

# RESEARCH NEWS

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**Fraunhofer at the Hannover Messe 2025**

## Innovative Recycling Method for Carbon Fiber

**Researchers from the Fraunhofer Institute for High-Speed Dynamics, Ernst-Mach-Institut, EMI have developed a technology that makes it possible to reclaim continuous carbon fibers from composite materials — without diminishing material quality. High-power lasers are used for local degradation of the matrix of multi-layered fiber-reinforced plastics at high temperatures. This method offers not only ecological benefits but also considerable economic potential.**

Carbon fiber composites are exceptionally strong and lightweight, making them preferred materials in many industries. But the disposal and recycling of these high-performance materials pose significant challenges. The research team at Fraunhofer EMI has now developed a process in which fibers from used composites are efficiently prepared for reuse — without adversely affecting their mechanical properties. Current recycling methods for fiber-reinforced plastic involve a shredding step, which shortens the fibers and leads to a downcycling.

### Crash course in materials science: thermosetting vs. thermoplastic composites

A carbon fiber composite consists of yarns of fibers embedded in a polymer. This makes it possible to hold the fibers together, maintain the geometry of a component and protect the fibers from environmental influences. The fibers can be embedded in two kinds of plastic: Thermosetting composites consist of a matrix that cannot melt, meaning that they cannot be re-processed, these behave like an adhesive that cures and then forms a durable bond. Thermoplastic composites, by contrast, can be melted and re-processed. However, thermosetting plastics are easier to process, and are therefore used more frequently in industrial structural applications.

### Peeling-based recycling of wound structures

The researchers at Fraunhofer EMI use a high-power laser for controlled reclamation of the fiber reinforcement from thermosetting composites. This method is especially relevant for pressurized hydrogen tanks, where a continuous carbon fiber roving is wound around a plastic liner to make the tank able to withstand high internal service pressures of up to 700 bar.

The advantage of this innovative recycling method lies in the ability to remove the thermosetting matrix surrounding the carbon fibers via a local pyrolysis, while leaving the

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fibers themselves nearly undamaged. »What makes this process special is that we perform the pyrolysis of the matrix and the unwinding of the fiber roving simultaneously, at a reasonable speed without damaging the carbon fibers«, explains project manager Mathieu Imbert.

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The challenge lies in defining the optimum process window, as the matrix thermal degradation occurs at temperatures of 300 to 600 degrees Celsius, while the fibers might start getting damaged when the temperature reaches about 600 degrees Celsius. »We found a very good compromise between the process efficiency and the quality of the recycled material. Our results show that the continuous fibers reclaimed in this way have the same excellent performance properties as new fibers, which makes this method highly attractive«, Imbert says.

### **Economic and ecological advantages in one**

The innovative method offers not only ecological benefits but also considerable economic potential for recycling companies. Because heat is applied locally and the fiber roving is continuously reclaimed at the same time, there is no need for the long pyrolysis times and high process costs typically required when working with the thick-walled hydrogen tanks. Furthermore, the laser-assisted reclamation process requires only about one-fifth of the amount of energy required to produce new fibers. Those are key advantages in the current context of rising energy costs and increasing environmental requirements.

The project is slated to run until the end of 2025. It is part of the DigiTain project funded by the German Federal Ministry for Economic Affairs and Climate Action (BMWK). The researchers are currently working to make the process even more energy-efficient and to further improve the quality of the reclaimed fibers. The research team views the extremely positive link between the high quality of the recycled material and low process costs as the key argument in their plans to transfer the new method to the recycling industry. The experts from Fraunhofer EMI will be presenting the project at the Hannover Messe from March 31 to April 4, 2025 (Hall 2, Booth B24).

### **[Website Peeling-based recycling](#)**



**Fig. 1** Experimental setup used for the local high-power laser-induced pyrolysis of a wound composite ring with simultaneous reclamation of the matrix-free carbon fiber roving. During the process, pyrolysis takes place at the position indicated by the red laser spot.

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