Automotive Lightweighting Materials

Hybrid Joining of Composites

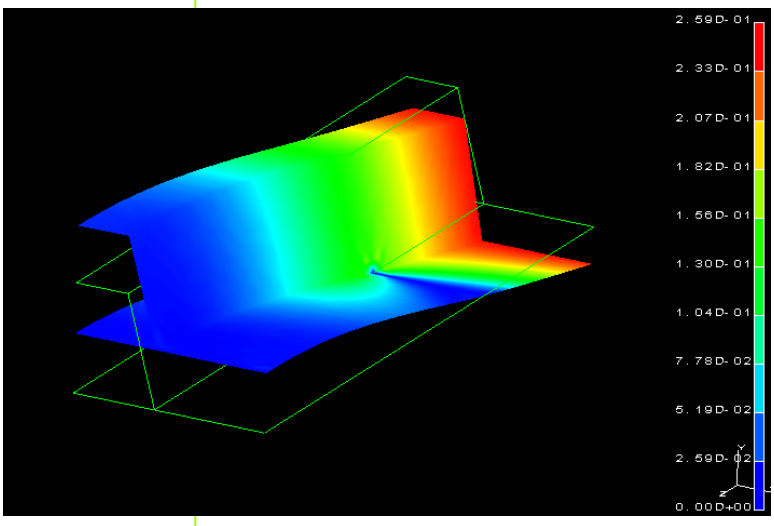
Background

Weight reductions and increased fuel efficiency can be achieved in automobiles, without compromising structural integrity or utility, through innovative designs utilizing lightweight materials such as polymeric composites in conjunction with traditional structural materials such as steel. Despite the advantages associated with such dissimilar (hybrid) material systems, there is a reluctance to adopt them for primary structural applications because of the limited knowledge of joining techniques between composites and metals. Traditional fastening methods such as welding, riveting, and bolted joints used in metals are often inappropriate for composite materials. One solution to this joining problem is the use of hybrid joining techniques that employ a combination of two or more fastening methods to attach dissimilar materials, such as a riveted joint that is also adhesively bonded. This combination of a mechanical fastener in conjunction with adhesive bonding could serve as compromise between familiar mechanical attachment and also reduce stress concentrations and crack nucleation sites associated with using mechanical fasteners in polymeric composites.

The Technology

Although benefits can be derived from using hybrid joining techniques, little or no practical information is available for automotive manufacturers concerning the performance and durability of hybrid joints. This project is developing the technologies to allow automotive designers to incorporate hybrid joints into vehicle designs. The project is developing new techniques to quantify joint integrity and predict long-term durability through a comprehensive mechanical test program and predictive modeling effort. Identification and understanding of key issues associated with hybrid joint performance, such as

Less dependence on foreign oil, and eventual transition to an emissions-free, petroleum-free vehicle



Hybrid joint rail model results

creep, fatigue, effects of environmental exposure, and damage evolution leading to catastrophic failure are being addressed.

Commercialization

The project is determining basic rules for joint design and realistic predictive models intended as design tools for industry partners to use in predicting the durability of hybrid joints in automotive structures. Modeling techniques will be available to all domestic original equipment manufacturers and will emphasize reduction in computational overhead by focusing detailed analysis in critical high-stress structural locations identified through mechanical testing while reducing computation effort and time in regions that are found to be less likely to serve as damage initiation sites.

Benefits

- Weight savings, resulting in increased fuel economy
- Increased joint rigidity, enhancing structural integrity
- Practical, efficient modeling techniques to streamline hybrid joint integration in vehicles

Where Can I Find More Information?

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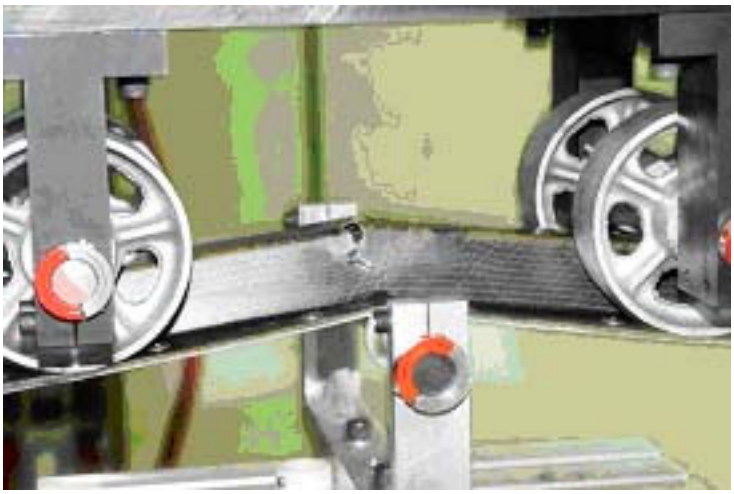

Hybrid joint rail test

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

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Energy Efficiency and Renewable Energy

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