dallas, Texas. Acceptance of the proof could lead to full qualification and a test contract in 2005 and 2006 with a production schedule of 500 units a year for 10 years projected to begin in 2007.

The composite wings are expected to improve performance by allowing the missile to fly further or to carry additional payload. The wing, originally designed with aluminum, would have weighed 8.9 pounds when scaled to NLOS requirements.

Program requirements for the composite wing specified a maximum weight of 5.76 pounds. Goal weight requirements were targeted at 5.25 pounds. Vector produced the wing at a weight of 3.7 pounds. Contacts generated by the exhibit with Army contractors are expected to unlock additional opportunities for other defense related structures.

Vector also showcased its C-17 pylon stub fairing made with NCC's **Rapid Fiber Preforming** technology and Vacuum Resin Transfer Molding (VARTM) process. Long Fiber Reinforced Thermoplastic (LFT) parts

generated leads and discussion with both military and commercial customers.

Litecast® also caught the attention of General Dynamics Land Systems, a major military vehicle manufacturer. In addition to exhibiting at DMC, Vector Vice President of Operations Dave Sabol, Greg Spurlock, Mechanical Design Engineer for Lockheed Martin Missiles and Fire Control, and Tom Whitney, Senior Research Engineer for the University of Dayton Research Institute (UDRI) presented a paper titled Affordable Composite Components for Loitering Missile Applications. The presentation was well attended and generated considerable positive feedback.

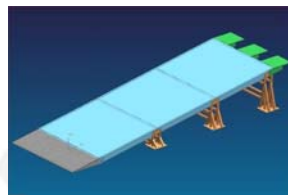
VECTOR CLOSES OUT FIRST YEAR OF OPERATIONS

With the close of December, Vector has completed its first year of operation. With NCC's **Rapid Fiber Preforming** technology Vector landed two significant contracts in its first 12 months.

Providing proof of concept composite wings for the NLOS-LS Loiter Attack Missile is a first step toward achieving a production contract on a major military system. The success of this project to date has established Vector's credibility with Lockheed Martin Missiles and Fire Control and the Army.

The second contract, for FMC in Orlando, Florida, has tasked Vector

to design and build two prototype ramps for the Air Force. The ramps will be used to drive military vehicles onto a loader which then raises the cargo to the aircraft (typically C-17, C-140 or C-130) for loading.



Rendering of composite ramp.

Using composites, Vector's goal will be to reduce the weight of each ramp section to less than 164 pounds – the maximum load two soldiers are permitted to carry. Vector expects to complete the ramps in January with testing to take place in February. Production could begin as early as April.

HOLIDAY GREETINGS FROM NCC

The staff at the National Composite Center hopes you had a memorable Christmas and wishes you a prosperous New Year. This year promises to be exciting with feature articles placing in trade magazines within the first quarter and milestone events taking place in February, March and April. We look forward to being able to share the details with you as we move into 2005.