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University of Dayton Electron-Beam Lab to be One of World's First to Make High-Tech Polymer Composites

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Contact: Jim Pickering
pickering@udayton.edu

UNIVERSITY OF DAYTON ELECTRON-BEAM LAB TO BE ONE OF WORLD'S FIRST TO MAKE HIGH-TECH POLYMER COMPOSITES

DAYTON, Ohio — By early 2000 the University of Dayton Research Institute's Center for Basic and Applied Polymer Research will have one of the first labs in the world for seeking novel ways of making high-tech polymer-composite materials.

The lab will be used to conduct basic research on manufacturing polymer composites — durable, lightweight fiber-reinforced plastics employed by the military and private industry — using electron beams instead of the traditional high-temperature curing process, explained Don Klosterman, a UDRI polymer engineer and coordinator for the lab.

Composite materials are used for such products as airplane wings and body panels, rocket casings, even automobile chassis.

"We see this particular research as an important newly evolving area of technology and are fortunate to get in on the front end of it," said Klosterman. "It's an exciting area that is gaining interest within the military and commercial aerospace communities."

Currently, advanced polymer composites (plastics reinforced with high-strength fibers) are formed under intense heat and pressure, a process which requires large, expensive, kiln-like pressure vessels called autoclaves.

"For example, if you want to cure an airplane wing that's 30 feet long or a rocket casing that's three stories tall, you will need a pressure cooker at least that big to complete the process. That's very expensive," Klosterman said.

The UDRI research team will pursue a different route, however, using a high-energy electron beam to trigger the needed chemical reactions to forge these materials. The composite will cure or set at room temperature and atmospheric pressure, eliminating the need for autoclaves, Klosterman explained.

Another advantage is that e-beam technology can be made portable, enabling it to navigate and fully cure all areas of a specific part, or to be used for field repair.

Klosterman is working with a team of UDRI researchers on the project, including Richard Chartoff, professor of materials engineering and a senior polymer engineer at UDRI, and Allan Crasto, a senior composites engineer who heads the UDRI Composites Research Group located at the Air Force Research Laboratory (AFRL).

This group works closely with a team of in-house AFRL researchers, including Tia Benson Tolle, John Russell and Janis Brown, who were instrumental in arranging support for the new electron

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beam facility, Klosterman said.

Initial funding for the facility is $610,000. The largest portion of this comes from a $318,000 grant from the Air Force Office of Scientific Research. Other agencies contributing the balance are the Air Force Research Laboratory at Wright-Patterson Air Force Base, the Ohio Board of Regents and private industry. UDRI is also sharing part of the cost of the new facility.

"We are pleased that UDRI has been awarded this grant," said L. Scott Theibert, chief of the structural materials branch of the Air Force Research Lab at WPAFB. "Research in this militarily critical technology is expected to achieve important technological advances that will contribute to Air Force missions in military aircraft of all types, unmanned aerial vehicles and space operations vehicles."

Klosterman said these advances could extend deep into the aerospace industry, where the technology could be used to fabricate aircraft structures, rocket casings and other composite structures. It also could carry over into shipbuilding for submarine and surface vessel components.

Private industry, too, could reap the benefits of e-beam composite curing, he said. For example, auto chassis could be made in one lightweight, highly durable piece instead of many parts, making the manufacturing process cheaper and faster.

The use of electron-beam curing in creating high-tech composites has been studied extensively in recent years because of its potential for lowering the cost of producing these structures. However, this research has been limited in depth, and "there remain considerable gaps in the current technology that will require basic research solutions before it can be applied to primary aerospace structures," Klosterman said. "We believe this research is best carried out in a university environment guided by an academia-government-industrial partnership."

E-beam technology has been used commercially for years in such procedures as sterilizing medical equipment and curing thin polymer films. However, there isn't a dedicated basic research facility nationwide with the proper equipment to carry out the necessary work for curing composite structures.

"We're going to be that facility," said Klosterman. "This grant is a big win for the Miami Valley and Ohio. It was a group effort. We think it's fitting that this lab be built in Dayton, Ohio, given its history of technological and engineering advances in both the aerospace and automotive fields."

The University of Dayton Research Institute conducts about $45 million annually in sponsored research. With 355 full-time researchers and support personnel, it is the region's leading research-and-development organization.

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For media interviews, contact **Don Klosterman** at (937) 229-2794 or via e-mail at klosterman@udri.udayton.edu. Information can also be found on the Internet at www.udri.udayton.edu/ebeam.